Concepts of schema theory

Remember those rats from EC Tolman's study? Very few things can compare to the excitement that a scientist feels observing something that might potentially become a groundbreaking discovery. Imagine Tolman's feelings as, at a time dominated by behaviourism (with its trial-and-error learning), he was observing his rats pick the pathway that was leading in the direction of the food reward. He must have thought that it looked like they were guided by some sort of an internal representation, a map of the maze. Trial after trial, his rats confirmed his interpretations, and he must have had difficulty falling asleep that night, thinking about all the exciting implications of this discovery.

It is not only rats who create internal maps of their surroundings. If you search your memory for a minute, you will find many other examples. Taxi drivers do not find themselves to be helpless if the road they have been taking for years is blocked. They quickly recalculate their route and use other roads, taking shortcuts and getting successfully to the destination. Basketball players always know where the basket is and always know exactly what force they should apply to the ball to send it to the target. Even as you are reading this, you are trying to fit this new information into your "internal map" of psychology, in which towns are the concepts and highways are the connections between them.

Cognitive schemas (or schemata) is an umbrella term for all such phenomena. Cognitive schemas are defined as mental representations that organize our knowledge, beliefs and expectations. **Mental representation** is a pretty broad concept. It can be applied to practically anything in the black box. Notice how this links to the principles underlying the cognitive approach to behaviour, especially the second principle: mental representations guide behaviour. So are cognitive schemas all mental representations or just a subset of them? In fact they are a subset, just those mental representations that organize our knowledge, beliefs and expectations.

To do so, these mental representations need to be quite stable, deeply rooted and organized. Schemas are derived from prior experience. If your potential business partner tells you that his favourite month is August, it will probably not influence your expectations and how you prepare for your first meeting. However, if he tells you that he is a 60-year-old Colombian, it might influence you. This is because, due to your experience, you

have some deeply-rooted age and cultural schemas (what 60 year olds are like, what Colombians are like), but most likely you do not have a schema for people who prefer different months of the year.

Since schemas cannot be observed directly, how do we go about studying them? One way of doing so is to look at the effects that schemas have on more directly observable processes such as memory. Research has shown that schemas influence memory processes at all stages—encoding, storage and retrieval. We will discuss two studies that support this claim.

ATL skills: Thinking and research

Before you read about the studies, try to think of an experiment that you might conduct to test the following theoretical hypotheses:

- Schemas influence encoding of material in memory.
- Schemas influence retrieval of material from memory.

What will be your independent variable (IV)?
What will be the dependent variable (DV)?
How would you operationalize them? What will your experimental procedure be like?

TOK

What is the role of prior experience in gaining new knowledge? Is it a tool for acquiring new knowledge or rather an obstacle?

One of the tests for truth in theory of knowledge, the coherence test, claims that something is true if it fits well into what you already know. What are the possible criticisms of this test for truth?

Schemas influence encoding

Bransford and Johnson (1972) carried out an experiment in which they investigated the effect of context on comprehension and memory of text passages. It followed an independent measures design, and used five groups of participants.

Irrespective of the group, all the participants heard the following tape-recorded passage:

> "If the balloons popped, the sound wouldn't be able to carry since everything would be too far away from the correct floor. A closed window would also prevent the sound from carrying, since most buildings tend to be well insulated. Since the whole operation depends on a steady flow of electricity, a break in the middle of the wire

would also cause problems. Of course, the fellow could shout, but the human voice is not loud enough to carry that far. An additional problem is that a string could break on the instrument. Then there could be no accompaniment to the message. It is clear that the best situation would involve less distance. Then there would be fewer potential problems. With face to face contact, the least number of things could go wrong". (Bransford and Johnson, 1972, p 719)

ATL skills: Research

Now that you have read the passage, try closing the book and repeating its main ideas.

Overall, there are 14 idea units in this passage. How many can you remember? (It is not necessary to remember word for word.)

Participants were instructed, after hearing the passage, to recall it as accurately as they could, and if they could not remember it word for word, to write down as many ideas as possible. They were given seven minutes to do that.

The five conditions were as follows.

1. No context (1): participants simply heard the passage.

2. No context (2): participants heard the passage twice.

3. Context before: prior to hearing the passage participants were provided with a context picture (see Figure 3.12) and given 30 seconds to study it.

