ENGLISH FOR INTERNATIONAL RESEARCHERS

Student's book

John Speller

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Politechnika Łódzka

IFE

Politechnika Łódzka Centrum Językowe

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UNIT 1
Articles

IN THIS UNIT YOU LEARN HOW TO:

1 Structure a research article
2 Write an academic profile
3 Differentiate between language for research articles and presentations

Pre-knowledge

This course focuses on the language skills required to write a research article. Research articles may be published in journals and conference proceedings.

Reflection

1 As a group, answer the questions.

1 Why is the ability to write well a key skill for scientists?
2 Why is it important for researchers to publish scientific articles?

Discussion

2 As a group, answer the questions.

1 What are the differences and similarities between the following types of scientific texts?

- Monographs
- Research articles
- Review articles
- Lab reports
- Grant proposals
- Conference proceedings

2 Have you written any of the above types of scientific text in English?

1.1 Structure a research article

Pre-knowledge

There are many possible structures of articles, depending on the type of article, the discipline, and the journal. Your chosen journal will provide guidelines and often a template.

3 Put the standard sections of a research article in the box into the most common order (1–11). Some of the sections have been done for you.

Conclusions | Authors | References | Title | Acknowledgements | Abstract | Keywords

1 _____
2 _____
3 _____
4 _____
5 Introduction
6 Methods
7 Results
8 Discussion
9 _____
10 _____
11 _____

Writing tip

The IMRaD model shown above is often used to teach the structure of research articles. The 'hourglass' shape is said to reflect the development of the content in the introduction from general background information to the particular focus of the article, and from discussion of the specific results to consideration of their wider implications.

Journal search

4 Look at a selection of articles from a top journal in your discipline. Do they follow the IMRaD structure?

1.2 Write an academic biography

Pre-knowledge

In addition to the sections of a research article mentioned in the previous section, some journals require that authors write an academic profile, which is included at the very end of the article, after the references. Similar profiles can be used on professional networking sites and university websites, as well as in conference materials.

5 Read the academic biography below, which is written in the style of *IEEE Access* [1]. Decide if the statements below (1–6) are true or false. Underline the parts of the biography that support your answers.

RAFAŁ E. JACHOWICZ was born in Lodz, Poland in 1987. He received B.S. and M.S. degrees in computer science from Lodz University of Technology, Lodz, Poland, in 2010. He is currently pursuing a Ph.D. degree at Lodz University of Technology, Lodz, Poland.[1]

From 2010 to 2016, he was a Research Assistant at the Institute of Applied Computer Science robotics laboratory. Since 2015, he has been a consultant Senior C++ Developer for Fujitsu, Cybercom, and Commerzbank. He is the author or co-author of five chapters in the monograph series "Computer Vision in Robotics and Industrial Applications" and five research articles. His research interests include image processing and analysis algorithms for mobile vision systems and sophisticated optimization methods.[2]

Mr. Jachowicz has been the recipient of numerous scholarships awarded for academic performance, including the Rector's scholarship at Lodz University of Technology and the Pro-quality Scholarship in 2006–2013, the Scholarship of the President of Lodz in 2011 and the Marshal of Lodzkie Voivodeship scholarship in 2012.[3]

1 Rafał Jachowicz studied for both his Master's and Bachelor's degrees at Lodz University of Technology.
2 He has completed his doctorate.
3 He provides specialist advice to businesses.
4 He has published in books and journals.
5 His main specialism is speech recognition.
6 He has received national and international awards and honors.

6 Match the statements (A–H) to the paragraphs in the academic biography. Write 1, 2, or 3 in the spaces provided.

A Lists types of degree held or being studied, including the field, institution, city, state, country, and year in which the degree was earned *1*
B Lists any awards ___
C Begins with the author's title and last name ___
D Begins with the full name of the author ___
E Uses the pronoun of the person (he or she) ___
F Gives the author's place and date birth ___
G Lists work experience ___
H Lists previous publications ___

★ Grammar Articles

There are three types of articles in English:

- Definite article (the): used for things we know about or which are specific.
- Indefinite article (a/an): used for things that are introduced for the first time or not specific. *An* is used before words that start with a vowel sound.
- Zero article (-): used for unspecified uncountable nouns, plural nouns, abstract nouns, and proper nouns.

7 Complete the academic biography with a/an/the/(-).

STEPHANIE B. BAXTER received [1]_____ B.Eng. degree (Hons.) in [2]_____ computer science from [3]_____ James Cook University, Townsville, QLD, [4]_____ Australia, in [5]_____ 2016, where she is currently pursuing [6]_____ Ph.D. degree in [7]_____ engineering and [8]_____ related technologies.

Previously, she was [9]_____ summer intern with [10]_____ Cochlear Ltd., where she was involved in [11]_____ individual research project in [12]_____ biomedical field. Her research interests include developing [13]_____ accurate biomedical sensors for [14]_____ medical diagnostics, and [15]_____ use of [16]_____ Internet of Things for [17]_____ provision of [18]_____ rural and emergency healthcare.

8 Compare your answers with a partner. Try to explain your choices with reference to the points in the Grammar box.

Reflection

9 What are the differences between the academic biography in Exercise 7 and the template given in Exercise 6? Explain the differences.

Discussion

10 Work in groups. Talk about what you would include in your academic biography.

Assessment

11 Write your own academic biography, based on the models in this section.

1.3 Differentiate between language for scientific articles and presentations

Pre-knowledge

This course also focuses on skills for presenting scientific research. Scientists often have to make presentations at conferences, project meetings, and lectures, to experts and non-experts. Video presentations and virtual conferences are also becoming popular.

Reflection

12 Why is it important for scientists to be able to give good talks?

13 Does the following advice generally apply to research presentations or articles, or both?

1 Use less formal language (e.g. *get, big,* phrasal verbs, contractions).
- ☒ Research presentations
- ☐ Research articles

2 Use mostly impersonal language, e.g. passives, nouns rather than verbs.
- ☐ Research presentations
- ☐ Research articles

3 Use examples and analogies from everyday life, parts of the body, etc.
- ☐ Research presentations
- ☐ Research articles

4 Use facts and statistics to explain the importance of your topic.
- ☐ Research presentations
- ☐ Research articles

5 Use attention grabbers, e.g. rhetorical questions, stories, jokes.
- ☐ Research presentations
- ☐ Research articles

6 Define the research focus and purpose.
- ☐ Research presentations
- ☐ Research articles

7 Support your argument with references to previous research.
- ☐ Research presentations
- ☐ Research articles

8 Explain the limitations of previous approaches, and how your research addresses this gap.
- ☐ Research presentations
- ☐ Research articles

9 Explain the limitations of your own research, and indicate directions for future work.
- ☐ Research presentations
- ☐ Research articles

10 Explain the possible benefits and applications of your work.
- ☐ Research presentations
- ☐ Research articles

11 Avoid sounding overconfident and critical of others.
- ☐ Research presentations
- ☐ Research articles

12 Discuss your personal motivation for conducting the research.
- ☐ Research presentations
- ☐ Research articles

13 Do not refer to the titles (Dr. or Professor) or first names of other researchers.
- ☐ Research presentations
- ☐ Research articles

14 Give detailed descriptions of the materials and methods you used.
- ☐ Research presentations
- ☐ Research articles

15 Limit your discussion of abstract theory, equations, formulas, etc.
- ☐ Research presentations
- ☐ Research articles

16 Make sure that all content is relevant to your topic, purpose, and audience.
- ☐ Research presentations
- ☐ Research article

Video activity

14 Watch Bhuwan Dhingra present his PhD research at a Three Minute Thesis competition [2].

15 Summarize the main points in the speaker's presentation using the words and phrases below.

- Scramble
- Ethnic minorities
- Pedestrians
- Neural network
- Machine learning

16 Now watch Daniel Crabtree present his research at a similar competition [3].

17 Summarize the main points in the speaker's presentation using the words and phrases below.

- Searches
- Keywords
- Queries
- Clustering
- Natural language

18 Which talk did you prefer? Why?

ⓘ Both Bhuwan Dhingra and Daniel Crabtree were winners of the competitions they entered.

19 The text below is suitable for a presentation. However, there is some language in bold that is inappropriate for formal scientific writing. Re-write the text in a more formal scientific style.

Nowadays artificial intelligence-based technologies are advancing rapidly. Artificial intelligence has already had a **big** impact on **a lot of** areas of science and engineering. **In my opinion,** the most dramatic advances have been in the field of radiology. Indeed, as **Dr Katie Chockley and Dr Ezekiel Emanuel observed in 2016**, many radiologists now see artificial intelligence as a threat, as it can detect some **things** better than experienced specialists. **But** artificial intelligence behaves differently from humans in two significant ways. Firstly, **if you set it a goal**, an algorithm **can't** adjust itself and only does what it has been programmed to explicitly. Secondly, algorithms can anticipate and detect changes, but **don't** understand their underlying causes. Nonetheless, artificial intelligence is **getting** smarter all the time, and many professionals now fear it will have a **bad** effect on **jobs** in their sector.

20 Compare your changes with a partner. Explain your changes with reference to the points in the Style guide box.

Discussion

21 Are you worried about the current uses and future capabilities of artificial intelligence?

Style guide General guidelines

Style is in some ways a matter of taste. Journals also often have their own requirements and conventions, as explained in a Guide for Authors. Here are a few general guidelines for formal scientific writing:

- Avoid contractions
  e.g. don't use *don't,* you can't use *can't*
- We don't like to introduce examples
  use e.g. *such as, for instance, including*
- Forget *get*
  use e.g. *obtain, source, procure*
- Avoid most phrasal verbs
  e.g. *get better* → *improve*
- Avoid unnecessary words
  e.g. *serves to explain* → *explains*
- Avoid idioms and clichés
  e.g. *think outside the box* → *find novel solutions*
- Avoid some simple words
  e.g. *a big sample* → *a large sample; a bad effect* → *a negative effect*
- Don't use informal words
  e.g. *boss* → *manager; chance* → *opportunity*
- Avoid starting sentences with *and* or *but*
- Avoid most personal language
  e.g. *in my opinion, me, you*
- Avoid most dramatic and emotive language—e.g. *to save the planet* → *to protect the environment; the number of bacteria plummeted* → *the number of bacteria fell significantly*
- Refer to sources using a standard referencing system

UNIT 2
Titles and Abstracts

IN THIS UNIT YOU LEARN HOW TO:

1 Write titles
2 Write abstracts
3 Design slides for research presentations

Pre-knowledge

The title and abstract are often the first parts of your article the audience will read. They are available for free, even when the rest of the article is not. On the basis of the title and abstract, your audience will decide whether the rest of your paper is of interest. Titles and abstracts are often considered to be the most important parts of a paper—and the most difficult to write effectively.

Reflection

1 As a group, answer the questions.

- Who are the potential readers of your title and abstract?
- What does this mean for how your title and abstract should be written?

2.1 Write titles

2 Match the titles (1–5) to the types of titles (A–E) [4–8].

1 Sleep quality, duration, and consistency are associated with academic performance among college students
2 Silane treatment as an effective way of improving the reinforcing activity of carbon nanofibers in nitrile rubber composites
3 Tracking online topics over time: understanding dynamic hashtag communities
4 Protection and control of microgrids using dynamic state estimation
5 Biochemical routes for uptake and conversion of xylose by microorganisms

A A descriptive (or indicative) title that states the topic
B A title that focuses on the method
C A declarative title that states describes the conclusion
D A title that focuses on the result
E A two-part title

Journal search

3 Search on the internet for a list of the top-cited articles in your discipline. Which types of titles do they use?

Style guide Punctuating titles

The titles of scientific articles should not be placed in inverted commas. Titles never end in a period (.). Two-part titles are separated by a colon (:). There are two ways to capitalize titles:

1) capitalize only the first letter of the first word as well as any proper nouns (sentence case),
2) capitalize all words except for articles and prepositions (Title Case).

