CHAPTER 6

CONSCIOUSNESS: CONSCIOUS VERSUS UNCONSCIOUS PROCESSES

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Route Map of the Chapter

The main uses of the term consciousness are defined initially, in order to be clear about the domain we intend to address. The major theories of consciousness are then introduced, namely higher order theories and integration theories. The following section constitutes the bulk of the chapter, considering the evidence for unconscious mental states for different types of mental states, and how that evidence relates to the theories just discussed. First, unconscious memory is considered and the role it plays in perception, liking, and controlling our behaviour. Next subliminal perception is considered, and how it can shed light on attention, advertising, the neural correlates of consciousness, and how our action is controlled. Then we discuss implicit learning, that is, how unconscious knowledge of the structure of the environment can be acquired. Finally we discuss how intentions, desires and emotions can be unconscious. To conclude, we briefly indicate how the difference in properties between conscious and unconscious states can be used to determine the function of consciousness.

Chapter Outline

Learning Outcomes

After you have read this chapter, you should be able to:

- Describe two main approaches to explaining consciousness (namely, higher order theories and integration theories)

- Evaluate the methods by which memories, perceptions, knowledge, emotions, attitudes and intentions can be determined as conscious or unconscious
- Discuss the relative roles of conscious and unconscious processes in our lives

INTRODUCTION

Consciousness has been defined as the presence of any kind of subjective experience at all. When you are conscious, there is 'something-it-is-like' to be you. This 'something-it-is-likeness' goes away when you are unconscious (for example during dreamless sleep) and is never there at all for things like tables and chairs. That is, you have conscious experiences; tables do not. Our lives would mean nothing to us if our experiences were not conscious! But how can we be conscious at all? Why are some mental states conscious? Can mental states be unconscious? Can we have unconscious perceptions, memories, learning, intentions or emotions? And what does this tell us about the function of consciousness? These are the questions we will consider in turn. First we will define different uses of the term 'conscious' (there is little agreement here, even among 'experts'), and then consider theories of consciousness.

When psychology started as a science in the 19th century, it was the study of conscious experience. Psychologists looked inward to identify what was there. By the middle of the 20th Century, behaviourism had rendered mention of the word consciousness taboo. Psychology was strictly about what could be publicly observed, behaviour. Only since about the beginning of the 21st Century has that taboo really been broken, with consciousness once more widely recognized as the central problem that it is. Consciousness can be tackled by having subjects look inward, while at the same time using the objective procedures of science to measure their behaviour and the activity of their brains. We will see how this can be done.

Different Uses of the Word 'Conscious'

In everyday life, sometimes when we use the word 'conscious' we apply it to a creature as a whole; for example we may say of Tom that he is conscious or unconscious. Call this use of the word **creature consciousness** (the term introduced by the New York philosopher, David Rosenthal). It means roughly that the creature is awake, responsive to the world, rather than asleep or knocked out. We will see later that such consciousness comes in degrees or levels. Tom could be partially conscious. Even if Tom were, as a creature, conscious (he is awake, alert), he might have mental states that were unconscious. According to Freud, he might be acting on desires he does not know that he has. Or he might be flashed an image on the cinema screen that he did not know that he saw (unconscious seeing, or subliminal perception). Conversely, Tom might be asleep while having conscious experiences (maybe dreaming). So individual mental states can be conscious or not independently of whether the creature is conscious or not. Thus, apart from creature consciousness, there is also mental state consciousness. Our theories ultimately need to account for consciousness in both senses.

It will be useful to distinguish different types of mental states, so as to be clear about what mental state is claimed to be conscious or unconscious. Seeing a panda eating bamboo is a different mental state from seeing a nightingale on a tree. So mental states differ in what content they have. In one case 'a panda eats bamboo' was the content of the state; in the other, the content was 'a nightingale is on a tree'. (Content of mental states will be indicated in quotation marks.) Different

contents mean different mental states. Mental states also differ in how the content is held, what relation we bear to the content. *Seeing* that ' a panda eats bamboo' is a different mental state than *remembering* that 'a panda eats bamboo'. So even when the content is the same, mental states differ in how that content is held: For the same content, perceiving, thinking, dreaming, and so on, are different types of states. In this chapter we will consider the conscious status of perceptions, memories, acquired knowledge, intentions, and emotions. In what follows it will be useful to consider both exactly what the content is, as well as the way it is held, in considering exactly which mental state is conscious or unconscious.

THEORIES OF CONSCIOUSNESS: HIGHER ORDER VERSUS INTEGRATION THEORIES

Theories

What does a theory of consciousness need to explain? We can get some clues from considering some of the characteristics of conscious states. When we consciously perceive a situation, we know how we are perceiving it; for example, you know if you are seeing the situation, hearing it, and so on (Overgaard et al., 2013). When we consciously see a tree, we know that we are specifically *seeing* a tree. (Try it now, if you can.) Consider, by contrast, a person with **blindsight** (Weiskrantz, 1997). These people have had damage (usually due to a stroke) to a part of their visual cortex called V1, the first area of the cortex that visual information reaches. They consider themselves blind in a part of their visual field, the part corresponding to where V1 has been damaged. Nonetheless, they can be persuaded to guess about the properties of objects in their blind field. For example, if they are shown an X or an O, they can be asked to guess 'X' or 'O' (despite the protests they sometimes make that the task is pointless because they do not see anything). And their accuracy can be very good. So they must have seen the shape, because they can discriminate what was there. Yet they may deny seeing at all, and insist that they are completely guessing. That is, the patient sees but there is no corresponding conscious visual experience.

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The case of blindsight allows us to compare two popular theories of consciousness: 'higher-order' theories, and 'integration' theories. Let's take higher order theories first (e.g. Rosenthal, 2005). In blindsight there is a visual mental state about the shape of the stimulus. In that minimal sense, the person 'sees' the shape. But the seeing is not conscious seeing. We can characterize the mental state as the person sees that 'the shape is X'. What is missing, according to higher order theories, is a mental state that makes one aware of the seeing itself; i.e. one that asserts that 'I am seeing that the shape is X'. This latter mental state would be a mental state about a mental state (because its content is about seeing). A mental state about a mental state is called a higher order state. Conversely, a state about the world (e.g. the shape being X) is a first order state. According to higher order theory, for a mental state to be conscious there must be a relevant higher order state. For example, for seeing to be conscious one needs to represent that one is seeing (and thereby be aware of seeing). By higher order theory, in the case of blindsight, it is precisely because the person earnestly and seriously denies seeing, that we are justified in regarding the seeing as unconscious. In general, conscious knowledge means you know that you know; if you know without knowing that you know, the knowledge is unconscious!

There are different variants of higher order theory. For example, one variant says that for a mental state to be conscious you have to actually have a higher order state that asserts one is in the

lower order state (Rosenthal, 2005); a different variant says that you just have to be disposed to have a such a state (for example, you only need to be able to represent that you are seeing if you were asked, or wondered about it yourself) (Carruthers, 2000). It has been postulated that there is a region responsible for **higher order thoughts (HOTs)**, a HOT box, in the frontal area of the brain, possibly the dorsolateral prefrontal cortex (Lau & Rosenthal, 2011).

Integration theories of consciousness start from considering other characteristics of conscious states. Conscious information seems to be available to be used in many different ways. For example, if you consciously saw a glass of water you could drink it, leave it where it is, throw it down the sink, put sea monkeys in it, or any other action. On the other hand, a thirsty person with blindsight confronted with a glass of water in the blind field, would not spontaneously do anything with the glass. They could only guess that one was there if forced by an experimenter. Unconscious knowledge, like unconscious perceptions, seems to be used in only very specific ways. A child of five uses nouns and verbs appropriately, and so knows of each word whether it should function as a noun or a verb. But, unschooled in grammar, she could not perform any arbitrary task, e.g. hop on the left leg if a word is a noun and the right if a verb. Unconscious grammatical knowledge is used only for processing language. Some integration theories emphasize this flexibility in the use of conscious information. On some integration theories, in the case of blindsight, it is precisely because the visual information cannot be used flexibly, that we are justified in regarding the seeing as unconscious.

The property of flexibility is closely related to the fact that the conscious scene before you this very moment seems unified, you experience it as a whole. Further, even in experiencing it as a whole you are making many small discriminations: the colours and shapes of different objects, the qualities of different sounds, the pressures on your body, the temperature on your skin, all as part of one experience. In this way of looking at things, your conscious experience can be characterized as highly integrated and yet highly differentiated at the same time. Other integration theories start from this premise.

These two approaches to integration theory (i.e. flexibility vs a unified experience) are best represented by two prominent theories: **Global workspace theory** and **information integration theory**. According to global workspace theory (GWT) (Baars, 1988; Dehaene, Changeux, & Naccache, 2011), the brain consists of many unconscious processors which do their job, make their discriminations, on the information given to them. By themselves, these local processors can only implement very specific functions. The output of each processor competes for access to a 'global workspace'. When some output wins this competition, it is broadcast to many other processors (accounting for flexibility) and at the same time becomes conscious. One way to think of this is that 'winning' information is like an actor on a stage suddenly picked out by a spotlight. In the brain, the global workspace is often identified with large parts of the frontal and parietal networks.

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Information integration theory (IIT) develops the second view, that conscious experiences are simultaneously integrated and differentiated. IIT – and 'complexity' theories more broadly – are distinguished by proposing explicit mathematical quantities that may correspond with the degree or level of consciousness a creature may have. While the details are complicated, the basic idea is not. Imagine a brain in which all the neurons fired independently of all others. Such a brain would be highly differentiated (i.e., capable of entering many different states) but there would be no integration, and hence no possible unity to any corresponding conscious scene. On the other hand, a brain in which all the neurons fired on-and-off together, in waves of synchrony, would be highly integrated but not at all differentiated (there would be only two states, all neurons on or all neurons,

off) meaning that it would incapable of representing the rich space of discriminations needed for consciousness. (In fact, neurons firing simultaneously is characteristic of the brain in seizure, when a person is unconscious.) A conscious brain needs high levels of both integration and differentiation; this is the idea of 'complexity'. Tononi and Edelman (1998), Tononi (2008), and Seth, Barrett, and Barnett (2011) have conjectured relevant 'complexity' measures that are high only when both integration and differentiation are high. Supporting these ideas, it has been found that if a brain is stimulated by a short magnetic pulse, in a waking brain the pulse produces activation over many parts of the brain, lasting a long time, showing sustained integration between areas; in a sleeping brain, the activation spreads only locally and transiently, showing limited integration (Casali et al., 2013; Massimini et al., 2005).