4. Context after: the same picture was shown, but after participants heard the passage.

(a) Full context
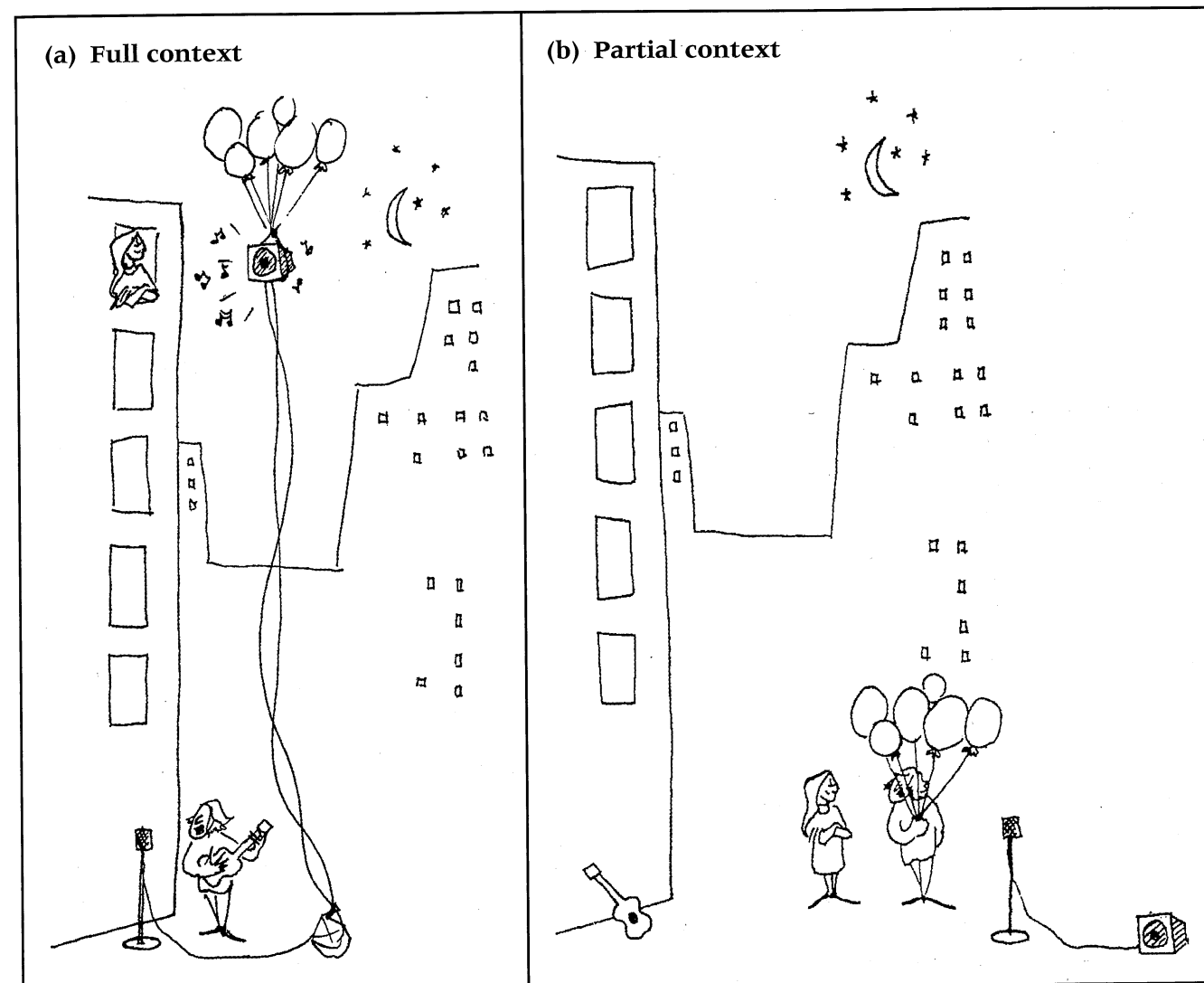
(b) Partial context

▲ Figure 3.12 Stimulus material used in Bransford and Johnson (1972)

5. Partial context: a context picture was provided before the passage. This picture contained all the objects, but the objects were rearranged (see Figure 3.12).

Out of the 14 idea units contained in the passage, this is how many, on average, participants were able to recall:

1. No context (1): 3.6 idea units

2. No context (2): 3.8 idea units

3. Context before: 8.0 idea units

4. Context after: 3.6 idea units

5. Partial context: 4.0 idea units

Clearly, the "context before" condition made a difference. Hearing the same passage twice makes almost no difference in terms of comprehension and memory; presenting the context after the passage is no good; and a partial context (which shows the objects but not relations between them) is only marginally better than no context at all.

Using the schema theory, this finding can be interpreted by referring to a "mental representation" that the full context picture creates prior to hearing the text passage. After the schema has been created (or activated), it influences the organization of our knowledge. Arguably, the idea units from the text passage are more effectively encoded because, in the process of encoding, they are linked with the schema.

We use the example of Bransford and Johnson's (1972) study extensively in Unit 9 of this book ("Internal assessment"). It would be useful to know details about the study and familiarize yourself with the original paper published in the *Journal of Verbal Learning and Verbal Behaviour*.