Some titles are written in all caps. Always check the requirements of your chosen journal.

4 Re-write the titles in Exercise 2 in Title Case.

Style guide Compound nouns in titles

Authors often use compound nouns to make their titles more concise. A compound noun is a noun modified by an adjective, verb, or another noun. Compound nouns can be built up to form noun strings. However, such titles can be ambiguous and difficult to read. Compare:

× Bionic compound eye moving object detection imaging system
✓ Imaging system for moving object detection using a bionic compound eye

As a general rule, try to limit noun strings to a maximum of three modifiers in a row.

5 Find examples of compound nouns in the titles from Exercise 2.

6 Improve the titles by shortening the noun strings, replacing the prepositions and articles, using verb forms, etc.

1 Municipal Solid Waste Classification Methodology
2 *Staphylococci* Biofilm-Forming Ability
3 Carpooling Services Recommendation System

★ Grammar Compound nouns and adjectives

Compound nouns are sometimes one word, like *database*, or two words, like *computer science*. If two or more words are used to modify a noun (or a compound noun) they may be joined with a hyphen, as in *billion-dollar particle collider.* This is known as a compound adjective.

Nouns that modify another noun are usually singular, even if they refers to something plural:

- Engines for cars: *Car engines*.

However, in some cases the noun modifier remains plural. For example:

- *Skills training:* more than one skill will be taught.
- *Data analyst:* the singular form *datum* is rare.
- *System(s) administrator:* the *s* is optional.

7 Re-write as compound nouns and compound adjectives.

1 A system for detecting objects in real time.
2 The pattern of radiation from an antenna.
3 Software for managing inventory.
4 Types of data.
5 A turbine powered by steam.
6 A robot for guiding tourists.
7 A machine that uses a jet of water for cutting.
8 A satellite used for communications.
9 A system for delivering drugs.
10 A device that senses the temperature of coolant in an engine.

Writing tip

A good technique for generating titles is to note down key words and try them in different combinations. It is recommended to write several possible titles and then choose the best.

8 Write titles based on the key words.

1 Sustainability; Network design model; Bioenergy production; Anaerobic digestion; Agricultural residues
2 Eco-friendly concrete; Recycled plastic; Mechanical properties; Life-cycle assessment
3 Electric vehicle; charging station; Photovoltaics

2.2 Write abstracts

Pre-knowledge

There are many types of abstract, which vary depending on the subject and the journal. However, typically they should include information about the following:

- general background about the topic
- the problem your research addresses
- the purpose of your study
- the solution you developed and/or methods you used
- the implications of your research

9 Read the three abstracts A, B, and C. Match the abstracts to Figures 1, 2, and 3 on page 9.

A

Soft actuation allows robots to interact safely with humans, other machines, and their surroundings. Full exploitation of the potential of soft actuators has, however, been hindered by the lack of simple manufacturing routes to generate multimaterial parts with intricate shapes and architectures. Here, we report a 3D printing platform for the seamless digital fabrication of pneumatic silicone actuators exhibiting programmable bioinspired architectures and motions. The actuators are composed of an elastomeric body decorated with reinforcing stripes at a well-defined lead angle. Similarly to the fibrous architectures found in muscular hydrostats, the lead angle can be altered to achieve elongation, contraction, or twisting motions. We establish design principles based on lamination theory for the digital fabrication of silicone-based soft actuators with functional responses programmed into the properties and architecture of the material. Exploiting such programmability enables 3D printing of a broad range of soft morphing structures.

B

The vision systems of arthropods such as insects and crustaceans are based on compound-eye architecture, consisting of a dense array of individual imaging elements (ommatidia) pointing in different directions. This arrangement is particularly attractive for imaging applications requiring extreme size miniaturization, wide-angle fields of view, and high sensitivity to motion. However, mimicking the eyes of common arthropods is complicated by their curved geometry. Here, we describe a lensless planar architecture, in which each pixel of a standard image-sensor array is coated with an ensemble of metallic plasmonic nanostructures that only transmit light incident along a small geometrically-tunable distribution of angles. A set of near-infrared devices providing directional photodetection peaked at different angles was designed, fabricated, and tested. Computational imaging techniques confirmed the ability of the devices to reconstruct high-quality images of complex objects.

C

The mosquito uses a combination of mechanisms, including an insertion guide, to bite and feed off larger animals. Here, we describe a biomimetic strategy inspired by the mosquito's insertion guide for the implantation of intracortical microelectrodes into the brain. Next-generation microelectrode designs leveraging ultra-small dimensions and/or flexible materials offer the promise of increased performance, but present difficulties in terms of reliable implantation. The prototype guides presented here provide a reproducible method for the insertion of small, flexible devices into the brain. With the biomimetic guide in place, the rate of successful microprobe insertion increased from 37.5% to 100% due to the 3.8-fold increase in the critical buckling force of the microprobes. In the future, similar approaches may be considered for the insertion of other difficult to implant medical devices.

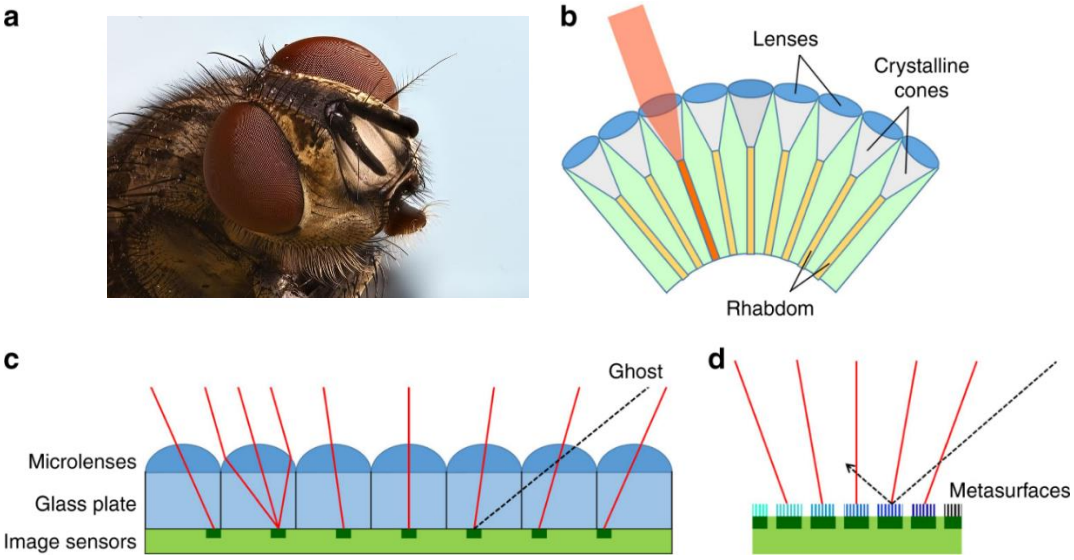

Figure 1. The caption has been removed [10, 14].

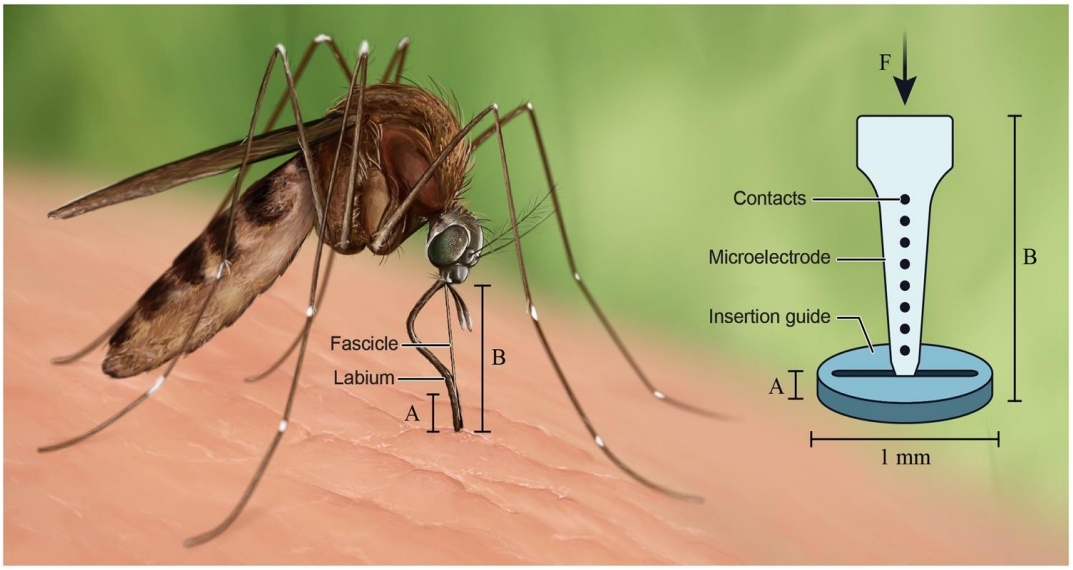

Figure 2. The caption has been removed [11].

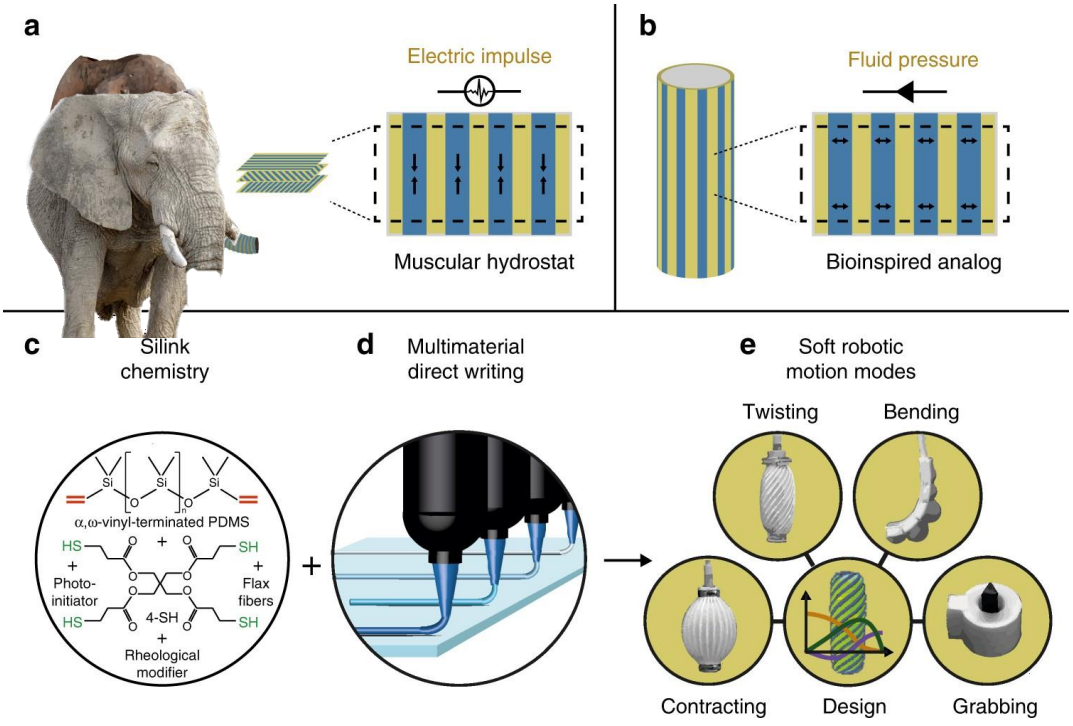

Figure 3. The caption has been removed [9, 13].