These different theories of consciousness are compatible in many ways. For example, the architecture of the brain proposed by global workspace theory is well suited for promoting the high integration and differentiation required by information integration theory: Information in the workspace should be easily integrated with information in any processor. Also, information in a 'global workspace' is generally available for any processing so should be available to any mechanism responsible for higher order thoughts (the HOT box). So the theories may often agree about when a mental state is conscious or unconscious. But the theories are not the same. For example, if information were in the global workspace but blocked from the HOT box, it would be conscious by global workspace theory yet unconscious by higher order theory. (Consider an animal with a global workspace but no HOT box: It would be capable of conscious states by global workspace theory but not by higher order theory.) A bigger difference has to do with which aspects of consciousness the theories try to explain. Higher order theory and global workspace theory are a theories about conscious content: they specify whether mental states are conscious or not. They do not specify whether a creature is conscious, or what level of consciousness it might have. Integrated information and complexity theories, on the other hand, are first-and-foremost theories of **conscious level**: for example, they would account for the difference between normal waking consciousness and general anesthesia in terms of levels of integration and differentiation. One can delve further into each theory to find aspects related to both level and content, but this difference in overall aim is worth remembering.

There are other theories of **conscious content**. One of these, re-entry theory, says that a mental state becomes conscious when it elicits a wave of 'feedback' or '**re-entrant'** neural processing (Lamme, 2010). That is, activity flows not only forward from simple sensory areas to higher areas of the cortex, but also back from higher areas to lower areas, making a loop, where higher and lower areas modify each other's activity. Activation can be sustained by such loops. According to Lamme, these feedback loops (i.e. re-entrant processing) produce conscious experience of the content coded by the areas, even if the loop is local to a particular sensory area. This conscious content is only verbally reportable when the re-entrant loop happens to encompass prefrontal and parietal brain regions. According to the theory, activation briefly passing through a bit of brain, and not sustained by recurrent loops, constitutes unconscious processing – even if this activation reaches frontal areas. Such theories explain the phenomenal fact that conscious experience lasts for a period time, say at least a few hundred milliseconds (a fact also explained by higher order and integration theories). On local theories, information can be conscious even when people sincerely and earnestly deny knowing the information and when they cannot use the information in flexible ways (because the loop is local and does not encompass parietal and pre-frontal regions). This marks an important distinction with higher order and global workspace theory.

There is lot of evidence for the role of 're-entrant' processing in conscious states (Lamme, 2010); the question is whether re-entry is sufficient in itself to produce conscious experience or rather it is just a prerequisite for e.g. access to a HOT box or global workspace.

Measuring the Conscious Status of Mental States: Measures and Theories

In the UK, subliminal messages are banned in advertising. Imagine your job is to determine whether a briefly flashed brand name in an advert is perceived consciously or unconsciously, in order to determine whether or not the advert should be banned. You could ask people at the end of the advert whether they noticed any words. Let us say that no one mentions the brand name. Does that mean they did not consciously see the brand name in the advert? If the advert lasted a few minutes, maybe they just forgot a brief visual impression by the time the advert was over. Or maybe they were somewhat sure they saw the brand name, but not completely sure, and did not want to look silly saying something was there that might not have been there. So we need a more sensitive test. As soon as the word was flashed we could stop the clip and force people to choose between one of two brand names as the one that was just flashed. Now people are forced to use whatever knowledge they have, even if they were not completely sure. But if there was just one trial of this, the test would still be insensitive – one trial is not able to pick up on much. So the procedure could be repeated, using one of two brand names each time, and people have to guess which one was presented on each trial, for many trials. Now if people were unable to choose the presented name at above chance levels, we could conclude that that could not have consciously seen the word. On the other hand, if people could discriminate at above chance levels which word was shown, does that mean they must have consciously seen the word? Not according to higher order theory and integration theories of consciousness.

According to higher order theory, discriminating what word was there requires only a first-order mental state, namely a state whose content is about only the world. For example, the state could represent visual perceptual content about the word 'blitz' which has content that roughly means '"Blitz" is displayed'. Such a state could guide one to choose 'blitz' from another word. But without a corresponding higher order state, the seeing would be unconscious. In fact, on the higher order account, finding above chance performance on discriminating what word was there could be the first step to showing there was subliminal perception - and hence banning the advert. To determine if an appropriate higher order state was present, i.e. a state that asserts 'I am seeing that the word "blitz" is displayed', one needs to determine if the person can tell what mental state they are in: Can they tell whether they are seeing or guessing? After choosing which word might have been presented on each trial, people could be asked to say whether they 'guessed completely' or 'saw' the word. Or they could be asked to give a confidence rating, saying how confident they were, from complete guessing up through intermediate confidence to completely sure. If when people say they are completely guessing, they still pick the right word at above baseline levels, the *guessing criterion* of unconscious knowledge is satisfied (as with blindsight patients). If people cannot tell if they are seeing or guessing, there should be no relation between confidence and accuracy. No relation between confidence and accuracy is called the *zero correlation criterion* of unconscious knowledge (Dienes, 2008a).

Tests asking people to tell what is in the world (for example, what word was displayed) are called **objective measures**. Tests asking people to tell what mental state they are in (for example a confidence rating) are called **subjective measures**. Higher order theories motivate the use of subjective measures. Most integration theories do too; when the content of a mental state is widely

integrated it will be available to higher order thoughts. Thus on both theories, showing knowledge on objective measures while showing lack of awareness of the knowledge on subjective measures indicates that the knowledge is unconscious. By contrast, on re-entry theories showing a lack of awareness by subjective measures in no way indicates that the knowledge is unconscious. If people can discriminate which word was there at above chance levels but they claim they were completely guessing, then the seeing could have been (but need not be) conscious. However, on re-entry theories (as on HOT and GWT theories), if people are at chance on objective measures, then one can conclude that the knowledge was unconscious.

Integration theories motivate another test of knowledge being conscious. If knowledge is conscious, one can flexibly use that knowledge in many ways, according to the theories. That is, one should have control over how the knowledge is used (Jacoby, 1991). So for example, if one was asked to pick the word that had NOT just been flashed, conscious seeing would enable one to pick the other brand name; unconscious seeing may draw one to the very word flashed, an impulse one would not know to oppose. On higher order theory, unconscious knowledge could in principle be used flexibly, just so long as it did not elicit appropriate higher order states. Indeed, below we will present examples of flexible control over the use of knowledge one does not know one has.

In sum, the appropriate measure of the conscious status of mental states depends on what theory one presupposes. We need not declare that any of the theories must be the one true theory; an everyday word like 'consciousness' is bound to have multiple meanings. There may be several natural phenomena that people mean by the word 'conscious'. What we do require of any theory though is that it takes part in generating testable interesting conjectures; then we will be in the business of science (Dienes, 2008b)!

Section Summary

- The term 'conscious' has a number of uses; for example, it might apply to a creature or to a mental state. Our theories ultimately need to account for consciousness in both senses.
- By the middle of the 20th Century, behaviourism had rendered mention of the word consciousness taboo. Psychology was strictly about what could be publicly observed.
- Consciousness re-emerged as a serious topic in psychology and neuroscience in the 1990s.
- The case of *blindsight* allows us to compare two popular theories of consciousness: 'higher-order' theories, and 'integration' theories.
- According to higher order theory, when you have a conscious mental state, you know what that mental state is - by having a mental state about that mental state.
- According to integration theories, your conscious experience can be characterized as highly integrated and yet highly differentiated at the same time.
- Approaches to integration theory are best represented by two prominent theories: *global workspace theory* and *information integration theory*
- There are other theories of conscious content. One of these, *re-entry theory*, says that a mental state becomes conscious when it elicits a wave of 'feedback' or 'reentrant' neural processing; that is, activity flows not only forward from simple sensory areas to higher areas of the cortex, but also back from higher areas to lower areas, making a loop.
- Tests asking people to tell what state the world is in are called *objective measures*.

- Tests asking people to tell what mental state they are in are called *subjective measures*.

Test Yourself

1. What does 'conscious' mean?
2. In what main ways do mental states differ?
3. What are the main theories of consciousness?
4. What are the main ways of measuring whether a mental state is conscious or unconscious?
5. Which measures go with which theories?

CONSCIOUS VERSUS UNCONSCIOUS MENTAL STATES

We now consider the evidence for a distinction between conscious and unconscious mental states, for memory, perception, learning, intentions, and emotions.

Conscious versus Unconscious Memory

Unconscious memory occurs when a person uses memory but is not aware of using memory. Warrington and Weiskrantz (1974) provided a demonstration of the phenomenon that inspired much further research in the field of 'implicit memory' – or unconscious memory. (Implicit versus explicit was used as a name presumably because it obviated the need to refer to 'conscious', still virtually a taboo word in experimental psychology at the time.) They gave people with amnesia a list of words to remember. As expected, on a later recognition test, people with amnesia did worse than those without (which is how such people were diagnosed with amnesia in the first place). People were also given a stem completion test. For example, people might be asked to complete the stem PAT--. When people were shown 'patio' as one of the words to be remembered, they completed the stem as 'patio' more often than when they had not been shown 'patio' before. The increase in accuracy or speed in performing a task because the stimulus has been presented before is called **priming.** Both people with and without amnesia showed priming (for a review of relevant studies see Hayes, Fortier, Levine, Milberg, & McGlinchey, 2012). Because people with amnesia showed priming, there was some form of memory for the word presented earlier (demonstrated in the priming effect), that does not depend on consciously remembering the word. Hence, people with amnesia have a form of unconscious memory. We now consider some examples of the role of unconscious memory in everyday life.