The paper can be accessed here: https://tinyurl.com/kp479dh Read the paper and find out what confounding variables the authors controlled and how.
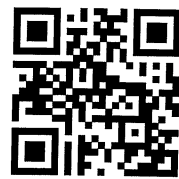
Think about all the possible implications of this finding. The takeaway message might be that if you want to understand and remember things better, make sure that you clearly know the context *before* you start studying the new material. For example, before studying schema theory, it is important to understand that schema theory is a consequence of one of the principles that define the cognitive approach to behaviour (mental representations guide behaviour), that schema is an umbrella term for a large number of mental representations, and that mental representations are the building blocks of the black box that cognitive psychologists studied to prove wrong the trial-and-error approach of classical behaviourism. If you know the context, everything makes much more sense.

Schemas influence retrieval

Anderson and Pichert (1978) demonstrated that schemas not only influence the memory process of encoding (transferring information to LTM), but also have an influence at the stage of retrieval (retrieving information from LTM).

Imagine you are a participant in their study. You are an introductory educational psychology student who is participating in the study in order to fulfill a course requirement. You are invited for a briefing and told that the study concerns "how people think about and remember stories". Being a psychology student and hearing such a vague explanation of the aim of the study, you might start to suspect that the experimenters are using mild deception and are not telling you the complete truth about the actual aim of the experiment.

ATL skills: Communication

Is deception justified in this study? Why? Explain it in no more than two sentences.

After this, there's a series of tasks that you are required to perform.

1. You are assigned either the homebuyer or the burglar perspective ("Imagine you are a homebuyer", "Imagine you are a burglar").

2. You are asked to read a text passage (373 words) about what two boys did at the home of one of the boys when they were skipping school. The passage contains a number of points of interest to a burglar or real estate agent, a total of 73 ideas. For example, the story includes such details as: "Tall hedges hid the house from the road", "They went in the side door, Mark explaining that it was always open in case his younger sisters got home earlier than his mother", "The basement had been damp and musty ever since the new plumbing was installed".

3. You are given two minutes to read the passage.

4. There is a filler verbal task (for 12 minutes you are solving problems on a vocabulary test).

5. Following this, you are given two blank pages and asked to reproduce the story in as much detail as possible.

6. There is another five-minute filler task.

7. Next, the instructions require you either to keep the same initial perspective (homebuyer or burglar) or to change it.

8. You are required to recall the text for a second time (without reading it again).

In all there were four groups of participants:

	Same perspective	Change in perspective
Homebuyer	1	3
Burglar	2	4

▲ Table 3.3 Conditions in Anderson and Pichert (1978)

Results revealed the following pattern.

- For the first recall, the group that had the burglar perspective recalled more burglar information whereas the group that had the homebuyer perspective recalled more homebuyer information.

- The people who changed perspective recalled more information important to the second perspective but unimportant to the first. Subjects who changed perspective (groups 3 and 4) recalled an additional 7.1% of the now important information (note that they did not recall these details during the first recall). On the other hand, subjects who did not change perspective (groups 1 and 2) recalled 2.9% less of the still unimportant information.

Evaluate the following aspects of the study.

- Internal validity: what are the potential confounding variables? How well were they controlled?

- External validity: are there any issues with generalizing the findings to a wider population?

- Construct validity: what are the independent variable and dependent variable and how were they operationalized? Does the operationalization capture the essence of the theoretical constructs?

- Replicability

- Theoretical and practical implications

Do not forget that evaluation implies a balanced approach, considering both strengths and limitations.

If you identified limitations, how could you modify the study to overcome them?

Imagine you are replicating this study for your internal assessment. It is too complex but how can you simplify the procedure to fit the IA requirements?

Schemas organize knowledge that is stored in our memory. Any new information that we acquire does not just get passively registered; it is actively perceived through the lens of existing schemas. They start acting at the stage of encoding and they continue acting as we store information in our LTM, and even as we retrieve it from there. The study of Anderson and Pichert (1978) supports the idea that schemas influence retrieval of information from memory as well as encoding. Although the effect is not large (7.1% of information relevant to the new perspective), it is significant.

We have just compared schemas to a lens through which we perceive reality. How clean is this lens, though? Can it distort information? Apparently, it can, and it gives rise to a number of **biases** and **memory confabulation** (these will be further discussed later in the section "Reliability of memory").

Types of schemas

There are many special cases and types of schemas, depending on the particular aspect of human experience that is influenced by mental representations. For example, the following types of schemas have been proposed:

- social schemas—mental representations about various groups of people, for example, a stereotype

- scripts—schemas about sequences of events, for example, going to a restaurant or making coffee

- self-schemas—mental representations about ourselves.