10 Work in groups of three. Take it in turns to briefly summarize the main idea of the research described in the abstracts, looking only at the figures on page 9.

11 Identify the sections in the abstracts based on the information in the Pre-knowledge box.

12 Put the useful phrases for abstracts into the correct order.

1 work This aims to…
2 addresses study the issue This of…
3 is method The on… presented here based
4 potential The proposed applications solution has for…
5 we Here, propose…
6 limited Current are technologies by…
7 paper, we this present In a solution novel to…
8 by… of X Full has been exploitation hindered
9 In for… similar the approaches be may considered future,
10 combines Our of… the benefits solution
11 such limiting for the development factors of devices include... However,
12 we on these Building insights, propose…
13 for…The paves proposed the strategy way
14 X in years. has considerable attracted attention recent
15 approach Our opens way for… the
16 demonstrate results The that…
17 wide including… X a range of applications, have
18 current This extends knowledge of… study
19 among X are most the used… widely
20 understood However, X poorly remains

13 Group the phrases in Exercise 12 (1–20) to match the sections of an abstract in which they are most likely to appear.

★ Grammar Tenses in abstracts

Scientific abstracts usually require only a small number of tenses. The most common tenses are listed below.

Tenses	Uses
Present simple	
Present perfect	
Past simple	
Future simple and modal verbs in future time (e.g. *could, might, may*)	

14 Read the abstracts A–C again. Find examples of the tenses listed in the grammar box.

15 Decide why the tenses in the Grammar box were used in the abstracts. Complete the information in the Grammar box.

16 Compete the abstract with the best options [17].

Light detection and ranging (LiDAR) **becomes / has become / became** an essential technology for automated applications, from robotics to driverless cars. These systems typically **rely / have relied / relied** on laser scanning to recover position information. Here, we **propose / have proposed / will propose** a hybrid LiDAR approach which **combines / has combined / combined** a multi-view camera system for position and distance information with a simple scannerless LiDAR system for velocity tracking and depth accuracy. We **show / have shown / will show** that it is possible to create a compound image of a scene at more than 1 frame per second and with depth accuracy of 2.5 cm or better. Our hybrid approach **avoids / has avoided / avoided** the need for bulky and expensive scanning systems, while supplying additional velocity information. We hope that this solution **has provided / will provide / may provide** a simpler, more robust alternative to 3D scanning systems for autonomous vehicles.

Style guide First-person pronouns

Although the style of scientific writing is generally impersonal, many journals accept the use of personal pronouns, especially to present your research, express opinions, and refer to your results. As scientific papers are often multi-authored, it is common to use *we* and *our*. However, the use of *I* (as well as *me* and *mine*) is controversial.

Reflection

17 As a group, answer the questions.

- Why is the style of scientific writing generally impersonal?
- Is the use of the first person "*I*" common in your discipline?

18 Read the same abstract from Exercise 16, in which the personal pronouns have been replaced with impersonal phrases [17]. Which version do you prefer?

Light detection and ranging (LiDAR) has become an essential technology for automated applications, from robotics to driverless cars. These systems typically rely on laser scanning to recover position information. **This paper proposes** a hybrid LiDAR approach which combines a multi-view camera system for position and distance information with a simple scannerless LiDAR system for velocity tracking and depth accuracy. **The authors show** that it is possible to create a compound image of a scene at more than 1 frame per second and with depth accuracy of 2.5 cm or better. **The presented** hybrid approach avoids the need for bulky and expensive scanning systems, while supplying additional velocity information. **It is hoped that** this solution will provide a simpler, more robust alternative to 3D scanning systems for autonomous vehicles.

Writing tip

Writing your abstract first can help you plan the other sections of your paper. However, many writers prefer to write the abstract last, so they can be sure they have included all the essential information. A good tip is to write a rough abstract first, then revise it once you have written the other sections of your paper.

Assessment

19 Imagine your team has invented one of the technologies below (or made a significant step in that direction). Write an abstract for a paper presenting your research. Invent any necessary details.

1 A teleporter
2 A time machine
3 A warp drive
4 A mind reader
5 A new element

OR

Write an abstract for a research project you are working on, or would like to do in the future. Invent any necessary details.

- Select 3–4 key words from the abstract. Write a title for the abstract.

Abstracts are usually written as a single paragraph of 300 words or less.

Discussion

- Do you think the technologies mentioned in Exercise 19 will one day be possible, based on current knowledge?

2.3 Design slides for research presentations

Pre-knowledge

Slides are an important part of a research presentation. Preparing your slides can help you to plan your talk, and during your presentation they can help your audience to follow and understand what you say.

20 What advice would you give to someone about creating slides for a research talk? Consider:

- How many slides per minute
- The first slide
- The last slide
- Slide headings/titles
- How much text
- Use and number of bullet points
- Content
- Colors and contrast
- Slide tools
- Animations
- Fonts
- Multimedia (e.g. audio recordings, video, webpages)

Discussion

21 Show a slide deck from a presentation you gave recently. Discuss what is good about the slides and how they could be improved.

OR

Find a slide deck for a presentation related to your discipline, e.g. from Slideshare or MIT OpenCourseWare. Discuss what is good about the slides and what could be improved.

UNIT 3 Introduction

IN THIS UNIT YOU LEARN HOW TO:

1 Structure an introduction
2 Review the literature
3 Highlight the contribution
4 Make a presentation opening

Pre-knowledge

The content of a typical introduction is similar to that of an abstract. It should:

- provide background information;
- describe the specific research problem;
- state the purpose of the study, mention the methods; that were used, and highlight the outcomes.

However, the introduction should not simply repeat the abstract. Differences with an abstract may include:

- the introduction provides more detailed and wider background information;
- the introduction summarizes the results of related research, including citations;
- the introduction outlines the structure of the rest of the article (e.g. the content of the various sections).

By the end of the introduction, the reader should understand the scope and the contribution of the article.

3.1 Structure an introduction

1 Scan the introduction to an article about artificial compound eyes on the next page [15]. You do not need to understand everything.

2 Match the paragraphs (1–4) in the introduction to the descriptions below (A–D). You may use each description more than once.

A Gives background information and defines the topic.
B Outlines the rest of the paper.
C Discusses related work and its limitations.
D Describes how the authors address the research problem.

Writing tip

The length of each section of an introduction, especially the background information and review of the literature, may vary depending on the topic and the discipline. Not every introduction will include all the sections described here, or sequence them in the same order.

3 Read the text again. Decide if the statements are true or false.

1 The overall structure of the introduction moves from general background information to the specific focus of the article.
2 Relevant literature is summarized and cited, but not discussed in depth.
3 The authors explain their objectives and motivations.
4 The authors give in-depth details of their methods.
5 The authors state the main outcomes of their research, but include only their key results.
6 The authors highlight their contribution.
7 The authors end with a summary of the content and main conclusions of the article.

Reflection

4 Look again at Figure 1, which you first saw in Unit 2, and read the caption [10]. Discuss what the figure shows.

- Do you have a better understanding of the scope and contribution of the article than you did after reading only the abstract?

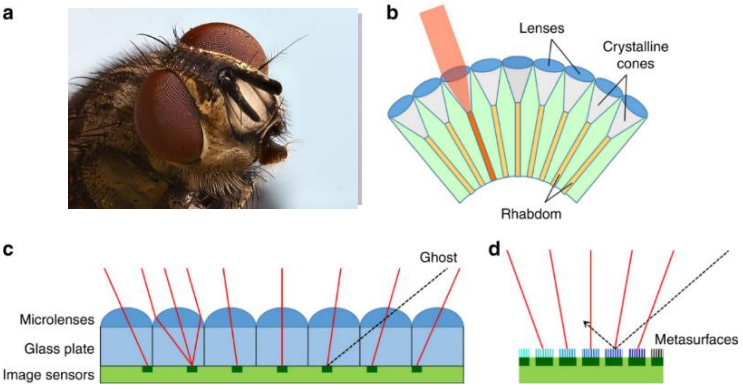

Fig.. 1. a Micrograph of the compound eyes of a horse fly. **b** Schematic illustration of the apposition compound-eye architecture. **c** Artificial compound-eye camera based on a planar microlens array and a photodetector array separated by a glass plate. By design the two arrays have different periodicities, so that each sensor detects light incident along a different direction. **d** Compound-eye camera based on the angle-sensitive metasurfaces developed in the present work, where only light incident along a different direction is transmitted into each image sensor.

Traditional cameras used for common imaging applications consist of one or multiple lenses projecting an image of the object of interest onto an array of photodetectors. This configuration, which is similar to the architecture of the human eye, can provide excellent spatial resolution but suffers from a fundamental tradeoff between small size and wide field-of-view, originating from aberration effects at large angles of incidence. The solution devised by nature to address this issue is the compound eye[1], which is in fact found universally among the smallest animal species, such as insects and crustaceans (Fig. 1a). While different types of compound eyes exist, their basic architecture consists of an array of many imaging elements, called ommatidia pointing in different directions (Fig. 1b), each collecting a single point of information about the scene being imaged. Typical ommatidia found in apposition compound eyes include a facet lens, a crystalline cone, a waveguiding fiber (rhabdom), and photoreceptor cells. These elements can be packed together extremely tightly, providing nearly full hemispherical vision with no aberration. With such an arrangement, all objects in the field-of-view are also automatically in focus at all times (i.e., the depth of field is essentially infinite). PARAGRAPH 1

These advantages have motivated significant research efforts towards the development of novel cameras inspired by the compound-eye vision modality. Most prior technologies have been based on planar[2,3,4] or curved[4,5,6,7,8,9,10,11] arrays of microlenses combined with carefully aligned image-sensor arrays. The curved geometry directly mimics the compound-eye architecture of common arthropods, but is complicated by limited compatibility with standard microelectronic circuits, which are traditionally based on planar substrates. As a result, it requires either the introduction of bulky optical relay systems[5,8,9,11] or the development of complex fabrication and packaging processes to produce photodetector arrays and readout electronics on a curved surface[6,7,10]. A possible implementation of a flat compound-eye camera is shown in Fig. 1c, where the photodetector/microlens pair in each pixel detects light incident along a different direction, determined by the position of the photodetector within the focal plane of the microlens[3]. However, the field-of-view in this geometry is severely constrained by optical crosstalk between neighboring pixels at large angles of incidence, which can lead to the formation of ghost images unless interpixel blocking layers are employed. Even with multiple lens arrays, the maximum achievable field-of-view is limited by the *f*-number of the microlenses to values below ±35°[4]. PARAGRAPH 2

Here, we describe a compound-eye camera based on a fundamentally different approach that can provide wide-angles field-of-view (over ±75°) on a flat substrate. Its key innovation is the integration of each pixel of a standard image-sensor array with a specially designed metasurface (ensemble of subwavelength optical nanostructures) that allows for the detection of light incident along only a small, geometrically tunable distribution of angles, whereas light incident along all other directions is reflected (Fig. 1d). Computational imaging techniques are then employed to enable image reconstruction from the combined signals of the individual sensors. With this approach, ultrathin planar cameras can be developed without any lenses, featuring all the aforementioned desirable attributes of compound eyes and providing further miniaturization compared to previous implementations. In particular, the lack of a microlens array reduces both the camera thickness and the required spacing between neighboring photodetectors, allowing for higher density and therefore higher resolution. The metasurfaces can be fabricated directly on existing CMOS/CCD image-sensor arrays using standard lithographic techniques, with straightforward alignment to their respective pixels and full suppression of interpixel crosstalk. PARAGRAPH 3

In what follows, we present the design, fabrication, and characterization of a representative set of infrared devices based on metallic plasmonic nanostructures combined with simple Ge photoconductors, providing directional photodetection peaked at different angles. A computational imaging framework is then described, which was developed to simulate the imaging capabilities of cameras consisting of complete arrays of such devices. The simulations were carried out using both calculated and measured angular response patterns for the experimental devices, together with their interpolations for all other pixels in the array. The key conclusion is that high-quality images of relatively complex objects can be reconstructed over a wide field-of-view of ±75°, with realistic operational characteristics including the number of pixels, signal-to-noise ratio, and illumination bandwidth. PARAGRAPH 4

★ **Grammar** Reference words

Reference words usually replace nouns, but can also refer back to whole clauses, sentences, and parts of text. Always ensure that the antecedent of any reference words is clear. If in doubt, repeat the noun or provide a synonym.