Illusion of loudness

Can memory change how we perceive the world? It turns out memories can present themselves as perceptions rather than memories. When people have heard sentences before, those same sentences sound clearer when subsequently heard in noise. Jacoby et al. (1988) found that people rated the noise as less loud when listening to old rather than new sentences, even though the noise level was the same. Further, when told about this effect, and asked not to show it, people still thought the noise was quieter for old rather than new sentences. That is, people's memory for the sentences made the sentences appear to be spoken clearly through the noise; people were not aware of using memory, even though it was memory at work. Jacoby argued that unconscious memory expresses itself as *fluency*, i.e. an ease of processing a stimulus, but the way the fluency is

experienced depends on what the person is trying to do. When trying to listen to sentences through noise, the fluency is experienced as the volume of the noise. For an everyday example of memory experienced as perception, consider how when you have read the lyrics of a song, you can hear them clearly in the music. We will see below other ways unconscious memory can be experienced, such as liking. The robustness of the illusion of loudness in the face of attempts to overcome it indicates one way in which the unconscious status of memory could be established: By whether the participant can control the effect or not (Jacoby, 1991). People cannot make the illusion of loudness go away when informed of it; thus, Jacoby concludes, the influence is unconscious.

Illusion of truth

Here we explore how familiarity with a claim makes the claim seem true. In a classic experiment, Hovland and Weiss (1951) asked people to read an essay about 'Can a practicable atomic powered submarine be built at the present time?' then an issue of topical concern. After reading, one group was told the author was Robert Oppenheimer, one of the developers of the atomic bomb (who was also a Sanskrit scholar, as a hobby; when he first saw the bomb go off, he famously said to himself 'I am become death, the destroyer of worlds', his translation from the *Bhagavad Gita*). The participants regarded Oppenheimer as a highly credible source on the topic. Another group was told that the source was a Soviet Union newspaper, a source which had little credibility to the participants. When tested immediately for how much their attitude had changed, the first group (exposed to a credible source) changed their opinions considerably on the topic; the second group (exposed to a non-credible source) changed their opinions scarcely at all. But after a month's delay, the opinions of the second group had changed, and were now very similar to those of the first group. Hovland and Weiss called the increasing influence of the low credibility source over time, the 'sleeper effect'; that is, the low-credibility arguments did not have any influence immediately, it is as if they slept for a time, eventually waking up.

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The sleeper effect could be explained along similar lines as Jacoby et al. (1988) explained the illusion of loudness. Over time one forgets the source of the arguments, as conscious recollection of the details of that episode in the psychology lab fade. Nonetheless, when one is asked about the topic some time later, arguments may spring to mind. Now, with the source forgotten consciously, the arguments may seem like one's own– and therefore jolly good ones. Memory for the arguments presents itself not as memory per se but as one's own penetrating insight into the topic.
The phenomenon was explored further by Begg, Anas, and Farinacci (1992). In an initial learning phase, people were presented with obscure statements (like 'house mice can run an average of four miles an hour') labelled as true or false. In a subsequent test phase, participants were presented with new and old sentences, each was categorized as true or false. When people had not been exposed to the sentences before, they thought 45 per cent of them were true. This is the baseline level of believability of the sentences. When a sentence had been labelled 'true' in the learning phase, people thought 66 per cent of such sentences true in the test phase. The 66 per cent is substantially greater than baseline, which is not surprising. Now the interesting condition is when a sentence had been labelled false. Conscious recollection of the context in which one had this sentence would make one more likely to call it false, so people should endorse such sentences as true at below baseline levels. In fact, people regarded 59 per cent of such sentences true, substantially above baseline. That is, the familiarity of the sentence made it seem true, even though when it was initially presented it was labelled false! Further, it cannot be that people tried to guess 'true' or 'false' 50 per cent of the time, not being sure which it was; they responded 'true' more than

50 per cent of the time. Familiarity with the sentence made it seem true in a way one could not control. In addition to unconscious memory, there was some conscious memory shown; the 66 per cent for sentences labelled 'true' was higher than the 59 per cent for sentences labelled 'false', a distinction made by consciously recollecting the context.

The illusion of truth effect is often used by authoritarian regimes. Dissenting views are suppressed, while the views of the government are repeated endlessly. The repetition of a claim gives it fluency; and fluency gives it credibility. You might think that such an approach would be too obvious to work. Indeed, many people governed by authoritarian regimes may believe their government's tactics to be crass. But that need not stop the tactics from working. As we have just seen, the effects of unconscious memory are those we find difficult to control and overcome. And indeed there is a rational basis to the illusion of truth effect. The more independent times we acquire evidence for a claim (such as hearing the claim asserted by unrelated people), the more likely is the claim to be true. Our brains may come to acquire short cuts to exploit this fact (namely, we learn to associate fluency with truth). Unfortunately, when manipulative regimes (or companies or religions) take advantage of the short cut, fluency may no longer be a reliable guide to truth. One can even take advantage of the short cut oneself in an especially sneaky way – by denying the very facts one wants people to eventually believe of you!

Focus Point 6.1

Unconscious Plagiarism

As we discussed in the case of the illusion of truth, exposure to a new idea can change how one thinks about a topic. Later, one may not be able to recollect the episode consciously. Nonetheless, when thinking about the topic again, the idea one was exposed to may pop into one's head. The idea would feel like one's own. Thus, unconscious memory can lead one to plagiarize without knowing it is plagiarism. For example, George Harrison's 'My Sweet Lord' (1970) melody was taken from 'He's so fine' (1963) by the Chiffons. Harrison was fined, but there is no reason to doubt his own claim that he was unaware of the plagiarism that had taken place. Similarly, Wilhelm Fliess suggested to Freud that everyone starts out life bisexual; Freud scorned the idea, only to proclaim it as a new idea – to Fliess himself – 2 years later! Unconscious plagiarism can be replicated in the lab. Marsh et al. (1997) asked participants in groups to brainstorm ways to e.g. improve the university. After a one-week delay, participants came back and were asked to generate four new ways to address the problem. Participants were specifically told not to repeat ideas from the previous session; nonetheless, about 20 per cent of their 'new' ideas could be shown to come from the initial session. Stark and Perfect (2007) showed that unconscious plagiarism substantially increased, even when people were very confident that the ideas were their own, if participants had previously been asked to elaborate other people's ideas so as to improve them. Once you have made an idea your own, it is part of how you think.

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The Mere Exposure Effect

The mere exposure effect refers to how exposure to a novel stimulus can lead people to like it more (Zajonc, 1968, 1980). For example, if novel shapes are flashed to people quickly, then the more times

they are flashed, the more people will like the shapes. You may have had the experience of not being interested in a song when you first heard it; but after hearing again, and possibly again, you just seem to start liking it, an effect that can be shown in the lab (Szpunar et al., 2004; the lab studies on music also showing how boredom eventually sets in). Similarly, exposing children to a small piece of food (e.g. a new vegetable) can substantially increase both their liking and subsequent intake of the food (Wardle et al., 2003). Seeing people, even just in the background, can make them seem more attractive. Moreland and Beach (1992) had a group of women sit in lectures, either 0, 5, 10 or 15 times, without interacting with the students. When photos of the women were later rated, there were large increases in rated attractiveness according to the number of times a woman attended a lecture.

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What role does conscious memory play in the mere exposure effect? Kunst-Wilson and Zajonc (1980) showed that when novel shapes were quickly flashed to people, the mere exposure effect occurred even when people could not recognize the old shapes as being previously displayed. Indeed, Bornstein and D'Agostino (1992) found larger mere exposure effects for shapes that had been displayed subliminally rather than supraliminally (consciously). The converse pattern is also found: Newell and Shanks (2006) found larger effects for supraliminal rather than subliminal stimuli, so there is no necessary relation between conscious memory and the mere exposure effect, one way or the other. Although the mere exposure effect can be impaired by some types of brain damage that also impair conscious memory (e.g. to right temporal lobes), patients with severe global amnesia can have intact mere exposure effects (Marin-Garcia, Ruiz-Vargas, & Kapur, 2013). In sum, the mere exposure effect does not depend on conscious memory for the exposure episode. It is a form of unconscious memory. Once a stimulus has proven itself safe, because you have survived the encounter with it, we become attracted to that stimulus, whether we consciously remember it or not. The moral is: If you want someone to like you, expose yourself to them.

Focus Point 6.2

Dissonance Reduction

We often change our beliefs and attitudes to make them more consistent with our behaviour, a process called *dissonance reduction* (Festinger, 1957). For example, once people have made a choice, they come to like the chosen object even more, and dislike the rejected items even more (thereby further justifying their choice). Does this effect depend on consciously remembering what choice was made? Lieberman et al. (2001) asked people to rate art posters for how much they liked them. They were then given a difficult choice between certain posters to take home, posters chosen so as to be almost identical in ranked liking. After a distraction, people re-ranked the posters. As dissonance theory predicts, people's liking increased for the chosen posters and reduced for the rejected ones. The crucial finding was that this effect was the same for people with amnesia, who when asked to recollect which posters they had chosen were at chance! That is, dissonance reduction does not depend on conscious memory; our attitudes can change without us remembering the cause of that change. Indeed, simply committing to an attitude, especially publicly, can make it stronger, due to dissonance reduction. Do not be too sure that the strength of your opinions on a topic are based just on the cogency of your arguments (Tavris & Aronson, 2007).

