


3. Second, wildlife management programs have contributed to growth in the populations of many species of wildlife that are often involved in strikes. For example, the once-endangered Canada goose population has grown by more than 10% each year for the last 30 years. Canada geese and other birds, such as gulls, have expanded into urban and suburban areas, including airports. Third, the number of commercial and non-commercial flights has more than doubled over the last two decades _____.
- ; therefore, the parallel increases in wildlife populations and air traffic contribute to a higher probability of a wildlife strike
 - . This concurrent increase in wildlife populations and air traffic contributes to a higher probability of a wildlife strike
 - , contributing to a higher probability of a wildlife strike



Language Focus: Passive Voice

In most technical solutions, it is necessary to describe a process or a method. In the passages in Tasks Four and Five, the explanation of how the water is collected provides this necessary information. In addition, when you are describing the method you used to carry out some research, you will essentially be writing a process description. We have looked at adverbs in process descriptions; it is now time to turn to verbs.

The passive voice often plays an important role in process descriptions. We can see why in this example. Look at these brief notes about how influenza vaccines are produced.

Three sample virus strains	The virus strains most likely to cause disease are identified and three are selected for vaccine development.
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Selected virus strains	Manufacturers inject the virus samples of each selected strain into separate batches of fertilized eggs to amplify the amount of virus. Each virus strain is grown separately inside the eggs over the course of several days, after which it is harvested, inactivated, and purified.
Inactivated virus strains	The three virus strains are then combined to create the vaccine, blended with a carrier fluid and dispensed into vials.

These steps are descriptive and not intended as a set of instructions. If the goal is to offer instructions, imperative forms are used to indicate the necessary steps, as shown in this example of how to inoculate eggs with the influenza virus.

Inoculation of eggs in flu vaccine development

1. Place eggs into egg trays with the blunt end up, and label eggs with a specific identification number. Allocate 3 eggs for each specimen.
2. Wipe the blunt end of each egg with 70% ethanol and punch a small hole in the shell over the air sac.
3. Aspirate 0.6 ml of processed specimen into a tuberculin syringe with a 22 gauge, 1 1/2-inch needle.
4. Hold the egg up to the candler and locate the embryo. Insert the needle into the hole in the shell and, using a short stabbing motion, pierce the amniotic membrane and inoculate 100 μ l of the specimen into the amniotic cavity. Withdraw the needle by about 1/2 inch (1.25 cm) and inoculate 100 μ l of the specimen into the allantoic cavity. Remove the needle.

However, if we are interested not in providing guidance for actually performing a particular task, but in explaining how something is done—as in a process—we would be more likely to write this.

First, the virus strains most likely to cause disease are identified and three are selected for vaccine development. The virus samples of each selected strain are injected into separate

batches of fertilized eggs to amplify the amount of virus. Each virus strain is grown separately inside the eggs over the course of several days, after which it is harvested, inactivated, and purified. The purified virus strains are then combined to create the vaccine, blended with a carrier fluid and dispensed into vials.

Source for flu vaccine content: World Health Organization, 2011, *Manual for the Laboratory Diagnosis and Virological Surveillance of Influenza*. Geneva.

Notice that each sentence now refers to a particular stage in the process: the identification stage, the preparation stage, and the dispensing stage.

What would be the effect if the process were described using the active voice? As you can see from the following passage, the focus on the stages is lost and the emphasis shifts to the agent (the person doing the steps—the researchers or technicians). If the person performing the activity is part of the sentences and becomes the link of familiar or old information, the process itself is backgrounded (less in focus).

First, researchers identify the virus strains most likely to cause disease and select three for vaccine development. Technicians inject virus samples of each selected strain into separate batches of fertilized eggs to amplify the amount of virus. Technicians grow each virus strain separately inside the eggs over the course of several days, after which they harvest, inactivate, and purify it. The technicians then combine the purified virus strains to create the vaccine, blend it with a carrier fluid and dispense it into vials.

Of course, there may be some occasions when different agents are an important part of different steps in the process.