5 Look at the highlighted words in the article. Complete the rules below about reference words.

- We often use __*this*__ / __*these*__ at the start of a sentence or paragraph to add new information to a topic begun in a previous sentence or paragraph.
- *That/those* are more emphatic, and are often used to differentiate one thing from another.
- When comparing the properties of two things, we often use *that/those* to avoid repeating the name of the characteristic—e.g. *The **thermal efficiency** of an internal combustion engine is typically higher than **that** of an external combustion engine.*.
- We can use _____ to refer to something we have just mentioned. The possessive form is _____. The plural form as the subject of a sentence is *they.* The plural form as the object of a sentence is *them*.
- *The former* refers to the first of two mentioned things, *the latter* to the second. It is advisable to use *the latter... the former* only to avoid significant repetition. Otherwise, use a synonym or repeat the noun for clarity.
- _____ can be used to refer to something described or discussed previously in the same section. If you are referring to something that was described or discussed in a different section, you should say in which one.
- We can use _____to mean 'of the same or a similar kind'.
- We can use the phrase _____ to introduce a summary of the next section(s) or the rest of an article.
- We use _____ followed by a noun to refer to things that have been introduced or are known to the reader.

6 Complete the sentences with the best options.

1 It is estimated that around 30 types of crops currently account for as much as 95% of human food consumption. _____ has an adverse effect on soil quality, species diversity, and ecosystem resilience.
A It
B This
C That

2 The human body is inhabited by at least 10 times more bacteria than there are human cells. The majority of _____ are found in the human gastrointestinal tract.
A those bacteria
B them
C such bacteria

3 Bionic compound eyes offer several advantages over single lens cameras. _____ include small size, light weight and wide viewing fields.
A These
B Those
C They

4 The density of titanium is almost half _____ of steel.
A the one
B that
C –

5 The SSF process of POS production is more efficient than _____.
A that of SHF
B the SHF one
C the SHF process

6 The unique structure and properties of carbon nanofibers combined make _____ an attractive nanofiller for polymer composites.
A them
B they
C carbon nanofibers

7 Although the navigation system presented here was developed for use by the blind, _____ could also be applied in autonomous robots and unmanned aerial vehicles.
A that
B this system
C it

8 There are two main types of rolling-element bearings: ball bearings and roller bearings. In _____, the rolling elements are spherical balls, whereas in _____ the rolling elements are cylindrical, tapered, or spherical rollers.
A the former... the latter
B the latter... the former
C ball bearings... roller bearings

9 We used a short section of ~100 μm-diameter polyamide wire (Stroft ABR, Stroft) or 125 μm-diameter fused silica optical fiber (SMF-28, Corning) as the cylindrical template. _____ was found to be more suitable than _____ for the fabrication of multi-turn spiraling micro-tentacles.
A The former… the latter
B The fused silica optical fiber… the polyamide wire
C The second one… the first one

10 Non-metallic materials based on fibers are of particular interest for the military, the aerospace industry and manufactures. The advantages of _____ include high strength, low weight, corrosion resistance, and chemical as well as magnetic inertia.
A the latter materials
B such materials
C the aforementioned materials

7 Check your answers with a partner. Explain your choices with reference to the rules in Exercise 5.

3.2 Review the literature

Pre-knowledge

A literature review is used to survey past research on the topic. Some articles require a separate literature review section. In other cases, the literature review material appears at appropriate points in the body of the text (especially in the Introduction and Discussion). Some articles consist entirely of an extended literature review. These are called review articles.

Reflection

8 How can you find papers for your literature review?

9 How can you decide which papers to include in your literature review?

Writing tip

There is some flexibility with regard to tense choice in a literature review. Generally, you can use the present perfect to give an overview of a paper or a number of papers, the past simple to discuss individual papers in more detail, and the present simple to tell the reader where they should look for particular information.

10 Complete the paragraph below from a literature review [15] with the verbs in brackets in a suitable tense. More than one correct answer may be possible.

There _____ **(*be*)** a number of studies in the literature on the syntactic and semantic errors made by novice programmers [1]–[3]. Other studies _____ **(*focus*)** on how much time students spend correcting errors [4] and the frequency of particular errors [5]. Jadud [6] _____ **(*investigate*)** the mistakes and attempts at solutions made by students writing programs in Java. Kohn [7] _____ **(*analyze*)** over 4000 instances of error messages elicited by Python programs, and _____ **(*identify*)** the most common error categories. A more complex study of mistakes made by novice programmers in Python _____ **(*be*)** given in [8], including a quantitative analysis of the distribution, duration, and evolution of errors. However, there _____ **(*be*)** few studies concerning error and warning messages for programs written in C language.

Style guide Referencing

Most references in this book are in the ordinal-number style, in which references are numbered to correspond to the full citation listed in the References. This is normally the order in which the cites first appear, although some journals require you to list your references alphabetically. Numbers are placed in square brackets [Ref] in both the text and the References. When citing multiple sources, these may be placed in the same brackets separated by commas [1, 2, 3] or a dash [1–3], or alternatively in their own brackets separated by commas or dashes—e.g. [1], [2], [3] or [1]–[3]. As always, check your journal's style guide and be consistent.

Another referencing style uses superscripted ordinal numbers, as in the reading text in Section 3.1.

A third popular referencing style is the Harvard (author date) system, which uses author surnames and the year of publication in square or round brackets, like this: (Blogs 1990). According to some style guides, the surname and date may need to be separated by a comma. When citing multiple sources, these are placed in the same brackets, in alphabetical order, separated by semicolons, like this: (Blogs 1990; Smith and Jones 2010). The bibliography is then listed in alphabetical order according to the first author's surname. When references have two authors, the surnames of both authors are usually given, separated by "and" or "&". When references have more than two authors, only the first author's surname is usually given followed by "et al."—e.g. (Smith et al.). Note that "et al." is an abbreviation, so it requires a stop.

There are two main ways to use citations. In the author-prominent method, the author name is given as part of the sentence, followed by the cite. In the Harvard system, author names are not repeated in the brackets—e.g. 'Blogs (1990) showed that…' In the information-prominent method, author names are not mentioned as part of the sentence, and the cite is given at the end—e.g. [Ref].

Journal search

11 Which referencing systems are most common in your discipline?

12 How can you store and manage the bibliographic data of the articles you read?

3.3 Highlight the contribution

Pre-knowledge

Towards end of the introduction, often after reviewing the literature, it is usual to highlight the contribution of your article to the current state of knowledge. This may include the following elements: 1) a statement of the purpose of the paper; 2) a summary of the methods that were used; 3) the key results, and 4) an outline of the rest of the paper.

13 Read another paragraph adapted from the same paper as Exercise 10 [21]. Does it include the elements (1–4) mentioned in the Pre-knowledge box?

In this paper, we classify and analyze C compiler diagnostic messages generated by novice programmers. The classifications refer to particular errors made by first-year students learning C. A method for generalizing compiler diagnostic messages is proposed, which was used to obtain 374 message patterns (Section 3.2). Almost 110,000 faulty programs were analyzed in terms of the most common compiler and linker errors (Section 3.3). Due to the substantial size of the sample, the conclusions can be considered reliable. Over 70 error categories were identified and analyzed (Section 3.4). The proposed categories significantly extend the research presented in [18] and [28]. The results could help to inform and improve classroom instruction. For instance, the most common errors may be presented and discussed during classes.

14 Match the main types of contributions that a scientific paper can make (1–4) to the examples (A–D).

1 Theoretical
2 Methodological
3 Empirical
4 Practical

A Possible applications
B A more accurate or efficient way to solve a problem
C Better understanding of concepts and their interrelationships
D Data

15 Identify the main contributions of the paper outlined in Exercise 13.

16 Put the useful phrases for introductions in the correct order.

1 numerous There have been studies have on X [Ref].
2 [Ref]. studies Other focused X on have
3 X extensive has the [Ref]. been of research subject
4 given [Ref]. An review of literature is in extensive the
5 of wide-ranging the X. is a literature There on subject
6 on a study X, Smith [Ref]… In seminal
7 by first [Ref]. systematic The on was study performed X
8 this The of that… study lies in novelty fact the
9 the first paper is to describe… This
10 as this contributions The major of paper follows: are
11 the previous To best of the there have been authors, no studies on… knowledge
12 solution applied here The could be to… presented
13 solution We an innovative the problem of… provide to
14 This opens research the of… possibility
15 applications, wide This technology including… has a of range industrial possible
16 a previous Compared technologies, solution to advantages, presented here has the of number including…
17 fundamentally Here, different we a technology describe based on a approach that…
18 improve… The could to help results
19 key The conclusion that… is
20 rest the is The structured of as follows: paper

Writing tip

Novice writers are sometimes advised to re-use common phrases and structures from the scientific articles they read. Because these are typical phrases, this is not plagiarism. However, many papers—even those published in top journals—contain incorrect or inelegant formulations. If in doubt, consult a reliable phrasebank or contact a proofreading service.

Assessment

17 Write one or two short paragraphs reviewing the literature and highlighting the main contributions of the research for which you wrote the abstract in Unit 2.

- Use the paragraphs in Exercises 10 and 13 as models, as well as paragraphs 2 and 3 in the reading in Section 3.1.
- Use the referencing system most common for your discipline.
- Invent any necessary details.

3.4 Make a presentation opening

Pre-knowledge

The beginning is a key moment in a talk, when you should have the audience's full attention. The kind of introduction you give will depend on the type of presentation, your audience, and the topic.

Reflection

Decide why a presenter might decide to (or not to) do these things in the opening to a research presentation.

- Introduce themselves by name
- Thank the audience
- State the title/topic of the presentation
- Give the plan of the talk
- Say how long the presentation will last
- Give some background to the topic
- Explain the purpose of the presentation
- State the key findings
- Discuss the implications and applications of the research

18 Correct the mistakes in the common phrases from a traditional presentation opening below. There is one mistake in each phrase.

1 Good day. Thank you for coming.
2 Let me introduce me.
3 For those of you who don't know me, I'm called…
4 The subject of my today's presentation is…
5 First I'm going to tell about…
6 Next I will say you…
7 After, I will discuss…
8 Finally, I will explain you…
9 My presentation takes about ten minutes.
10 If you have any question, feel free to ask at any time.