Comment [NN7]: Link to video of cognitive dissonance https://www.youtube.com/watch?v=gN-6nBs7sbI

General Anaesthesia and Sleep

What people hear while unconscious because of general anaesthesia can sometimes later influence them (Deeprose & Andrade, 2006). Some studies showed increased recovery rates afterwards if positive suggestions were repeatedly played from headphones during an operation, but these effects have been hard to replicate. Further, these studies did not rigorously measure depth of anaesthesia. The latter point is important because patients can regain consciousness to varying degrees while under general anaesthesia; the level of anaesthetic needs to be titrated to maintain anaesthetic depth, a procedure that is more rigorously applied these days than it used to be. In fact, analysing the many studies as a whole, evidence remains not for positive suggestions but for the more simple phenomenon of the priming of word stem completion by those very same words being presented during anaesthesia. This effect holds even when depth of anaesthesia has been ascertained. For example, Iselin-Chaves et al. (2005) found that people completed word stems at above baseline level for words presented during deep anaesthesia, even when patients has been instructed to avoid using the words presented during that period.

Deeprose and Andrade (2006) point out that studies controlling awareness have not found evidence of unconscious memory before an incision is made; studies finding evidence of unconscious memory have been when stimuli were presented after the first incision. The physiological response to pain may include activation of the amygdala, a structure known to be involved in forming memory traces, especially for fear relevant material. Future research may yet reveal that positive words or statements may under some conditions be beneficial during an operation; in the meantime it would seem safest for surgeons to try to avoid negative statements during operations.

While general anaesthesia is quite an unusual state to be in, we each fall into dreamless sleep for at least part of each night. Whether we can learn new information during sleep has however remained unclear. One recent study, by Arzi and colleagues (2012), suggests that we can – at least when it comes to smell. Specifically, they found that sleeping subjects were able to learn novel associations between particular odors and auditory tones, as shown by 'selective sniffing' the following day. In one recent study, by Kouider and colleagues (2014), awake participants classified words into different categories, while transitioning toward sleep. Strikingly, their brains showed task-specific preparatory responses even after sleep onset, as revealed by so-called 'lateralized readiness potentials'. However, even if some forms of simple conditioning and word processing can occur during sleep, that does not mean that sleep is a good way of learning your course material. Wood et al. (1992) found no implicit or explicit memory for words played during sleep, unless the person was immediately awakened. The main use of recordings of our lectures played to yourself at night may only be to give yourself a good night's sleep.

Irrational priming

So far the argument that the effects discussed are due to unconscious memory have been that the effects occur despite one's intentions (e.g. the illusion of loudness), or because the memory was formed under anaesthesia, subliminal conditions (e.g. mere exposure effect), or retrieved under amnesia (e.g. effects of dissonance reduction). Another argument that could be used for the effect of previous exposure of a stimulus constituting unconscious memory is that the effect would be irrational if produced consciously. Such an argument could be made for the phenomenon of social priming, whereby the way one interacts with people is influenced by a specific previously exposed

irrelevant stimulus. For example, Williams and Bargh (2008a) found that if asked to hold a hot rather than cold drink briefly, participants later rated other people as being warmer in terms of personality (by 0.5 units on a 1–7 scale). Williams and Bargh (2008b) found that if asked to plot arbitrary points on a graph close rather than far apart, people later rated their bond to family members as close rather than far (by 0.75 units on a 1–7 scale). A similar form of behavioural priming was shown by Bargh, Chen, and Burrows' (1996), who found that people who read words to do with being elderly walked more slowly when they left the lab (8.3 vs 7.3 seconds). Similarly, Dijksterhuis and van Knippenberg (1998) found that people asked to describe attributes of 'professor' rather than 'hooligan', could subsequently answer more general knowledge questions correctly (10 per cent difference). These effects are part of a large number of similar ones explored over the last decade or so (for a review see Bargh et al. 2012). In each case, it would be implausible to claim the effect occurred because of the conscious use of memory; holding a warm cup briefly has no logical bearing on how warm people will be that one later meets.

These behavioural priming effects are intriguing, and often cited in popular science. Indeed, minor one-off priming events (like holding a warm cup for a few seconds) appear to produce large interpersonal effects many minutes later (0.5 units on a 1–7 scale). It would seem that with some well thought-out primes, a smooth operator could cynically manipulate romantic dates, business deals, or other interactions. However, attempts to replicate any given effect exactly have met with failure: for example, Lynott et al. (2014), with 861 participants, failed to replicate the warm coffee effect at all; Pashler et al. (2012) failed to replicate the closeness effect at all; Doyen et al. (2012) could only obtain the elderly effect if the experimenter was aware of which participant had been primed; and Shanks et al. (2013) failed to replicate the professor effect at all, with a convincingly sensitive set of experiments. In sum, effects are smaller than many of the studies imply, and likely non-existent under many conditions. Under exactly what conditions behavioural priming may occur remains to be established (e.g. Bargh et al., 2012, suggest that behavioural priming effects may be higher for self-conscious people). Do not be surprised if after asking your client to sit in a soft chair, she is still a hard negotiator.

Newell and Shanks (2014) point out that there is one form of irrational priming that is frequently replicated: the **anchoring effect** (first investigated by Tversky & Kahneman, 1974; Kahneman was co-awarded the 2002 Nobel Prize for Economics for such work on human judgement). People given a number for any reason, subsequently bias their estimates of a quantity (date, price, temperature, etc) towards the given number. For example, if initially asked whether John Kennedy was first president before or after 1962, and then to estimate the exact date, the use of 1962 pulls estimates towards that anchor. Even the use of obviously irrelevant numbers can sometimes provide anchors for later estimates. When people were first asked whether they would buy each of a range of products for a dollar figure equal to the last two digits of their social security number, the social security number anchored their later estimates of the most they would be willing to pay for the product (Ariely, Loewenstein, & Prelec, 2003). Similarly, people's estimate of how much they would pay for a meal in a restaurant shown in a photo was higher for a restaurant called 'Studio97' than for otherwise the same restaurant called 'Studio17' (Critcher & Gilovich, 2008). Anchoring effects can be overcome to some extent by motivation and considering arguments to discard the anchor, so long as one knows the direction in which the anchor is likely to misleadingly pull (Simmons et al., 2010). Thus, when you next go to a restaurant, consider carefully why the most expensive item on the menu may be on the list: Not for you to buy it, but to anchor you.

Motivated forgetting of episodes

The phrase ‘unconscious memory’ may bring to mind the Freudian theory of emotional events being apparently forgotten, by the motivation to keep the memories from consciousness, only for them to influence one later. For example, a painful memory of being told off may be forgotten, but make one uncomfortable in similar situations, because the unconscious memory is still active. This Freudian notion is often combined with the therapeutic practice of attempting to bring the memories back to consciousness in order to rob them of their power. Some therapies are based on the conjecture that specific childhood events are responsible for various clinical conditions; for example, a conjecture that specifically sexual abuse, or alien abduction, satanic ritual abuse - or traumas in previous reincarnations - lead to eating disorders, or to phobias and so on. The evidence provided for such theories by their proponents is sometimes the fact that, although at the beginning of therapy a client does not recall the right sort of event in any way, by the end of therapy they do, and indeed have conviction in their recovered memories (see Yapko, 1994, for a survey of psychotherapists for their opinions on the reality of the phenomenon). Thus, the conclusion goes, the memory was there all along, unconsciously doing its work.

Unfortunately, the fact that people can be readily led to have convincing memories is not evidence that the events really happened (e.g. Loftus and Ketcham, 1994). Completely false memories can be constructed in the lab in half an hour. Laurence and Perry (1983) asked people to nominate a night the previous week they had slept solidly. They were hypnotically age regressed back to that night and asked if they remembered any loud bangs that woke them up. After hypnosis, a third of subjects maintained that the noises had actually happened; and most of these subjects continued to insist it had actually happened even after being told the noises were only suggested. Other procedures, without the use of hypnosis, have been used to create false memories of being lost in a shopping mall when one was a child (Loftus & Pickrell, 1995). Thus, a client who cannot originally remember being abducted by aliens and spends numerous therapy sessions with a therapist who is themselves convinced the client must have been abducted by aliens, may well end up remembering the abduction - whether or not it actually happened.

The clinical evidence for repressed memories may be unconvincing. But it can be routinely demonstrated in the lab that some people can forget whole episodes by being motivated to do so, and such memories can continue to exert influence while apparently forgotten. Specifically, consider a highly hypnotizable person given a post-hypnotic suggestion. The suggestion may be to scratch their eyebrow whenever they hear the word ‘experiment,’ but, it is suggested, they will forget that they have been asked to do so until told otherwise. Highly hypnotizable subjects given such a suggestion will scratch their eyebrow when a hypnotist says ‘experiment’ and claim not to remember any instruction to do so (e.g. Orne et al., 1968). (Importantly, in an academic setting, unlike hypnosis on TV, there is evidence that subjects rarely fake, that is, they tend to have compelling subjective experiences if they claim to have them; e.g. Kirsch et al., 1989.) The post-hypnotic suggestion is forgotten, yet the forgotten material continues to influence the subject (in a way consistent with the subjects’ overall goals, Spanos et al., 1987). So there can be motivated forgetting of episodes that remain influential, at least for highly hypnotizable people. This fact has clinical relevance. Normally, hypnotic response furthers the goals of the subject, i.e. the hypnotic response is only pursued to the extent it is appropriate and furthers one’s projects (in contrast to, say, the hallucinations and disorders of volition in schizophrenia). But what if one had conflicting goals? The hypnotic response may then work against the subject’s other goals. Indeed, hypnotic response appears to involve the same processes as conversion disorders, which may involve amnesia (or blindness, paralysis or other conditions) with no organic cause, i.e. no physiological brain or

neuronal dysfunction known to produce such effects (Oakley & Halligan, 2013). These conversion disorders may fulfil some goal of the patient, while apparently contradicting others: they appear to be self-given hypnotic responses gone wrong.

Focus Point 6.3

What Is The Unconscious Content?