One example that illustrates the effect of social schemas on our perception and interpretations is **Darley and Gross (1983)**. In this study, one group of participants was led to believe that a child (a girl) came from a high socio-economic status (SES) background and the other group was told that the child came from a low-SES background. Both groups then watched the same video of the child taking an academic test. They were required to judge the academic performance of the girl. In accordance with the predictions of social schema theory, participants who thought that the child came from a high-SES environment gave considerably higher ratings for the academic performance of the girl in the video. This showed that pre-stored schemas (about what it means to be rich and what it means to be poor) were used as a lens through which the ambiguous information was perceived, and participants' interpretations were changed accordingly.

A study by **Bower, Black and Turner (1979)** showed how scripts stored in our memory help us make sense of sequential data. The aim of the study was to see if in recalling a text, subjects will use the underlying script to fill in gaps of actions not explicitly mentioned in the text. The idea behind the study is as follows. Suppose an underlying abstract script exists for the following sequence of events: a, b, c, d, e, f, g. Now suppose there is a text that includes sentences corresponding to events a, c, e, g. If you present this text to a group of participants and ask them (after a series of filler tasks) to recall the text, they will probably "fill in the gaps", that is, remember events b, d, f even though they were not originally in the text. This rests on the idea that we encode the text based on the underlying script, that is, we remember the generalized idea behind a text rather than the text itself.

Here is an example of two texts that served as manifestations of the same underlying script:

> The doctor. John was feeling bad today so he decided to go see a family doctor. He checked in with the doctor's receptionist, and then looked through several medical magazines that were on the table by his chair. Finally the nurse came and asked him to take off his clothes. The doctor was very nice to him. He eventually prescribed some pills for John. Then John left the doctor's office and headed home.

> The dentist. Bill had a bad toothache. It seemed like forever before he finally arrived at the dentist's office. Bill looked around at the various dental posters on the wall. Finally the dental hygienist checked and x-rayed his teeth. He wondered what the dentist was doing. The dentist said that Bill had a lot of cavities. As soon as he'd made another appointment, he left the dentist's office.

> (Bower, Black and Turner, 1979, p 190)

Note how in these two stories the only similar ideas are the opening statement and the closing statement. Technically, the stories are completely different in all other aspects.

As predicted, after reading both the stories (and carrying out a 20-minute filler task) participants were prone to insert gap fillers, for example, recalling "checking in with the receptionist" for the dentist story.

The concept of self-schemas is used extensively in **Aaron Beck's theory of depression**. The negative self-schema that depressed people develop about themselves, and the corresponding automatic thinking patterns are, in this theory, the driving force of depression. You will learn more about Aaron Beck's cognitive theory of depression later (see Unit 5 on abnormal psychology).

Bottom-up and top-down processing

The concept of schemas raises an important issue that goes far beyond the realm of psychology. Generally speaking, there are two broad types of information processing: bottom-up processing and top-down processing.

- Bottom-up information processing occurs when the cognitive process is data-driven; perception is not biased by prior knowledge or expectations. It is a case of "pure" information processing based on the reality as it is.

- Top-down processing occurs when your prior knowledge or expectations (schemas) act as a lens or a filter for the information that you receive and process.

A classic example that can help to visualize top-down processing is the **Rat Man of Bugelski and Alampay (1961)**. Participants in this study saw an ambiguous picture (see Figure 3.13) after being exposed to a series of drawings of either animals (condition 1) or faces (condition 2). In the first condition, participants were more likely to interpret the ambiguous stimulus as a rat; in the second condition they were more likely to see a man wearing glasses. After viewing a series of drawings they had an implicit expectation which influenced their perception of reality.

▲ Figure 3.13 The Rat Man

One might think, intuitively, that top-down processing is a bad thing, because it can potentially lead to a variety of biases. However, it is actually very necessary. In sciences, arguably, it's simply impossible to "perceive data" without the background of a theory. Theory tells the scientist what to look for and how to look for it. Otherwise real-life data is too fuzzy. Without the guiding theory this data does not make sense. In a similar fashion, if we didn't have some (simplified) expectations about the world, sequences of events, ourselves and other people, we would find it extremely difficult to make day-to-day decisions. Schematic processing might, indeed, be simplified and biased, and it can lead to stereotypes, but it saves energy.

Using schematic processing, we see patterns in otherwise unstructured stimuli (**pattern recognition**) and find meaning in those patterns (**effort after meaning**). In one of his TED Talks entitled "Why people believe weird things", Michael Shermer, the founding publisher of *Sceptic* magazine and editor of Sceptic.com, calls humans "pattern-seeking animals".

Arguably, evolution has predisposed us to see certain patterns even when the stimulus is not clear or is vague, because these patterns might be potentially important to us. That might explain, for example, the buzz around the "Face on Mars", the famous photograph of the Mars surface taken by NASA's Viking spacecraft in 1971. Back then, the resolution was low and the image was not particularly clear, but there have been claims that this picture proves the existence of artificial objects on Mars and, potentially,