Discussion

19 Work in groups. Discuss the questions.

- Can you think of any more interesting ways to start a presentation?

  E.g. *Ask the audience a question.*

20 When might you use an attention-grabbing opening, and when might a more traditional introduction be more appropriate?

Video Activity

21 Read the opening lines below from five different presentations [16–21]. Which talk would you like to watch? Why?

1 "My name is Anushka Vidanage. and I was born on 29th February, 1990. My address is Number 17 Barry Drive, Acton. My phone number is 041-0927-517. And my credit card number is 5217 1690 2640 7534." ▶ 3

2 "Cancer sucks. And if you're like me and have experienced chemotherapy, it sucks too." ▶ 4

3 "Can you guess how I fell in love with electric cable bacteria?" ▶ 5

4 "'Renewable energy is limitless and will last forever.' UN secretary-general Ban Ki-Moon used these words last year as he presented the UN sustainable development goals in Dubai." ▶ 6

5 "Imagine opening a can of soda." ▶ 7

22 Watch the presentation you chose in full. Note the key words.

23 Work in small groups. Summarize the main idea of the research described in the presentation, based on your notes from Exercise 22.

Discussion

24 Have you seen any other presentations with attention-grabbing openings? Which techniques did they use?

25 Put the useful phrases for making a presentation opening into the correct order.

1 my Hello, name is…
2 introducing Let start by myself me
3 me of hands. Please let a show have
4 you Did that…? know
5 in I'd do like to this is… What presentation
6 presentation focusing In this I be on… shall
7 Today be I'll addressing main topics. three
8 main divided My will be into three sections. talk
9 will My last around… talk
10 some There be time will for at the end. questions

Presentation tip

Some experts advise presenters to write the introduction and conclusions of their talks, so they are well-structured and concise. However, it is important not to read any part of a presentation. On the other hand, presentations learned by heart can also sound artificial. Aim to be well-prepared, but leave room for spontaneity.

Assessment

26 Prepare a presentation opening based the topic you wrote about in Exercise 17.

OR

Prepare a presentation opening based on another topic related to your research area.

You should do all or some of the following:

- Introduce yourself by name
- Thank the audience
- State the title/topic of the presentation
- Give the plan of the talk
- Say how long the presentation will last
- Give some background to the topic
- Explain the purpose of the presentation
- State the key findings
- Discuss the implications and applications of the research
- Use attention grabbers

UNIT 4 Methods

IN THIS UNIT YOU LEARN HOW TO:

1 Describe methods
2 Use sequencing words and phrases
3 Use numbers and units
4 Present methods

Pre-knowledge

The methods section (sometimes titled Materials and Methods) should provide a clear and concise description of the procedures and equipment that were used in the study. The aim is that someone with the necessary scientific knowledge and skills should be able to replicate your experiments or numerical simulations, etc.

Discussion

1 Think about how you could create or test the capabilities of the technology you first wrote about in Unit 2. Discuss your ideas with a partner. Take notes for use later.

4.1 Describe methods

Style guide Describing methods

Many methods sections are divided using sub-headings that indicate the focus of each stage of the research. The experiments should be presented in a logical order, according to the narrative of your paper. This is often (but not necessarily) the same order in which they were performed. Visual elements such as schematic diagrams, tables, and flowcharts can help the reader to understand the steps, variables, and parameters in your method. It is not necessary to describe procedures that are well-known or described in detail elsewhere. If you are following the IMRaD structure, you should not normally discuss the methods used by other researchers in similar studies, or other possible methods you could have used. This information should be left for the Discussion section. Because there is normally no ambiguity about who performed the actions described in the Methods, this section should be written predominantly in the passive voice.

2 Read a description of the method that was used to test the mosquito-inspired guides you first read about in Unit 2. Identify the steps shown in Figure 1 [11].

Guide-Assisted Insertion of a Dynamically Softening Microelectrode

We anaesthetized rats with 5% isoflurane and **gave them** an intraperitoneal shot of a ketamine-xylazine-atropine cocktail (KXA), as described elsewhere[60]. **We secured each animal** in a stereotaxic frame and **administered dexamethasone** subcutaneously. **We applied lidocaine** at the incision site. **We shaved the scalp** and **removed the skin** from the skull area. **We fabricated insertion guides** with a diameter of 3 mm and a height of 1 mm. Each guide had a slit approximately 0.25 mm in width running to the side of the device, so that **we could remove it** after implantation. **We conducted implantation tests** using non-functional thiolene/acrylate SMP microprobes from the Voit lab (UT Dallas) with a 3 mm shank, a width of approximately 200 µm, and a thickness of 30 µm. **We inserted the microprobes** using a stereotactic arm with a micropositioner. **We positioned the microprobe manually** directly above the insertion guide, and **we activated the motor drive** to lower the microprobe through the guide and into the brain at 2000 µm/s. **The University Bioethics Committee approved all procedures and animal care practices**.

Grammar Passives

The passive is formed using the verb *to be* in the correct form and the past participle of the main verb.

If the same object is used for more than one passive verb in the same sentence, the object and the verb *to be* can be omitted for each subsequent passive verb after the first, like this:

- The sample was first heated to 210°C at 10°C min^{-1}, then ~~the sample was~~ equilibrated for 10 min, and finally ~~the sample was~~ cooled to −10°C at 5°C min^{-1}.

If the object changes but the form of the verb *to be* is the same, when the two actions are closely connected then the verb *to be* can often be omitted, like this:

- The solution was filtered and the filtrate ~~was~~ collected.

3 Rewrite the parts of the text in bold using the simple past passive. Use omission if possible.

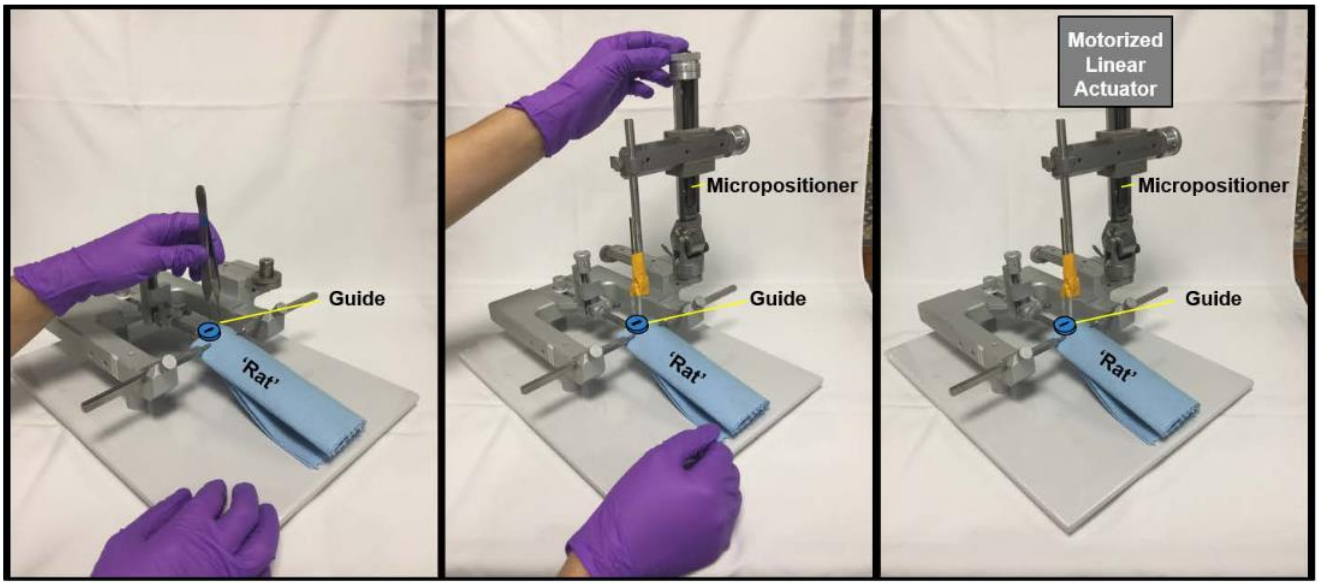

Fig. 1. Photographic representation of insertion using the guide [11].

Discussion

4 Work in groups. Answer the questions.

1 Do you think that testing on animals is ethical?
2 What do you think are the main ethical issues related to science today (e.g. artificial intelligence, genetic modification, geoengineering)?
3 Are there any ethical issues related to your research?

4.2 Use sequencing words and phrases

Style guide Positioning sequencers

There is some flexibility with regard to the positioning of sequence words and phrases within sentences. Sequencers that mark the most important stages of a process or method can be used at the start of a sentence (e.g. *In the first step, In the next step, Finally*). Less important steps can then be marked by sequencers positioned next to the verb, or between the verb *be* and the past participle in the passive (e.g. *then, subsequently*). Some sequencers can also be placed at the end of a sentence (e.g. *beforehand*). Do not repeat or over-use sequencing words.

5 Read the paragraph from the methods section of an article about the modification of carbon nanofibers [5], opposite. Choose the best alternative, A, B, or C, for each gap.

2.1. Silanization of carbon nanofibers

The chemical procedure for silanization consisted of two steps. [1]_____, as-received carbon nanofibers (CNF) were oxidized with a mixture of concentrated H_2SO_4 and HNO_3 (volume ratio 3 : 1) in a water sonication bath at room temperature for 4 h. The oxidized carbon nanofibers (O-CNF) were [2]_____subjected to repeated filtration and washing with distilled water, [3]_____ neutral pH was obtained. The filtration residue was [4]_____ dried at 70 °C for 24 h. [5]_____, silanization was performed by immersing a 5% concentration of acid-treated CNF in a silane ethanol solution with the application of ultrasound (Hielscher Ultrasound Technology, UP400S, Teltow, Germany) for 2 h. The ethanol solution had been prepared [6]_____. [7]_____ the reaction, the solvent was evaporated using a rotary evaporator (Heidolph, Laborata4001 efficient, Schwabach, Germany). [8]_____ the obtained amino-silanized carbon nanofibers (APTS-CNF) were dried in a vacuum oven at 60°C for 24 h. A scheme for the silane treatment of CNF is presented in Figure 2.

1	**A** In the first step	**B** At first	**C** In the beginning
2	**A** after	**B** then	**C** consequently
3	**A** till	**B** until	**C** after that
4	**A** subsequently	**B** later	**C** afterwards
5	**A** In the second step	**B** Second	**C** Secondly
6	**A** beforehand	**B** already	**C** before that
7	**A** Following	**B** Prior to	**C** On the end of
8	**A** In the end,	**B** Finally,	**C** At last,

6 Discuss the other alternatives with a partner and as a class. Can you think of any other contexts in which they could be used?

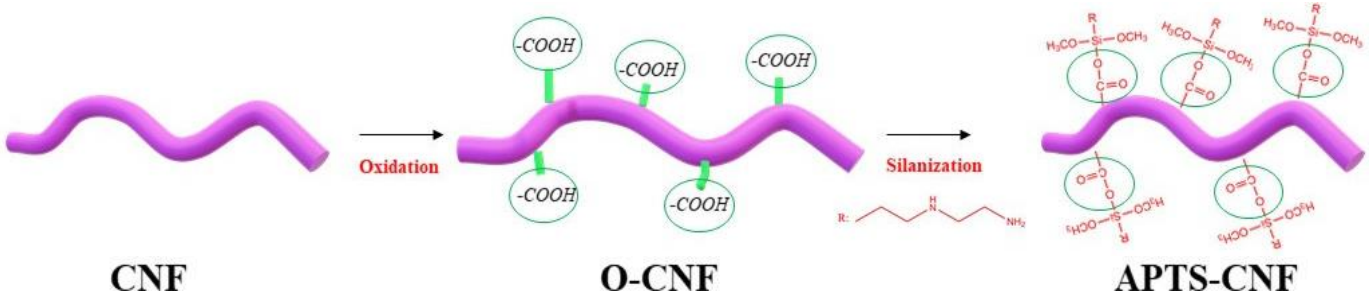

Fig. 2. Schematic reaction of APTS silane coupling agent with carbon nanofibers (CNF).