In the above examples we have considered a range of cases in which memory is involved but the person is not aware of using memory. Thus, in this sense, they can all be described as cases of unconscious memory. But there is another sense in which the use of the term unconscious memory may be misleading. Remember we said of a mental state that it involved some content held in a certain way. In the above examples, was there any content actively being held (used), but which was unconscious? In most cases, we do not need to postulate active unconscious content. Consider the first example of unconscious memory, the illusion of loudness. Initially hearing the sentences builds connections between the representations of the words in the sentences. Thus, when the sentence is heard again, the representation of each word and their connections is accurately activated, and thus heard clearly. There is no need to postulate any content that is actually unconscious; the content which is active is about the words, which are consciously experienced. There is no need to postulate activation of the content 'I studied the sentence for the first time in the lab at 3 o'clock', for example. That is, we do not literally have to postulate a representation of the memory that is unconscious. This analysis is true for the illusion of truth, unconscious plagiarism, mere exposure effect, dissonance reduction, and irrational priming. In these cases there *is* a previous external influence that the person is not conscious of as an influence, that is the sense in which there is unconscious memory; but there need be *no* representation of that influencing event that is unconscious, that is the sense in which there is no unconscious memory. By analogy, consider a fat bee that has eaten a lot of nectar; the bee need not be aware that is fat *because of* that past nectar. (So the past nectar *is* an unconscious influence on its current fatness.) But nor does the bee need unconscious representations of having eaten the nectar. (There are no unconscious contents!) The bee just needs to have eaten the nectar and hence be fat.

The general anaesthesia and sleep results may require postulating unconscious content; namely the content of the words perceived during the operation (or while asleep). These example involve unconscious perception, and it is while perceiving the words that a case could be made for active unconscious content. (If the person while creature unconscious only had unconscious mental states.) We will explore unconscious perception in the next section and consider further evidence for active unconscious contents. Post-hypnotic suggestion involves conscious perception - and also unconscious contents, but this time operating at the memory stage. The claim for the memories being genuinely unconscious in posthypnotic suggestion rests on the evidence that in general, in an academic setting, highly hypnotizable subjects rarely fake (the interested reader might like to pursue that issue further: Halligan & Oakley, 2013; Kinnunen et al., 1994; Kirsch et al., 1989; Ward et al., 2003).

We have seen how past events can influence a person without their awareness: Past events can make sentences seem clearer, people and objects more pleasant, and estimates of magnitudes more biased. Further, memories can be hidden hypnotically and still influence people. In these cases the initial events were perceived consciously. We will now consider whether perception itself can be unconscious.

Section Summary

- Unconscious memory occurs when a person uses memory but is not aware of using memory.
- The increase in accuracy or speed in performing a task because the stimulus has been presented before is called priming.
- Memories can present themselves as perceptions rather than memories.
- The sleeper effect is a psychological phenomenon that relates to persuasion. It is a delayed increase of the effect of a message that has been discredited.
- Research has demonstrated that the repetition of a claim gives it fluency; and fluency gives it credibility.
- The mere exposure effect refers to how exposure to a novel stimulus can lead people to like it more.
- We often change our beliefs and attitudes to make them more consistent with our behaviour, a process called *dissonance reduction*.
- Even conscious exposure to stimuli can result in irrational behavioural effects: for example, anchoring is a cognitive bias that describes the common human tendency to rely too heavily on the first piece of information offered when making decisions.
- The fact that people can be readily led to have convincing memories is not evidence that the events really happened.
- It can be routinely demonstrated in the lab that some people can forget whole episodes by being motivated to do so, and such memories can continue to exert influence while apparently forgotten.

Test Yourself

1. What is unconscious memory?
2. What is the mere exposure effect?
3. Describe the evidence for one other way in which unconscious memory can express itself.

Conscious versus Unconscious Perception

Methods

For many stimuli, perception involves conscious perception. To make perception unconscious or subliminal, something needs to interfere with the normal perceptual processing. We will consider methods for interfering with conscious vision so that only subliminal perception is left. The most common method is a **backward mask** (see Figure 6.1). First a word or a picture (the target) is shown on a screen; then a *pattern mask* is shown. A pattern mask consists of a similar sort of stimulus as the target; for example, a string of letters to mask a word; one face to mask another face. The time from the beginning of the target to the beginning of the mask is called the **stimulus onset asynchrony** or **SOA** for short. SOAs are typically measured in milliseconds (thousandths of a second). For example if the target was displayed for 48ms immediately followed by the mask, the SOA is 48 ms (and the gap between the end of the target and the beginning of the mask, or *the interstimulus*

interval, ISI, is zero.) The mask interrupts processing of the stimulus, so, for the right SOA, the participant may perceive only the mask consciously and not the target. (In fact, interference goes in both directions; if a long mask is put before a short target, it can also mask the target, in which case it is called a *forward mask*. But back masking is the more effective technique.) The SOA is the crucial parameter for a pattern mask; for very long SOAs (for example, above 100ms) there is no masking effect. The critical SOA is different for different people; it may be 15ms for one person and 200ms for another (e.g. Armstrong & Dienes, 2013).

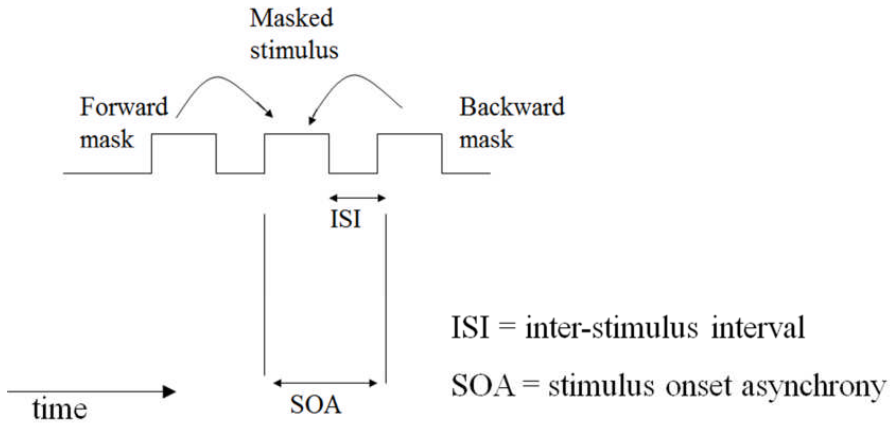


Figure 6.1
Terminology used in masking experiments (see text for explanation).

Pattern masking has been used for decades. Recently two new methods have been developed that allow the subliminal stimulus to be displayed for considerably longer than 100ms: **continuous flash suppression (CFS)** (Tsuchiya and Koch, 2005) and **gaze contingent crowding (GCC)** (Faivre, Berthet, & Kouider, 2012). CFS relies on the phenomenon of *binocular rivalry* (see Figure 6.2). If one image is presented to one eye (for example, a face) and another image to the other eye (for example a house), the person does not see a house-face; rather they see either a house or a face. There is a rivalry between the two images, and the brain decides only one of the objects must really be there. So first the person might consciously see just a house. The conscious experience of the house will last for some seconds, then it will break down at the edges, eaten away by a face, and the face then comes to be consciously seen as the single object there. The face lasts for some seconds, before another switch occurs and so on. In CFS, this switching between the percepts is prevented by using one image that is very salient. One eye is presented with a random mixture of coloured blocks that are continuously changing. This is the mask. A static target is presented to the other eye. The salient mask captures conscious processing, so the mask remains all the person is conscious of. In this way, the target can be kept masked for an almost indefinite period of time.

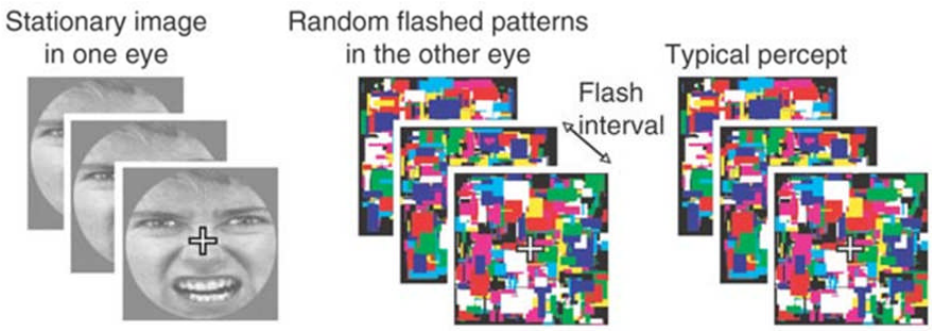


Figure 6.2 Continuous Flash Suppression
One eye sees the to-be-masked stimulus (here a face), and the other eye sees random colours and motion. The conscious percept is just of random colours and motion.
Source: Reprinted by permission from Macmillan Publishers Ltd: NATURE NEUROSCIENCE (Tsuchiya, N., & Koch, C. (2005). Continuous flash suppression reduces negative afterimages. *Nature Neuroscience, 8*, 1096–1101), copyright 2005.

Gaze contingent crowding (GCC) relies on the fact that stimuli in the periphery can be processed unconsciously. That is, when looking straight ahead, what you focus on for an extended period is likely to be attended to and processed consciously. Stimuli, or changes in stimuli, slightly to one side are often not consciously noticed. In GCC, a peripheral target stimulus is surrounded by masks (i.e. 'crowded'), which means the target is not consciously processed – so long as it remains in the periphery. In GCC, an eye-tracker is used, which is a device for measuring exactly where the person is focusing (see Figure 6.3). As soon as the participant stops focusing straight ahead, the target disappears, and reappears when the participant focuses straight ahead again (this is the 'gaze contingent' part). This way, the participant never gets to focus on the target so that the target can be kept unconscious almost indefinitely.

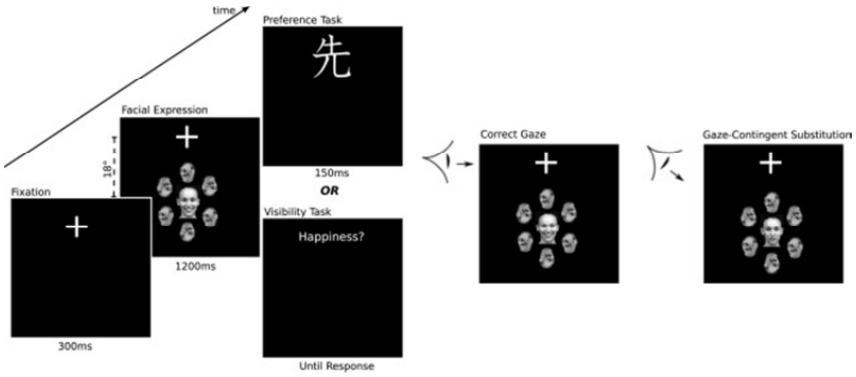


Figure 6.3 Gaze Contingent Crowding (GCC)
The participant is requested to fixate on the cross. In the periphery a prime is shown (here a happy face), flanked by masking stimuli. If the participant moves their eyes to the prime, it is immediately replaced (here by a neutral face), so that the true prime is never consciously perceived.
Source: From Faivre, Berthet, & Kouider, 2012.