Technician 1 injects virus samples of each selected strain into separate batches of fertilized eggs to amplify the amount of virus. Technician 2 grows each virus strain separately inside the eggs over the course of several days, after which the technician harvests, inactivates, and purifies it. Technician 3 then combines the purified virus strains to create the vaccine, blends it with a carrier fluid, and dispenses it into vials.

However, this now looks more like a job specification or duty roster than a process description. If information about the agent is important—which is uncommon—it would be better to describe the process in the following way.

The virus samples of each selected strain are injected by Technician 1 into separate batches of fertilized eggs to amplify the amount of virus. Each virus strain is grown separately inside the eggs over the course of several days, after which it is harvested, inactivated, and purified by Technician 2. The purified virus strains are then combined by Technician 3 to create the vaccine, which is then blended with a carrier fluid and dispensed into vials.

According to research studies, using *by* + a human agent is rather uncommon in formal academic writing, except when describing the history of the field, as in these examples.

The theory of transformational grammar was first developed *by Noam Chomsky*.

The Bayesian method has been used *by statisticians* for many years to aid decision making on the basis of limited information.

In fact, we are more likely to find *by* + process or *by* + a non-human agent.

The impact velocity can be obtained *by calculating* the difference of the arrival times of the two waves.

This enzyme is used *by the cancer cells* to replicate.

The increased mobility provided *by this new joint* allows wearers of the finger prosthesis to hold a cup, to pick up a piece of paper, and in some cases to write again.

Do the three *by* phrases in this next short passage introduce a process or a non-human agent?

The rate at which heat will be lost by conduction from the body will be determined by the magnitude of the temperature gradient—the steeper the gradient, the greater the heat loss—and the rapidity with which the cooler air in contact with the skin is replaced by colder air.

The *by* + process statements provide no details. Such *by* phrases are typical in published journal articles, especially in the Methods section (see Unit Seven) of articles in the sciences. However, sometimes further information is useful. For instance, when you are writing a paper for a class, it might be to your advantage to make the *by* phrases more informative.

The passive voice allows you to keep the focus on the something other than the agent and also allows you to maintain a good flow of ideas. Thus, it is reasonable to use passive constructions in sections other than a process description.

TASK TEN

Expand these statements, making them more informative by replacing the noun phrase with one or more verb phrases. Here is an example.

Teaching can be improved by in-service training. →
Teaching can be improved by asking teachers to attend a range of short courses throughout much of their careers.

1. Bacteria found in meat can be killed by radiation.
 2. Possible harmful effects of drugs can be reduced by testing.
 3. Information on political preferences can be obtained by polling.
 4. Cultures are partly preserved by ceremony and ritual.
 5. Changes in land use can be detected by remote sensing.
 6. The spread of infectious diseases can be controlled by vaccination programs.
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Location Elements and Summaries

Many data commentary sections begin with a sentence containing a location element and a brief summary of what can be found in a visual display of information, as shown in these examples.

- a. *Table 5 shows* the types of internet misbehavior common among university students.
- b. *Table 6 provides* summary statistics for the variables used in the analysis.
- c. *Figure 2 shows* a honeycomb solid oxide fuel cell (SOFC) unit with air cooling paths.
- d. *Figure 1 plots* wealth as a function of age.

As you can see, location statements direct readers to view important information in a table, chart, graph, or other figure. Even though research indicates that readers often look at the visual information before reading, location statements are expected. They are considered to be a form of metadiscourse—sentences or phrases that help readers make their way through a text by revealing such things as organization, referring readers to relevant parts of a text, or establishing logical connections. Metadiscourse is a noticeable feature of academic writing, although its value and frequency of use varies from one writing culture to another.

While grammar checking tools may influence you to largely use active voice in your writing, the passive can also be used, as demonstrated here. In fact, in some published texts, the percentage of passive verbs has been found to be as high as 25 percent.