Table 1. Sequencing words.

~~Hitherto~~	~~at first~~	~~later~~	~~in the meantime~~	~~sometimes~~	~~at last~~
until	initially	following	simultaneously	occasionally	in the end
previously	in the first place	in the second step	during	periodically	last but not least
in advance	starting with	in turn	meanwhile	at regular intervals	finally
by	at the outset	then	at the same time	intermittently	to finish
prior to	to start with	afterwards	over	from time to time	ultimately
beforehand	firstly	subsequently		continuously	at the end
once	to begin with	next		now and then	lastly
formerly	in the beginning	consecutively			

7 Look at Table 1. Cross out any sequencing words and phrases that you think are unsuitable or rarely used for describing methods.

4.3 Use numbers and units

Pre-knowledge

Notice that in the example paragraphs in Section 4.1 and Section 4.2 the authors give precise details about the conditions of the experiments, including variables such as time, temperature, speed, concentrations, and dimensions. This enables the reader to replicate the method and interpret the results.

Style guide Numbers and units

- All numbers that are associated with an abbreviated unit, a percentage, or a mathematical operation (including decimals), as well as with tables and figures, are written as numerals (e.g. Figure 1, 10%, 20 cm).
- Numbers up to nine that are not associated with one of the above are usually written as words (e.g. four samples). Exceptions are when there is a series of numbers, ratio, or range, etc., including numbers both above and below 10 (e.g. 9–10 weeks).
- All numbers from 10 are usually written as numerals. An exception is when you have adjacent numbers (e.g. "twelve 20-ml samples"), or when numerals are being used to describe similar quantities (e.g. "the samples were incubated for between 4 and 12 weeks").
- Do not start sentences with numerals (nor with a symbol or a variable). Reformulate the sentence, use an introductory word or phrase, or write the number as a word.
- Write generic numbers and common fractions as words (e.g. tens, hundreds, half, quarter). Do not abbreviate a unit that follows an approximate number (e.g. several hundred nanometers)
- Abbreviations for units of measure do not require a stop (.). They should always be singular. Use SI unit symbols.
- Measured quantities take a singular verb (e.g. "Next, 3 ml of the solution was added to each sample").
- Use the words for large amounts such as millions or billions, with the number in numerals (e.g. 2.5million). We do not add the plural ending 's' to million or billion etc. when they are used after a number.
- Use points for decimals (e.g. 3.1415), and the numbers of millions and billions, etc. Use commas or spaces for whole numbers with more than four digits, every three digits counting right to left (e.g. 31,415 or 31 415).
- Use the indefinite articles a/an before numbers depending on how they sound when they are spoken (e.g. "an 80-fold increase").
- Symbols for physical quantities (and variables in equations and formulas) are italicized. Symbols and abbreviations for units and labels are not italicized (e.g. Planck's constant $h = 6.62607015 \times 10^{-34}$ J·s).
- Use a space between most units of measurement and the number. Exceptions include 3D, 14GB. Sometimes the space is optional (e.g. 50%/50 %, 75°C/75 °C).
- Use spaces either side of mathematical symbols that function as verbs (e.g. 2 + 2 = 4). Do not use a space when the symbol is being used as a modifier (e.g. 10× or >10). Use the correct mathematical symbols (e.g. × not x for multiplication, ° not superscript ^{0} for degrees, − for the minus sign, not a hyphen - or a dash –).
- Use an en dash for a range of numbers (e.g. 1–3). Use hyphens to join two or more words when they modify something else (e.g. "a two-thirds increase").
- Use a font such as Cambria Math in Word or Latin Modern in LaTeX for maths.
- Do not break numbers or separate numbers from their units on different lines. Hold down the Ctrl and Shift keys when you press the spacebar in Word, or in LaTeX type the ~ symbol for a non-breaking space.

8 Work with a partner. There is one mistake in each sentence (1–15). Identify the mistake and decide how it should be corrected. Refer to the Style guide box to help you.

1 The samples were centrifuged for three min at 13,000 rpm using a benchtop microcentrifuge.
2 The cells were then washed 3 times with Tyrode's solution.
3 We compared the results for 10 25-g samples.
4 5-mg samples were weighed on an analytical balance.
5 Templated electrodeposition was used to produce metal nanowires 10s of nanometers in diameter.
6 In half of the experiments, terbutaline (2.1 pM) was added 15 mins before the first dose of KCI.
7 The mixture was filtered and 2.5 ml of the filtrate were added to 10 ml of sterile distilled water in a test tube.
8 Linear strain tests were performed for a total of 7.5 millions cycles.
9 Cylindrical specimens were prepared with diameters of 8,9 mm and lengths of 14 mm.

10 A 100× compound microscope with a 18× ocular lens and a 160 mm optical tube length was used to inspect the samples.
11 The Colebrook equation was used to calculate the friction factor, f, in the pipes.
12 Catalysis was performed for 24h at 30°C.
13 All samples were stored at -70°C until tested.
14 Samples with dimensions of 50 x 450 mm were cut out from a 2-mm stainless steel plate.
15 Insertion was considered successful if the microelectrode penetrated the agar to a depth of at least 2–3 mm below the surface.

Writing tip

There are many other rules regarding the use of numbers and units. Although the guidelines in this section are generally applicable, some rules may vary between disciplines and some journals have their own requirements. For more information, consult a comprehensive style guide for your discipline and read the Author Guidelines of your chosen journal.

Assessment

9 Based on what you have learned in this unit and your own knowledge, decide whether you agree with the advice for writing the Methods section.

1 Use subheadings indicating the focus of each stage of the research.
☒ Yes
☐ No

2 Use sequencing words and phrases.
☐ Yes
☐ No

3 Announce the purpose of each step you took and each form of analysis you conducted.
☐ Yes
☐ No

4 Give details of the equipment and materials you used.
☐ Yes
☐ No

5 Carefully describe the conditions of your experiments,
☐ Yes
☐ No

6 Mention the ethics approval, if relevant.
☐ Yes
☐ No

7 Describe well-known procedures you used in detail.
☐ Yes
☐ No

8 Use mostly the passive voice.
☐ Yes
☐ No

9 Discuss the limitations of your methods, other methods that could have been used, and methods used in similar studies.
☐ Yes
☐ No

10 Put the useful phrases for describing methods into the correct order.

1 purposes For the comparison… of
2 described was by The experiment conducted to according the method described [Ref].
3 provided details Full of the are in [Ref]. model
4 triplicate. All performed were experiments in
5 stage In first of the analysis… the
6 procedures Standard were to evaluate… used
7 approval Ethical obtained was from…
8 X control. was as used a
9 two-day The tested were at intervals samples.

11 Write a paragraph describing the method you discussed in Exercise 1 of this unit. Use the texts in Section 4.1 and Section 4.2 as models. Follow the correct advice in Exercise 9.

4.4 Present methods

Pre-knowledge

Unlike in writing, when presenting your own methods it is common to use the active voice and personal pronouns (*I, we*). You may also give credit to people in your research team who performed particular experiments etc.

12 Read the transcript of a presentation of the method you read about in Exercise 2. How is it different from the written description from the article? Can you explain the differences?

"So, here's a summary of our test procedure. We tested the insertion guides on live rats, which have been replaced with paper towels in these images. I can assure you that the University Bioethics Committee approved all procedures and animal care practices. The rats were fully anaesthetized and secured in a stereotaxic frame. The insertion guides, which you can see drawn in the pictures above (not to scale) and in reality below, were just 3 mm in diameter, 1 mm high, with a slit running to the edge approximately 0.25 mm wide, which is about the width of a human hair. The microprobes themselves were 3 mm long, and fractions of a millimeter wide and thick. We positioned the microprobe manually directly above the insertion guide, and then we activated the motor drive of the micropositioner to lower the microprobe through the guide and into the brain. Finally, the guide was removed via the slit that runs to the side of the device."

Assessment

13 Find a diagram of a method or process used in your discipline, or create your own. Present the method to a partner. Provide feedback on your partner's talk.

UNIT 5
Results

IN THIS UNIT YOU LEARN HOW TO:

1 Express causes and results
2 Write captions for figures and tables
3 Refer to figures and tables
4 Present results

Pre-knowledge

In some disciplines, there is a strict division between the Results and Discussion sections. In the results section, you should simply present your research findings. In the Discussion, you interpret the results in a wider context. Some journals have a combined section, titled Results and Discussion. In many articles, the results are reported and discussed along with the methods under different subheadings.

5.1 Express causes and results

1 Look at Table 1, which shows some common ways of expressing causes and results. Are there any words you do not understand or do not know how to use?

Writing tip

Use the past simple when referring to specific results and the present simple for general facts and conclusions.

2 Complete the sentences with one word in each gap. Use the past simple tense for verbs.

1 Increasing the temperature of the sample _____ in a decrease in deformation stress.
2 More in-depth analysis of the sample _____ to several unexpected findings.
3 The solution changed color in _____ to the addition of CO_2.
4 Mortality _____ to air pollution was estimated in terms of premature deaths and years of life lost.
5 The device was redesigned _____ extensive testing, which revealed several design faults.
6 Alkaline pH and UV radiation both _____ to increase the degradation efficiency.
7 The insulation was found to break down _____ exposure to extreme heat.

3 Write sentences in the present tense expressing cause and effect relationships in your discipline.

Table 1. Common ways of expressing causes and results.

With verbs		
cause	enable	prevent
generate	allow for	block
induce	contribute to	stop
give rise to	influence	inhibit
initiate	attribute to	decrease
lead to		deteriorate
produce		diminish
trigger		lower
give		affect
result in		
result from		
account for		
increase		
raise		
With nouns	**With conjunctions**	
one reason for	due to	
as a result of	owing to	
as a consequence of	because of	
in response to	therefore	
With sequence words	**With conditionals**	
following	if…	
then	when…	
upon		
after		

★ Grammar Hedging

When you are writing about causes and results, you sometimes need to use cautious language to avoid simplification, generalization, and sounding overconfident. However, do not use cautious language unnecessarily.

4 Choose the best option to complete the sentences.

1 Lack of sleep **may / might** cause health problems.
2 Our results **may / might** lead to the conclusion that methanol fuels do not pose a serious environmental risk. Excessive complacency, however, is unjustified.
3 Stress **can / could** increase the risk of heart disease.
4 Further research **can / could** reveal more about the origin of these features.
5 **Most / Most of / The most** participants in the study worked full-time.

6 This result **appears to / tends to** confirm our hypothesis.
7 It is **possible / probable**, but unlikely, that this was due to a placebo effect.
8 The results given here are **probable / probably** accurate to within ±10%.

5 Re-write the sentences to avoid unnecessary hedging.

1 It appears that this may have been due to the probable self-condensation of dansyl amino acids.
2 A possible cause may be assumed to be the likely tendency of CNTs to make bundles and aggregates.
3 This seems to suggest that lower germination may have perhaps resulted from the change in soil conditions.