Thresholds

Cheesman and Merikle (1984, 1986) first distinguished between the **subjective threshold** and **objective threshold**. People were shown on each trial one of the four words: blue, yellow, green or red. They had to say which word had been presented. They also gave a confidence rating, anything from 25 per cent, which meant they guessed at chance, they expected only 25 per cent of their responses were correct (25 per cent because they would be correct one in four times by chance alone, as there were four possibilities), to 100 per cent, which indicated certainty, they expected 100 per cent of their responses to be correct. For long SOAs between the word and a subsequent pattern mask, a given participant would be very confident and also get most answers correct. Perception was clearly conscious. As the SOA was reduced, a point was reached where the person gave a 25 per cent confidence rating, i.e. they believed that were just guessing. This point is the subjective threshold, because it (subjectively) seems to the person that they are performing at chance. Crucially, at the subjective threshold, people were actually correct 66 per cent of the time, substantially above a chance baseline of 25 per cent. The SOA needed to be reduced further to reach the point where people actually classified the words at 25 per cent (chance); this is the objective threshold, because it is the point where people are objectively at chance. After finding both thresholds for each participant, they performed a Stroop task. That is, they had to say what colour was presented to them, while a word was flashed. The word was presented below either the subjective or objective threshold. Stroop priming would be shown if people were faster to say the colour when the word was congruent (e.g. the colour was green and the word was 'green') rather than incongruent (e.g. the colour was yellow and the word was 'green'). In fact, Stroop priming was found below the subjective threshold but not below the objective threshold.

Comment [NN8]: Link to Stroop task https://www.youtube.com/watch?v=Tpge6c3Ic4g

What do these results mean? The answer depends on deciding which threshold marks a valid distinction between conscious and unconscious. Sceptics of unconscious processing prefer the objective threshold. It is, after all, well, more objective. The subjective threshold may depend on a person's bias in defining at what point they really could not see anything relevant to the choice. On these grounds, Cheesman and Merikle (1984) found no subliminal perception: There was no Stroop priming below the objective threshold. On the other hand, we saw in section 2.2 that higher order theory directly motivates the use of subjective measures; that is, the use of the subjective threshold. Being able to classify what word is there is no guarantee that the perception is conscious; it is only when one knows that one sees that the perception is conscious. One only needs the content that 'the word is RED' in order to be influenced towards saying 'red'; first-order contents allow performance on first-order discriminations. Conscious seeing requires the higher order content 'I see that the word is RED.' Global workspace theory effectively makes the same point; if information is in the global workspace, it is available to higher order thoughts. Thus, on these theories, subliminal perception was shown by Cheesman and Merikle in two ways. First, by the fact that below the subjective threshold, people were still above the objective threshold: They could classify accurately even they believed they had no knowledge (thus, satisfying the guessing criterion of unconscious knowledge). Second, subliminal perception was also shown by the fact there was Stroop priming below the subjective threshold. Cheesman and Merikle's results illustrate something further. As the SOA was reduced to the objective threshold, subliminal perception was degraded until it was difficult to detect. This, if one wants to know what subliminal perception can do, it would be a mistake to use the objective threshold, according to higher order and global workspace theories.

The sceptic of subliminal perception might be tempted to endorse local theories of consciousness in order to justify the use of objective thresholds. But one can accept higher order and integration theories and still accept that the sceptic's point is valid about the potential role of bias in subjective measures. When people in everyday life say 'I guess that...', they mean a range of things. They might even mean they are pretty confident. Leaving subjects free to define 'guess' loosely will surely overestimate the amount of unconscious knowledge. Rather than giving up on subjective measures, another solution is to devise ways of being more rigorous in their use. For example, 'guess' can be precisely defined as being no better than random, with examples (e.g. Cheesman & Merikle, 1984); people's confidence may be elicited by gambling or wagering, so actual rewards are on the line (Dienes & Seth, 2010; Persaud & McLeod, 2008); confidence can be taken after every trial rather than after blocks of trials (Kolb & Braun, 1995), and so on. The further crucial argument, provided by Merikle (1992), is that the subjective threshold ultimately proves its worth by showing it separates qualitatively different types of perception. If perception measured to be above and below the subjective threshold behaves like a theory of consciousness says it should, then we are in scientific business: There is something interesting to explain. An example will help illustrate the argument.

Merikle and Joordens (1997) presented one of two words: 'red' or 'green'. After a variable SOA a back mask was presented, which was a series of ampersands (&&&&&&), presented in a red or green colour. The task was to name the colour the ampersands were presented in. The trick was that the word and the colour were incongruent 75 per cent of the time, and hence congruent only 25 per cent of the time. Thus, if one could flexibly use the knowledge of what the word was, one should be able to predict that the colour would be the opposite, and hence be faster on the *incongruent* rather than the congruent trials; i.e. one would get a *reverse* Stroop effect. When the word was presented at above the subjective threshold, this was exactly what was found, a reverse

Stroop effect. But for words below the subjective threshold, the results were the opposite: A normal Stroop effect was found. The results indicate that the subjective threshold is not just a curiosity concerning at what point people happen to define themselves as guessing; rather, it has real consequences for perception and behaviour. Further, the consequences are as predicted by a theory of consciousness: If higher order thoughts are available only when information is in a global workspace, then perception above rather than below the subjective threshold should involve more flexible use of the information.

In general, it has been easy to obtain priming effects below a subjective threshold, and difficult below an objective threshold. However, using sensitive methods it has been possible to obtain evidence of processing below an objective threshold as well. For example, Naccache et al. (2005) tested patients undergoing brain surgery. The patients categorized back masked and unmasked words as threatening or neutral, and could not do so at above chance levels for masked words: The objective threshold was reached. Nonetheless electric field potentials recorded directly in the amygdala was different for threatening versus neutral words for both masked and unmasked conditions. That is, the meaning of the word was processed in emotion relevant parts of the brain. In another example, Faivre et al. (2012) masked faces using gaze contingent priming. The faces could have neutral happy or angry expressions. Participants were at chance at indicating which expression the faces were showing, so the objective threshold was reached. Despite even unconscious knowledge being degraded by the use of an objective threshold, because the primes could be displayed for over a second (unlike with pattern masking), there was sufficient information build-up to obtain priming. The target was a Chinese character which was rated as pleasant or unpleasant. Smiling faces made the character look more pleasant than the other faces. We will find more examples of priming below the objective threshold in what follows.

Process dissociation, awareness and control

In finding a threshold by adjusting SOA, a common logic is that one has found conditions under which the stimulus is never consciously perceived: Having found the threshold, any effects subsequently produced by a prime must have been due to unconscious processing. But what if the threshold fluctuates over time? Then claims for subliminal perception may be undermined. Jacoby, Toth, Lindsey and Debner (1992) illustrated how to show subliminal perception one did not have to find conditions in which a stimulus was never consciously perceived. That is, the tasks did not have to reflect purely conscious or purely unconsciously processes; there is a procedure by which one could dissociate the processes for impure tasks– i.e., tasks involving both conscious and unconscious processing. Hence the procedure has been called the **Process Dissociation Procedure** or **PDP** (see Jacoby, 2009).

In Jacoby et al.'s experiment, three words were presented in succession, e.g. one trial might have been 'glove', then 'patch', then 'flare'. The first and last words were presented for 500 ms (i.e. half a second) and were hence clearly visible; they acted as forward and backward masks, respectively, for the middle word. The middle word was presented for 50 ms. Finally a stem was given to complete, which on half of trials was the stem of the middle word, e.g. PAT--. In what they called an *exclusion test*, the instruction was to 'complete the stem with a word that comes to mind but not any you just saw displayed'. In the exclusion test, conscious perception of the word would lead one to make sure one did not use it; thus, any tendency to use the presented word at above baseline levels must be due to unconscious perception. In exclusion, conscious and unconscious perception act in opposition. By contrast, in the *inclusion test*, the instruction was to 'complete the

stem with one of the words flashed or, if unable to do so, with the first word that comes to mind.' In inclusion performance, conscious and unconscious perception act in concert; they would both lead one to complete the stem with the displayed word. Having both exclusion and inclusion tests allows one to estimate the relative contribution of both conscious and unconscious perception.

When people completed a stem without having just seen the word, stems were completed 36 per cent of the time with the words used in the experiment. This defines the baseline, the level of stem completion without priming. In the inclusion test the completion rate for the presented words was 63 per cent, which is above baseline. There was priming. But we cannot tell from this alone whether it was conscious or unconscious. The clever innovation was to combine the inclusion and exclusion tests in one experiment. On the exclusion test, subjects completed 50 per cent of the stems with the just displayed word. Inclusion was significantly greater than exclusion; so people had some control over the use of the information, they could give or withhold the response to some degree. Only conscious perception can allow this according to Jacoby et al. In fact the proportion of trials on which the word was consciously perceived can be estimated as precisely the difference (inclusion – exclusion) = 0.63 – 0.50 = 13 per cent. Was there any unconscious perception? Performance on the exclusion task (50 per cent) was significantly greater than baseline (36 per cent), showing a lack of control. Conscious perception would result in performance being below baseline. People must have often seen the word in exclusion because it was above baseline; but they cannot have consciously seen the word. So the exclusion performance is evidence for unconscious perception. Thus, for the same tasks and conditions, Jacoby et al. demonstrated a mix of conscious and unconscious perception.