Summary + Location Element with Passive Voice

- a. The types of internet misbehavior common among university students *are shown in Table 4.*
- b. Summary statistics for the variables used in the analysis *are provided in Table 5.*
- c. A honeycomb solid oxide fuel cell (SOFC) unit with air cooling paths *is shown in Figure 2.*
- d. Wealth as a function of age *is plotted in Figure 1.*

We bring two points to your attention. First, note the consistent use of the present tense. This occurs because the author is talking about his or her

present paper. Second, in English the active forms are just as appropriate as the passive versions. (However, in a number of languages it may not be natural to say that a graph or other inanimate object *reveals*, *gives*, or *suggests*.) Although switching between active and passive voice may seem to be a good stylistic strategy, a better strategy would be to choose active or passive on the basis of old-to-new information flow (see Unit One). Specifically, passive constructions can be used to place the old or familiar information in the subject position and the new information—that is, the location of the data at the end.

Notice that all the examples thus far provide general summaries of the data. We have been given no specific details or highlights. We do not know, for instance, what is significant in the SOFC design or at what age an individual might be the wealthiest or the poorest. Depending on what you are writing, you may want to focus more on some significant aspect of the data rather than merely generally pointing out what data is provided. This indication may be particularly important when you are using data to make a point. For instance, if you want to argue that students are likely to engage in misbehavior on the internet regardless of how they access it, you could write this sentence.

Table 5 shows that students engage in misbehavior on the internet using both private and public computers.

If your point is that wealth increases slowly with age but decreases quickly after reaching a peak, you could write this sentence.

Figure 1 reveals that wealth is accumulated slowly, but sharply declines after age 65.

Notice the use of *that* in the two sample sentences. Sentences containing *that* clauses do not easily go into the passive. (The flag indicates incorrect usage.)

⊞ That wealth sharply declines after age 65 is revealed in Figure 1.

While the passive version follows the rules of grammar, the sentence that results seems awkward in comparison to the version in the active voice. Thus, if you want to highlight some aspect of the data using a *that* clause, use the active.

These two ways of pointing the reader to the data are similar to a two-way classification often used to categorize journal article abstracts. *Indicative abstracts* merely indicate what kind of research has been done (i.e., they summarize); *informative abstracts* additionally give the main results and/or highlight something interesting about the data. The parallel, we believe, is close, and therefore we can describe location elements as either indicative or informative.



Language Focus: Verbs in Indicative and Informative Location Statements

There are approximately a dozen verbs commonly used to make reference to non-verbal material. Some can be used with both types of location statement. *Show* is one such verb.

- *Indicative* statement that summarizes what kind of research was done

Table 4 shows the types of internet misbehavior common among university students.

- *Informative* statement that highlights something interesting about the data

Table 4 shows that illegal downloading of music or films is common among students.

Notice that the information after the *that* clause is given in a clause with a subject and a verb.

Some verbs can be used with only one type of location statement. *Provide*, for example, can only be used in an indicative location statement and cannot be used with a *that* clause. (The flag indicates incorrect usage.)

Table 5 *provides* demographic information for the study participants.

Ⓜ Table 5 provides that most study participants were fairly competent internet users.

TASK FOUR

Decide whether each verb in the table can be used for an indicative (general summary) location statement, an informative statement (highlighting a specific aspect of the data), or both. Use the two sentences that follow the table to help you make your decision. Mark each box in the table with a Y for yes if the usage is possible and an N for No if it is not possible. The first two have been done as examples.

	Indicative	Informative
show	Y	Y
provide	Y	N
give		
present		
summarize		
illustrate		
reveal		
indicate		
display		
demonstrate		
suggest		

The table _____ the effect of social networking use on the duration of students' study time.

The table _____ that social networking has little, if any, effect on the duration of students' study time.

We looked at Ken Hyland's (2004) corpus of 80,000 words from 80 research articles in Biology, Physics, Electrical Engineering, Mechanical Engineering, Marketing, Applied Linguistics, Sociology, and Philosophy to determine

which verbs are most frequently used in full sentences to refer to figures and tables (Hyland, 2004). Table 6 shows the results of our analysis. All the verbs were in the present tense.