Style guide Viewpoint adverbs

A small number of viewpoint adverbs are often used to highlight and qualify results. These adverbs are usually placed at the beginning of the sentence, followed by a comma, and modify the whole sentence or independent clause. For example:

Obviously, ...
Interestingly, ...
Surprisingly , ...
Unsurprisingly, ...
Unfortunately, ...
Importantly, ...
Clearly, ...

Do not over-use viewpoint adverbs, or the tone of your writing may become sensational. Ensure that it is clear to your reader why a result is *interesting, surprising, unfortunate,* etc.

Assessment

6 Write a short paragraph reporting the results of the test you described in Unit 4 (Methods), or another experiment you have conducted recently.

1 Describe your key results (*Overall, X was found to… / A strong correlation was observed between…*)
2 Explain the possible causes of the results (*This may have been due to… / It is possible that this was caused by…)*.
3 Describe something that was unfortunate or surprising, etc.
4 Draw general conclusions from the experiment (*Our findings suggest that…. / Based on these results, it can be assumed that…*).

5.2 Write captions for figures and tables

Pre-knowledge

Figures and tables are used to present data and highlight the main results. Captions are normally written below figures and above tables. Do not begin a new section with a table or figure.

Reflection

7 Read the information in the Style guide. What do you think is the most important advice?

Style guide Captions for figures and tables

A typical caption will describe the data contained in the figure/table, followed if necessary by an explanation of its main elements, such as abbreviations and notation used, parameter values etc., possibly in the space under a table. Each table or figure, including the caption, should be self-explanatory, i.e. comprehensible without needing to read the main text. Although there are no standard rules for writing captions to figures and tables, the following are some general guidelines.

- Write "Table" or "Figure" (with a first capital letter or fully capitalized) followed by the number corresponding to the order in which the item appears. Word and LaTeX have good features for automatic numbering.
- Figure can be abbreviated as Fig., even at the start of the caption. You do not normally abbreviate Table (i.e. "Tab. 1" is rare).
- When there are two or more display items in a figure, label them using letters (e.g. "Fig. 1b").
- Most journals put a stop or a colon after the number of the figure or table, and begin the next sentence with a capital letter—e.g. *Figure 1. Schema of…*
- It is common to omit any article at the start of the first sentence, e.g. ~~*A*~~ *Micrograph of an undamaged sample.*
- Other articles may be omitted, but this is not advisable except for highly proficient users of English.
- Make your captions as concise as possible.
- You are not always required by the journal to end the caption with a stop, but you must be consistent.
- Ensure that all elements of figures and tables (axes, arrows, lines, etc.) are explained, by titles, labels, captions, or legends.
- Include a credit for any images/data that are not your own at the end of the caption. Request permission from the copyright owner if necessary.
- Captions are often written in italics or in a slightly smaller font, to distinguish them from the main text.
- Always check the guidelines of your chosen journal for exceptions to these rules.

Discussion

8 Imagine that you are researching one of the topics below (1–4). Plan what data you would collect and whether you would present the data as figures or tables.

1 The errors made by novice programmers.
2 The gender balance in science.
3 The quality of language in scientific articles.
4 Another topic related to your discipline.

Writing tip

Many scientists prepare their figures before they begin writing. This can help reveal the trends and important results in the data. The figures and tables can then be arranged and discussed in a logical order, according to the narrative of the paper. This is often the same order in which the experiments are presented in the Methods.

9 Write captions for one of the figures and one of the tables you planned in Exercise 8. Decide what type of figure to use and where to position the caption. You do not need to draw the table or the figure.

The conventions for drawing tables and figures are complicated, and lie beyond the scope of this coursebook. The *Chicago Manual of Style* [21] offers much useful advice.

Discussion

10 Work in groups. Answer the questions.

1 What would you expect to find if you conducted the research you discussed in Exercise 9?
2 What do you think might cause those results?

5.3 Refer to figures and tables

Pre-knowledge

All tables and figures should be referred to in the text. How much detail you give about each table and figure in the main text depends on the topic and the content of the display item. However, you should not summarize the whole figure or table—if you do, it might as well be omitted.

Reflection

11 How can you decide which results to highlight in the main text?

12 Read the information in the Style guide. What do you think is the most important advice?

Style guide Referring to figures and tables

A typical cross-reference will introduce the figure or table by saying what it shows, describe the general features or trends, and highlight the most important data. Ensure that you do not simply repeat all the data that is given in the figure or table. You should also avoid repeating all the information given in the caption.

- When the words "table" or "figure" are followed by a number, the first letter is always capitalized (e.g. Table 1).
- Do not put a stop after the number of a figure or a table in the text (i.e. do not write "Figure 1. shows…").
- Do not abbreviate the word "figure" if it is not followed by a number.
- Be consistent if you are abbreviating Figure to Fig. The plural abbreviated form can be Fig. or Figs.
- The abbreviation "Tab." for "Table" is discouraged in many style guides.
- Do not start sentences with the abbreviated form Fig.
- You can refer to figures and tables within the sentence, or in brackets like this: "The results showed a positive correlation (Fig. 2)" or "(see Figure 2)".
- Do not write "As it is shown in Figure 1…" or "As Figure 1 shows…". Do write "As shown in Figure 1…" or "Figure 1 shows…"
- In your first reference to a figure or table, always refer to by the number, e.g. "Table 1", never to its position in the text (e.g. "see the table below").
- In your discussion of a table or figure that has been introduced already by its number, you may subsequently use the definite article "the" to refer to "the table" or "the figure" that has been mentioned.
- Ensure that it is clear which figure or table you are referring to. Repeat the number if necessary.
- Always check the style guide of your chosen journal for exceptions to these rules.

13 Complete the sentences with the words and phrases for describing figures and tables.

standard deviation | correlation | respectively | four times | negligible | in the range of | fourfold | inversely | representative | plotted

1 The average particle size was found to be _____ 14 nm–28 nm (Table 1).
2 Figure 1 shows _____ curves for each group.
3 As can be seen in Figure 2, there was a significant positive _____, indicating that a greater amount of sleep was associated with a higher overall score.
4 The organic carbon content, total nitrogen, and available phosphorus were 5.47±0.02, 0.52±0.03, and 0.38±0.01, _____ (Table 3).
5 Between 1992 and 2008, the percentage of women aged 25–34 with a tertiary education increased almost _____, from 8.7% to 32.5% (Fig. 1).
6 As can be seen in Fig. 1, each year China graduates _____ as many engineers as the U.S.
7 Sleep inconsistency was defined for each participant as the _____ (SD) of the participant's daily sleep duration in minutes. The results are presented in Table 2.
8 Sleep inconsistency was _____ proportional to overall score, indicating that greater inconsistency in sleep duration was associated with lower test results (Fig. 2).
9 Figure 3 shows the values for each sample _____ against the concentration.
10 The neat COC copolymer showed a _____ color change, even after 500 h of aging (Fig. 4).

14 Complete the sentences describing figures and tables with prepositions.

1 The particle size was _____ 10 nm and 15 nm (Fig. 6).
2 Figure 1 shows changes in the concentration _____ time.
3 The concentration of cis-DCE remained _____ the same level throughout the experiment (Fig. 3).
4 Table 3 shows the results of tests performed _____ conditions of high temperature and pressure.
5 Figure 5 illustrates the velocity (v) of a particle plotted _____ time.
6 The standard deviation (SD) measures the values above and _____ the mean.
7 Around 95% of the data was _____ one SD from the mean.
8 Table 1 presents the test results _____ one of the working electrodes.
9 The results are presented _____ Fig. 1.
10 _____ the samples listed in Table 2, strain 14E shows the highest heat resistance.

15 Put the useful phrases for referring to figures and tables into the correct order.

1 can As be in Figure 1… clearly seen
2 1 Figure shows…
3 shown The in Figure 1. results are
4 on Table 2 data … displays
5 that… is apparent It Figure 1 from
6 interesting to It is from Figure 1 note that…
7 observe… compare If we the with results in Figure 1 in Figure 2, we those can
8 suggest presented The Figure 1 that… results in
9 conclude From 1 can we that… Figure
10 conclusions Several can be the from figure. drawn

Assessment

16 Look at Figure 1. Find examples of the following:

1 a peak
2 a dip
3 a slight blip
4 a sharp increase
5 a steady increase
6 a rapid drop

17 Watch videos of the experiments that produced these results. Can you explain the shape of the curves?

▶ 8

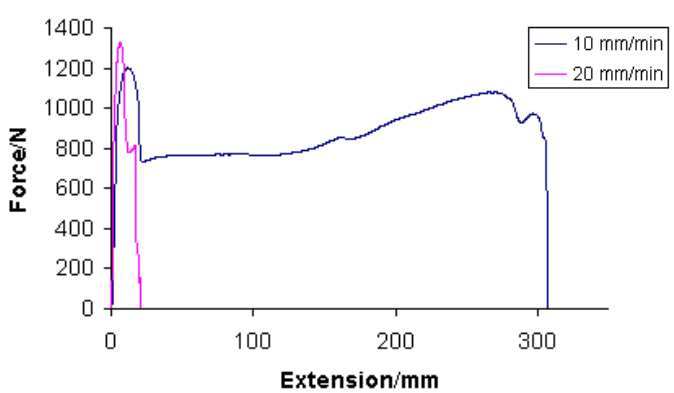

Fig. 1. Force plotted against extension for polyethylene samples stretched at 10 mm/min and 20 mm/min [22].

18 Write a short description of Figure 1.
OR
Write short descriptions of the table and figure you wrote captions for in Exercise 9.

Say what the table/figure shows, describe the general features or trends, and highlight the most important data.

5.4 Present results

Pre-knowledge

In a presentation, you should concentrate on your most important results only. You will not have time to explain all your findings, and your audience may not be able to digest large amounts of data. You should also consider how your datasets will look when projected on a screen.

19 Decide whether you agree with the advice below (1–12) for presenting results.

1 Do not show any datasets on the slide that you will not discuss.
☒ Yes
☐ No

2 Use colors, circles, animations, or zoomed insets to highlight key results in your datasets.
☐ Yes
☐ No

3 Limit the number of datasets on each slide to one or two.
☐ Yes
☐ No

4 Tell your audience where they can find all the relevant datasets if they are interested.
☐ Yes
☐ No

5 Use clipart and cartoons to make the data more interesting.
☐ Yes
☐ No

6 Use sentences and bullet points to highlight the main results.
☐ Yes
☐ No

7 Label all images, axes, lines, etc.
☐ Yes
☐ No

8 Make lines bolder and increase font sizes for easier visibility at a distance.
☐ Yes
☐ No

Assessment

20 Prepare a short presentation with one or two slides based on an experiment you have performed or an article you have read recently. Explain the purpose of the research, summarize the methods, and present the main results.

UNIT 6
Discussion and Conclusions

IN THIS UNIT YOU LEARN HOW TO:

1 Structure the Discussion section
2 Summarize and conclude
3 Present conclusions
4 Manage a Question and Answer session

Pre-knowledge

If your paper has a separate Discussion section, this is where you compare and contrast your methods and results with those reported by other authors. You may also discuss the limitations of your study and areas requiring further research. In many articles, the Discussion section includes a brief conclusion paragraph. Other papers have a separate Conclusions section, which summarizes the purpose and content of the article. Some articles have a combined Discussion and Conclusions section.

Reflection

1 Work in groups. Answer the questions.

- Why is it important to relate your work to previous studies?
- Why is it important to discuss the limitations of you research and avenues for future work?