In general, Jacoby's method, PDP, takes flexible control to be the functional criterion for consciousness. Flexible control as a function of consciousness aligns with global workspace theory. In this particular case, the use of PDP also aligns with higher order theory. The exclusion task was another way of testing for the subjective threshold: The instruction was to exclude a word if *you think you saw it*, i.e. if you have a relevant higher order thought. Can we make control (PDP) and subjective measures give different answers to whether perception is conscious or not? Armstrong and Dienes (2013) presented an instruction to exclude (e.g. 'not cat') or include (e.g. 'pick cat') at below the subjective threshold. Following the subliminal instruction, participants were presented with two words (e.g. 'cat' and 'dog'), perceived consciously, and were asked to follow the subliminal instruction by guessing one of the words. For the inclusion instruction, people picked the named word 60 per cent of the time, significantly greater than for the exclusion instruction (45 per cent), which in turn was significantly below baseline (50 per cent). So people exerted control, and the PDP therefore takes the words as being consciously perceived. But this is precisely what people denied; they said they were purely guessing, so perception was below the subjective threshold. By higher order theory, perception was unconscious, yet allowed some control. Further, the words cannot have been in the global workspace as they were not available to the HOT box. So PDP does not always produce answers that match the main theories.

Does the unconscious control found by Armstrong and Dienes challenge global workspace theory? When perception was above subjective threshold in the Armstrong and Dienes study, there was extensive control, with the named word picked close to 100 per cent of the time for inclusion trials, and close to 0 per cent for exclusion trials. Thus, conscious perception greatly facilitates control, which is consistent with the global workspace promoting flexible control. Some flexible control can occur unconsciously, though, a point we will return to in discussing implicit learning and also hypnosis (see also van Gaal, de Lange, & Cohen, 2012).

Just as the PDP can allow conscious and unconscious processes to be dissociated in impure tasks, confidence ratings and other subjective measures can also be used to provide trial by trial classifications of whether perception or knowledge is conscious or unconscious, without assuming the task is always purely one or the other. For example, for a given SOA, the trials on which people say they are purely guessing can be taken as involving unconscious perception; and the trials on which people say they saw, or have some confidence, can be taken as conscious perception (e.g. Lau & Passingham, 2006). As long as subjective measures are taken trial by trial, there is no need to assume a task is performed purely consciously or purely unconsciously.

Focus Point 6.4

Subliminal Advertising and Self-help

In 1957, James Vicary, a private market researcher claimed to have increased sales of drinks and popcorn in a movie theatre, by subliminally flashing messages such as 'Eat popcorn.' However, the study was never published and appears to have been a hoax. Surprisingly, the first authors to address whether subliminal advertising might actually work in the scientific literature are Karremans, Stroebe and Claus (2006). A single threshold was used for all participants: the trade name 'Lipton Ice' was flashed for 23ms, with a row of Xs presented just before and afterwards for 500ms, to act as forward and backward masks. A group of people were asked to guess what had been flashed; none could. In the main experiment, one group had 'Lipton Ice' flashed under similar conditions; another group was flashed 'Npeic Tol', an anagram of Lipton ice. Next people were asked how thirsty they were, and then offered one of a choice of three drinks, one of which was Lipton Ice. For people who were thirsty there was large effect; only 20 per cent of people selected a Lipton ice after exposure to the control prime, but more than 80 per cent did after subliminal priming of the brand name. That is, it is quite possible for subliminal advertising to be effective, though it still needs to be properly tested outside the lab.

Subliminal self-help tapes are often sold with claims that they can improve self-esteem or memory. Greenwald, Spangenberg, Pratkanis, and Eskenazy (1991) tested subliminal audiotapes claimed to improve memory and self-esteem in a double blind trial. Half the participants received the memory tape and half the self-esteem; and half of each of those were told they received the memory tape and half the self-esteem. Participants believed they had improved on the tape according to the label it had on it, not according to the manufacturer's claimed content. However, on standard tests, participants did not improve on either memory or self-esteem in any of the groups. Improving one's memory may need more than suggestions that it is getting better, subliminal or otherwise. (What's more, careful analysis of the content of such commercial tapes has revealed some brands have no subliminal content at all!)

Focus Point 6.5

Consciousness and Attention

What is the relation between consciousness and attention? The two are closely related, in that we consciously perceive in detail the objects we selectively attend to; and we have only a dim conscious awareness of objects in the periphery of attention. But attention and consciousness can be dissociated, as subliminal perception research shows. Jiang et al. (2006) used continuous flash suppression (CFS) to present a picture of a naked body on either the left hand or right hand side of the screen for 800 ms. People were at chance at indicating which side the naked figure was, meaning that the figure was presented below the objective threshold. In the main task, people had to make a further difficult perceptual discrimination, about whether some lines were pointing in one direction slightly or another (these stimuli were not masked). The discrimination occurred randomly on either the left or right hand side of the screen. The question is, did the naked figure draw attention to itself even though it was not consciously perceived? If it did, people would find the line discrimination easier if it occurred on the same side of the screen as the figure. In fact, such a priming effect was obtained. Straight men found the line discrimination easier when on the same side as a naked female; and harder when on the same side as a naked man. Conversely, women found the task easier when on the same side as a naked man. Further, homosexual people obtained priming consistent with their stated sexual preferences. Thus, one's attention is drawn to or repelled from objects one cannot consciously see, in ways consistent with one's sexual preferences. In sum, one can attend to the very same object that is not consciously perceived, so attention and consciousness are not the same (see also Koch & Tsuchiya, 2006). The function of attention is to select a region of space or an object for further detailed processing. But, for example, on the higher order theory, the function of consciousness must involve the use of second-order content (being aware of mental states), rather than selecting objects for further processing per se. On integration theories, the function of consciousness will involve integrating information to a high degree, rather than selecting objects for further processing per se. If attention and consciousness have different functions, no wonder they can be dissociated.

Neural correlates of consciousness

What is the difference between conscious and unconscious perception at the level of neural functioning? What processes in the brain are correlated with conscious awareness? That is, what are the **neural correlates of consciousness (NCC)**? One strategy for answering this question is to compare conscious and unconscious perception of the same stimulus. Dehaene et al. (2001) presented words either at the objective threshold or else clearly visible (see Figure 6.4). Brain scanning with fMRI while people were looking at the words indicated that both conscious and unconscious words activated an area of the brain involved in word processing, the left fusiform area. However, conscious words led to more extensive brain activity, over the parietal and frontal cortices, whereas processing of the subliminal words was localized. The results allow at least two interpretations. First, conscious awareness may depend on information being widely broadcast in the brain, as per integration theories. Second, conscious awareness may instead depend on information reaching a certain area, specifically the HOT box, in the prefrontal cortex, as per higher order theories.

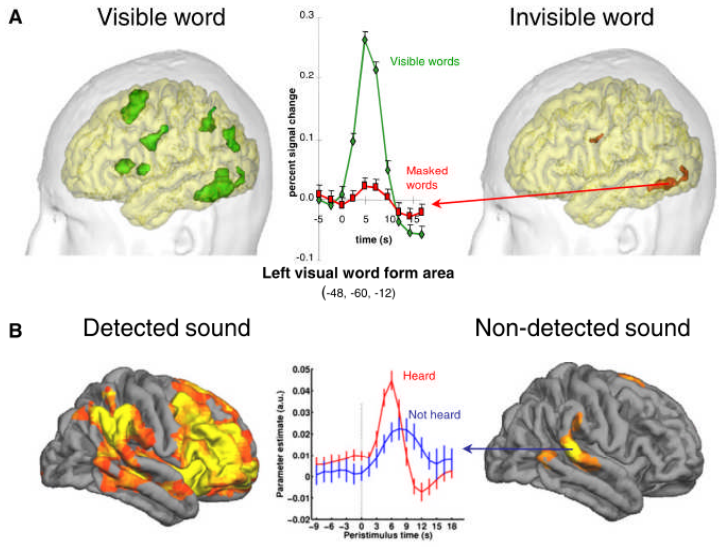


Figure 6.4 Neural Correlates of Perception I.
Conscious perception of words or sounds are often associated with widespread activation of the brain, whereas unconscious perception is associated with local activation in specialist processing areas.
Source: Dehaene, S., & Changeux, J.-P. (2011). Experimental and theoretical approaches to conscious processing. *Neuron, 70*(2), 200–227.

Lau and Passingham (2006) pointed out that when one compares clear conscious perception with perception below an objective threshold, there is a confound: the two conditions differ not only in being conscious versus unconscious, but also by the overall level of perception being very good versus degraded. Maybe very good perception leads to more activation around the brain than very poor perception. What one needs to do is equate objective performance between conscious and unconscious conditions so that only subjective experience differ. Lau and Passingham asked people to discriminate whether a diamond or a square had been presented; after the discrimination people said whether they had just guessed or had seen the shape. They found two backward masking conditions in which the actual ability to discriminate was the same; yet the proportion of 'guess' versus 'seen' responses differed. That is, first order perception (as indicated by ability to indicate what the world is like) was the same, but conscious experience differed. Brain scanning with fMRI now showed that the activation difference between conscious and unconscious conditions was very specific: It was apparently localized in the left mid dorsolateral prefrontal cortex (DLPFC) (see Figure 6.5). One interpretation is that this area is the HOT box responsible for creating accurate higher

order thoughts. However, the evidence is not yet clear. Hesselmann, Hebart and Malach (2011) equated objective performance between consciously seen and unseen trials using CFS, and using fMRI found differences in activation of the higher visual areas of the cortex. One problem with interpreting any of these studies is that any area that brain imaging shows as difference between conscious and unconscious conditions may not be the neural correlate of consciousness, but rather of a precursor to, or a consequence of consciousness (Aru et al., 2012; de Graaf, Hsieh, & Sack, 2012). For example, maybe extensive processing is required in higher visual areas before a HOT box (or a global workspace) can be reached by a visual stimulus; or maybe after a HOT box has been reached, further planning and elaboration happens in the DLPFC. The jury is still out.