TABLE 6. Active Verbs Following Reference to a Visual

	Reference to Figure	Reference to Table	Total
shows	31	15	46
presents	6	7	13
illustrates	7	3	10
summarizes	2	4	6
demonstrates	2	3	5
contains	0	5	5
provides	0	3	3
depicts	2	0	2
lists	0	2	2
reports	0	2	2
TOTAL			94

Hyland, 2004.

We then looked at verbs in the passive voice in references to figures and tables. The results are given in Table 7.

TABLE 7. Passive Verbs in Reference to a Visual

	Reference to Figure	Reference to Table	Total
shown in	21	23	44
illustrated in	29	5	34
presented in	2	10	12
given in	2	4	6
listed in	0	6	6
seen in	3	1	4
provided in	1	3	4
summarized in	1	3	4
seen from	3	0	3
TOTAL			117

Hyland, 2004.



Language Focus: Linking *as* Clauses

So far, we have used sentences in which the reference to non-verbal data is either the subject or the agent in the main clause. However, another common way to introduce informative statements is the linking *as* clause. Here are some examples.

As shown in Fig. 1 and Fig. 2, the companies used in this survey varied significantly in geographical location, size, and method of operation.

As can be seen in Table 6, the overall rate of recall, while low, also showed considerable variation.

Shallow junction GM APDs, peripheral area test structures, and gate-controlled diodes, *as shown in Figs. 1(a), 1(b), and 1(c)*, were manufactured in p-type epitaxially grown bulk silicon using a conventional 1.5 μm CMOS process reported previously.

As can be seen in Figure 1, the fully charged Lithium-ion battery supplies 4.2 volts.

These linking clauses (where *as* does not mean the same thing as *since* or *because*) are exceptional in English grammar. In the passive, these linking clauses have no subjects. Compare the following sentences.

- a. As it has been proved, the theory may have practical importance.
- b. As has been proved, the theory may have practical importance.

In Sentence a there is a causal relationship between the *as* clause and the main clause. Because the theory has been proved, it may have practical importance. In Sentence b the *as* clause serves to suggest that the practical importance of the theory (not just the theory) has been established. Although you may find examples that run contrary to this advice, remember not to use subjects in passive linking *as* clauses.

Finally, using prepositions with this type of linking statement can be tricky. Here are some of the main standard uses.

- | | |
|-----------|--|
| <i>in</i> | As shown <i>in</i> Table 1 |
| <i>by</i> | As predicted <i>by</i> the model |
| <i>on</i> | As described <i>on</i> the previous page |

TABLE 18. Frequencies of Selected Features in RP Sections

	Introduction	Methods	Results	Discussion
Present tense	high	low	low	high
Past tense	mid	high	high	mid
Present perfect	mid	low	low	mid
Passive	low	high	variable	variable
Citations	high	low	variable	high
Hedges	mid	low	mid	high
Evaluative comments	high	low	variable	high

As you can see, there are some similarities between the Introduction and Discussion, on the one hand, and between Methods and Results, on the other. This may suggest a pattern of more “concrete” inner sections and more “conceptual” opening and closing sections.

With a partner, discuss the features of RPs in your field. Would you rate the frequency of the features as high, variable, or low in each of the sections? Use the chart below.

Analyze 3–5 papers in your reference collection (or more, if you have time) to determine whether your perceptions were correct or correspond to Table 18. If possible, add another feature of your own to the final row.

	Introduction			Methods			Results			Discussion		
	High	Low	Variable	High	Low	Variable	High	Low	Variable	High	Low	Variable
Present tense	x					x						
Past tense												
Present perfect												
Passive												
Hedges												
Boosters*												
Citations												
Evaluative comments												
One of your own												

*Boosters consist of language that is chosen to add strength to a claim. They allow authors to indicate a strong conviction to a claim. Examples include *clearly*, *obviously*, and *of course*.