Discussion

2 How do you think sleep affects academic performance?

3 Look at the picture above [23]. Discuss what you can do to improve the quality of your sleep.

6.1 Structure the Discussion section

4 Read the Discussion section from an article about the effect of sleep on academic performance. Ignore the gaps. Do you find anything surprising? Is there anything you don't find surprising?

DISCUSSION

This study investigated the relation between sleep duration, sleep quality, and sleep consistency and academic performance. [1]__*H*__ Multiple linear regression revealed that these three sleep measures accounted for 24.4% of the variance in grade performance. Our results correlating overall sleep quality and duration with academic performance are in agreement with previous studies on the effects of sleep on cognitive performance [Ref]. **Likewise,** this study complements two linked studies which found that having more hours of sleep the week before final exams [Ref] and more consistent sleep for five days prior to a final assignment [Ref] enhanced students' performance. [2]_____ It thereby provides new insights regarding the relation between sleep and academic performance.

Unlike a prior study [Ref], we did not find that longer sleep duration the night before an exam was associated with better test performance. [3]_____ Therefore, simply having a good night's sleep the night before a test may not be as helpful as being able to concentrate fully during class [Ref]. As reported in previous research [Ref], female students tended to experience better quality sleep and with more consistency than male students. [4]_____ This female advantage in terms of academic performance was eliminated once sleep patterns were statistically equated, suggesting that it may be especially important to encourage better sleep habits among male students (**although** developing such habits may be helpful for all students).

[5]_____ First, sleep quality was determined using Fitbit, a wearable activity tracker. There is evidence that the use of cardiac, respiratory, and movement information from Fitbit devices can accurately estimate sleep stages [Ref]. **Nonetheless,** there is no published evidence that Fitbit's sleep quality scores represent a valid assessment of sleep quality. Second, the relation between sleep and academic performance may be moderated by factors that can affect sleep, such as stress, anxiety, motivation, personality traits, and gender roles. [6]_____ Third, our findings concern a particular student population at MIT enrolled on a particular course. Further studies are needed to assess the generalizability of these findings to other types of student populations and other kinds of classes.

[7]_____ The tested parameters together accounted for a substantial amount (about a quarter) of the overall variance in academic performance.

5 Choose the best sentence (A–H) for each gap in the text. There is one sentence you will not need.

A Establishing a causal relation between sleep and academic performance would require experimental manipulations in randomized controlled trials, **but** these are challenging to conduct in a real educational setting, when students care about their grades.
B **In conclusion,** this study provides evidence for a strong correlation between sleep and academic performance, based on quantifiable and objective measures of sleep quality, duration, and consistency in the ecological context of a live classroom.
C Females **also** received higher overall test scores compared with males.
D **However,** the present study extends our understanding of the relationship between sleep and academic performance significantly, by using multiple objective measures of sleep over an entire semester, with academic assessments completed along the way.
E **Instead,** both sleep duration and sleep quality over the full month and in the week before a midterm assessment were more strongly associated with test performance.
F Several limitations of the present study should be noted.
G **In fact,** the cognitive performance of an individual who has been awake for 17 h is equivalent to that exhibited by one who has a blood alcohol concentration of 0.05% [Ref].
H **Overall**, there was a substantial association between sleep and academic performance.

6 Decide if the statements are true or false. Highlight the words and phrases in the text that helped you decide.

1 The results of the study are consistent with data reported in some other studies.
2 The study adds to existing knowledge about the topic.
3 The results contradict some previous studies.
4 The results could have practical implications or applications.
5 Not all the possible variables were taken into account.
6 The results are universally valid.
7 More research is underway to confirm and expand the results.

★ Grammar Linking words and phrases

Linking words and phrases can be used to compare, contrast, and add ideas, as well as draw conclusions. Table 1 lists some common linking words and phrases used in scientific writing. More linking phrases for expressing cause and effect were given in Unit 5 (Table 1).

7 Which words or phrases from Table 1 could be used to replace the words in bold in the text? Would there be any change in meaning or emphasis?

8 Complete the text below with the best options.

Online education is one of the fastest growing segments of Higher Education. *Despite / Nonetheless,* many teachers and employers remain skeptical about its quality and whether it provides value for money [Ref]. *Whereas / While* there is ample evidence that online learning has some benefits, the present study supports the consensus that face-to-face teaching is more effective. Previous studies have suggested that students learn faster online [Ref], *however / although* this was not supported by our results. *We also found that / What is more* the top students performed similarly in online and in-person courses. *Although / However,* weaker students did much worse online. Most previous studies report that the majority of students have positive attitudes towards e-learning [Ref], *whereas / while* in our survey group opinions were mixed. *Overall, / In addition,* this study raises questions about the effectiveness and popularity of online education.

Table 1. Linking words and phrases.

Comparison or similarity
similarly
analogously
in the same way
Contrast
in contrast (to)
contrary to
nevertheless
despite
in spite of
yet
whereas
while
Addition
furthermore
in addition to
additionally
moreover
also
as well as
what is more
in fact
Conclusion
to conclude
in conclusion
in summary
in short
in brief
in general
on the whole
overall

Discussion

9 What are your experiences of e-learning? What do you think are its advantages and disadvantages?

6.2 Summarize and conclude

Pre-knowledge

If you have a separate Conclusions section, it is generally shorter than the Discussion. You should not normally add any new information, or discuss either your results or the research of others in detail. The Conclusions section should typically summarize the aims, methods, and main results of the article. It may also acknowledge the limitations of the study, and point to areas requiring further research. As such, it re-states much of the information given earlier in the paper. However, you should not simply copy/paste sentences and parts from previous sections.

10 Put this alternative conclusion to the article on sleep and academic performance into the best order. Note that there is no separate Conclusions section in the original article [4].

A

Wearable activity trackers were used to take multiple sleep measurements from students on an introductory college chemistry course. In total, 88 of the 100 participants completed the study. The duration, consistency, and quality of the students' sleep were correlated with their performance in quizzes and midterm examinations.

B

This study set out to assess the relationship between sleep and academic performance.

C

These findings provide quantitative, objective evidence that sleep quality, duration, and consistency each have a strong impact on academic performance in college. More work is needed to confirm the generalizability of the results and to explore possible moderating factors, such as stress, anxiety, motivation, personality traits, and gender roles.

D

In general, there was a strong correlation between longer, better quality, and more consistent sleep and better grades. Sleep measures accounted for nearly 25% of the variance in academic performance. Importantly, better grades were associated with the duration, quality, and consistency of sleep during the full month and in the week before a test.

E

No relation was observed between sleep measures taken on the night before a test and the overall score. Differences in the academic performance of male and female students were noted, but these were eliminated once sleep patterns were statistically equated.

11 Match the parts of the summary (A–E) to the sections of the article in which the information is most likely to have first appeared—the Introduction, Methods, Results, or Discussion.

12 Put the useful phrases for the Conclusions section into the correct order.

1 set This out study to…
2 this In work, investigated… we
3 was The of this aim research to…
4 research are The of this that… findings key
5 suggest Our that… results
6 the present limitations of study the include fact The that…
7 necessary research is to… More
8 concentrate work will on… Future
9 already the Research by is to… underway authors
10 fields the research possible has applications This in of…

Writing tip

Conclusions are what you infer from your research. A *conclusion* is the end, for example of a presentation. The most common heading for the concluding section of a research paper is *Conclusions.*

Assessment

13 Write a short Discussion and Conclusions section on the topic you first wrote about in Unit 2. Invent any necessary details.

OR

Write about another topic related to your discipline.

1 Briefly re-state the purpose of your paper.
2 Summarize the main methods you used.
3 State the key results.
4 Say how these methods/results compare to those described in previous research. Provide in-text references.
5 Mention the possible applications and implications of the research.

6.3 Present conclusions

Pre-knowledge

Along with the introduction, the conclusion is a key part of a presentation and needs to be well-planned. You should provide a summary of your key points and end with a strong final idea. A major difference between presenting conclusions in a paper and in a talk is that in a talk the conclusion is often a stepping-stone for the Question and Answer session (Q&A), and for networking opportunities.

Discussion

14 Discuss whether you agree with the following advice for presenting conclusions.

1 Signal that you have reached the end of the talk, using a phrase such as 'to summarize' or 'to conclude'.
☒ Yes
☐ No

2 If you are speaking at a conference, include your contact details on the final slide.
☐ Yes
☐ No

3 Write 'Thank you' or 'Thank you for your attention' on the final slide.
☐ Yes
☐ No

4 Outline future work or work in progress.
☐ Yes
☐ No

5 End with a recommendation or a prediction based on your presentation topic.
☐ Yes
☐ No

6 Explain the impact and implications of the research.
   ☐ Yes
   ☐ No
7 Use images on your final slide as a visual support.
   ☐ Yes
   ☐ No
8 Write your main conclusions on your final slide.
   ☐ Yes
   ☐ No
9 Make a link back to the start of your presentation.
   ☐ Yes
   ☐ No
10 Keep your conclusion short and to the point.
   ☐ Yes
   ☐ No

Video Activity

15 Read the final sentences from three short presentations by doctoral researchers, below [24–34]. Which full presentation would you like to watch? Why?

1 "So by targeting this and other communication molecules, can we stop pneumococcal disease? Can we use this strategy to prevent and cure other bacterial diseases? And ultimately can we avoid the impending antibiotic resistance apocalypse that stares us in the eye? Thank you." ▶ 9

2 "And so it's our hope that these flexible multi-layer probes with embedded active chips can provide durable and high-quality neural interfaces, and unlock the potential of brain-computer interfacing, improving the lives of millions. Thank you." ▶ 10

3 "I want everyone to look at this image again. Imagine living the rest of your life with vision like this. So the next time you're with your loved ones, study their faces, their every feature. Commit that to memory. Cherish that image, because one in seven of you will lose that ability if nothing is done about this disease. With the use of micro RNA, my hope and my goal is that for millions of people this image can become clearer. Thank you." ▶ 11

16 Watch the full presentation you chose in Exercise 15. Discuss the questions.

1 Does the conclusion restate and reinforce the key points from the presentation?
2 What was good about the presentation generally? What could be improved?

6.4 Manage a Question and Answer session

Pre-knowledge

After many presentations, the audience has an opportunity to ask the presenter questions. Time for questions is often limited to about 10 minutes. Key skills include the ability to answer questions on the spot, to be concise, and to avoid debates with individual audience members.

17 What advice would you give to someone preparing for a Question and Answer (Q&A) session? Think about:

1 How to anticipate questions that might be asked.
2 How to guide your audience towards asking certain questions.
3 What to say if you do not understand the question.
4 What to say if the question is irrelevant, or the questioner has misunderstood the issue.
5 How to deal with a comment, not a question.
6 What to do if the question is too complex to give a short answer.
7 How to avoid being drawn into an argument.

18 Put the useful phrases for a Q&A session into the correct order.

1 for a question, thank That's you asking it. great
2 So asking what me is… you're
3 For at back, the was… question those the
4 sorry, I'm not I sure understand, could repeat question? you the I'm
5 that your answer question? Does
6 need I about guess I to a bit that. more think
7 you for Thank your comment. anyone Does have any questions? more
8 I time I would think more to that answer question. need
9 break? Would like to meet to you discuss during the coffee that
10 you? Could email me you and I'll get that back to question

Assessment

19 Present the conclusions you wrote in Exercise 13.

- Summarize and highlight the main points of the research. Create a slide to accompany your presentation. Be prepared for a brief Q&A.

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