Figure 6.5 Neural Correlates of Perception II
When conscious and unconscious perception is equated on first order performance (i.e. people are just as good at indicating what stimulus is in the world) and differ only in the extent to which the person is aware of perceiving, conscious perception is associated not with wide spread activation but specific activity in the dorsolateral prefrontal cortex.
Source: From Lau & Passingham, 2006.

Focus Point 6.6

Phenomenal Consciousness and Perceptual Overflow

Having a conscious experience is one thing; being able to report it might seem to be another. Maybe you have had an experience but did not know how to express it in words: You might have asked yourself, just how to describe that taste, or smell, or colour, or emotional feeling? You had a conscious experience yet did not know how to put it in words. Yet in the studies described so far, the existence of a conscious experience is measured by the participant being able to report it. The problem was at least partly dealt with in the experiments by using clearly describable stimuli: Words, simple shapes, and so on. But even for such stimuli, it can be argued that we could be consciously aware of more than we can report. And if that is true, why accept any of the putative demonstrations of subliminal perception as showing there is anything subliminal going on?

Block (2011) argued that our conscious experience outstrips the contents that are actually accessed and hence reported on. Consider, for example, the Sperling (1960) partial report paradigm, in which people are briefly flashed a grid of letters, three rows of four letters each. People have the impression of clearly seeing the whole display. Yet when asked to report what letters were there, they can only report about four of them, until, people say, the image has gone and they can remember no more. We know there is something to people's impression of seeing clearly all the letters: If, after the display has disappeared, we indicate soon enough which row to report (top, middle or bottom), people can indeed report most of that row. That is, almost all of the display is in principle accurately accessible to people for a short period. In sum, the argument goes, people have a rich conscious experience of the whole display, but they can only report a fraction of that experience. Block thus distinguishes between *phenomenal consciousness* (of the whole visual display) and *access consciousness* (of what ends up in working memory and can be reported) (see also Lamme, 2010).

The argument that people had phenomenal consciousness of the whole display is based on their report that that is what they experienced. So interestingly, the content of conscious experience, even for phenomenal consciousness, is still based on people's reports about that experience. One strategy is to take people as having a conscious experience as of what they claim to be experiencing. That is, people may be experiencing the world as being a display of distinct letters. But one thing we should not in addition do is to presume that our representation of a thing has the same properties as that thing (Dennett, 1995). For example, we can represent there being five objects, without there actually being five representations. Or consider that the representation of an absence is not the same thing as the absence of representation. Although there being distinct letters there means there must have been some specific letters there, we can represent there being distinct letters without there being representations of specific letters. In fact, the visual system is constructed as a hierarchy of levels of abstraction; one level of abstraction may indicate 'R', while a higher level indicates 'letter'. Top-down influences could lead a higher level to indicate 'letter' even before a lower level had indicated which letter, even as a yet lower level had indicated sharp lines (cf. Hohwy, 2013). The experience could then be as of a distinct letter. Indeed, in Sperling's experiments, he found that, despite the sense of clearly seeing the stimuli, people could not report e.g. just the four digits in a display of letters, consistent with the precise identities not being consciously perceived. In a neat twist, De Gardelle et al. (2009) presented one item in the display that was not a letter but a pseudo-letter; people still often felt that they clearly saw a display of letters. Whether or not our conscious experiences are indeed richer than our moment-to-moment ability to report them suggests is still an active and much debated area of research.

Vision for Action

Goodale and Milner (1992, 2013) argued that the visual system contains two functionally different streams, the ventral stream (from early visual cortex to the temporal lobe) and the dorsal stream (from early visual cortex to the parietal lobe). The function of the ventral stream is to support the

Comment [NN9]: Link to video on two stream hypothesis https://www.youtube.com/watch?v=y8j0MQfGtjE

identification and recognition of objects; the function of the dorsal stream is to enable rapid interaction with the environment. The subliminal processing we have considered so far has involved processing in the ventral stream, as it involved recognition of words and shapes. However, unconscious processing may be more characteristic of the dorsal than ventral stream. Milner and Goodale found that patients with damage to the ventral stream, had difficulty verbally recognizing or describing the very same shapes that they could act on effectively. For example, DF when asked to reach for objects showed appropriate pre-shaping of her hand according to the size of the object; yet if she was asked to simply look and judge and size, she could not do it (cf Whitwell & Buckingham, 2013, for critical discussion).

Stottinger and Perner (2006) showed a similar dissociation in normal people. In Figure 6.6 the diagonal on the left figure looks larger than that on the right figure; in fact it is smaller. When people reached for the diagonals to grab the objects, their grip opened during the reach appropriately, being larger for the larger diagonal. However, when people were asked to shape their hand to manually indicate the size, the illusion was shown, with the grip larger for the smaller object. Thus it seems there are visual representations that can control action, but they are not globally accessible. Interestingly, global accessibility of a representation is no guarantee that every processor will use it (a feature of a processor called *cognitive impenetrability*); consciously thinking that the diagonal on the left is larger does not mean the action system will use that information – and just as well, too, as the unconscious knowledge is the more accurate! We now consider another example of where unconscious knowledge is better than conscious knowledge.

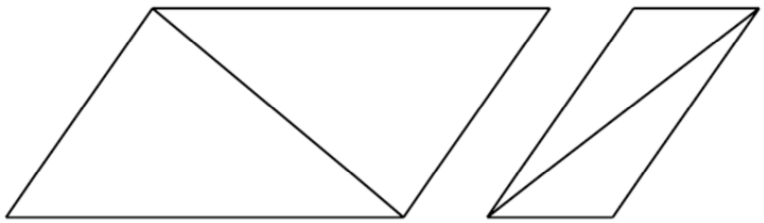


Figure 6.6 The Hand is Not Deceived
The diagonal on the left looks larger than that on the right figure; in fact it is smaller. If the eye is fooled, what about the hand? (See text for explanation.)
Source: Stottinger, E., & Perner, J. (2006). Dissociating size representation for action and for conscious judgment: Grasping visual illusions without apparent obstacles. *Consciousness and Cognition*, 15, 269–284.

Imagine a ballistic object, such as a cricket ball, flying towards someone; they have to run forwards, backwards, or stay where they are in order to intercept the object. For a flight of several seconds, in about half a second a person will start running in the right direction, with speed modulated so that they arrive at the right place at the right time. How is this achieved? McLeod and Dienes (1993) showed that people use a strategy involving the angle of gaze (see Figure 6.7). The line of sight from the eye to the ball makes an angle to the horizontal: this is the angle of gaze. As shown

in the figure, when the tangent of the angle of gaze is kept increasing at a constant rate, interception is guaranteed.

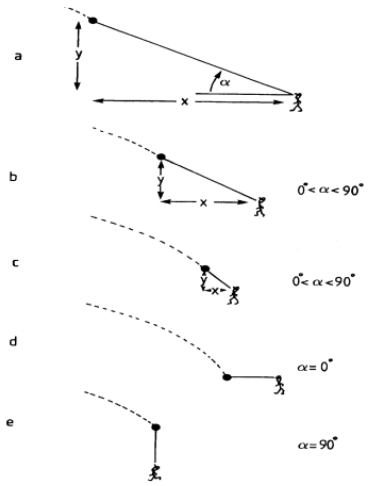


Figure 6.7 How to Catch a Ball
(a) The angle of gaze to the ball is the angle between the line of sight the ball and the horizontal.
(b)–(c) If this angle is kept between 0 and 90 degrees you will arrive at the same place as the ball lands, just as it lands.
(d)–(e) This is because there are only two ways to miss the ball: it falls in front of you, in which case the angle goes to 0; or it goes over your head, in which case the angle goes to 90. So any angle between 0 and 90 will ensure interception. In fact, the most efficient way to catch the ball involves letting the angle increase but never to 90 degrees. This can be achieved by letting the tangent of the angle increase at a constant rate. The only thing you need know about tangents is that they go to infinity as angle goes to 90 degrees. So if the tangent is increasing at a constant rate, the angle will never reach 90 degrees, but will be above zero, and so interception is guaranteed!
Source: McLeod, P., & Dienes, Z. (1996) Do fielders know where to go to catch the ball, or only how to get there? *Journal of Experimental Psychology: Human Perception and Performance*, 22, 531–543.

Further, when people are filmed catching balls, they kept the tangent increasing at a remarkably constant rate: people use the simple strategy that efficiently guarantees interception. People's conscious theories of what they do are rather different, however. Reed et al. (2010) showed that people believed in rules that did not describe their behaviour and would in fact guarantee failure if they were to be followed. A common theory stated by participants was that they waited until the ball has reached its highest point in its flight and then ran, as their angle of gaze declined from that half-way point. In fact, their angle of gaze increased steadily through the flight until at least the last 200ms for a successful catch. If people had let the angle of gaze decline from

halfway through the flight, they would have failed to get to the ball at the right time. People still believed their incorrect theories even just after running to successfully catch a ball with instructions to notice what their angle of gaze did; and people were every bit as confident in their incorrect beliefs as their correct ones (about what the angle does if, for example, the ball is missed and falls in front of them). So here, people's unconscious knowledge, guiding the specific action of intercepting a ballistic object, was more accurate than their conscious beliefs about what they saw, based on general theories. The moral may be that where there is a clear simple solution to an ecologically important problem, it is safer to keep performance shielded from flexible conscious knowledge. If you want to catch a ball, just keep your eye on it and run!

Section Summary

- For many stimuli, perception involves conscious perception.
- To make perception unconscious or subliminal, something needs to interfere with the normal perceptual processing. The most common method is the use of a backward mask, which interferes with conscious vision so that only subliminal perception is left.
- Continuous flash suppression (CFS) and gaze contingent crowding (GCC) are two new methods of blocking conscious perception.
- Continuous flash suppression (CFS) relies on the phenomenon of binocular rivalry.
- Gaze contingent crowding (GCC) relies on the fact that stimuli in the periphery can be processed unconsciously.
- Cheesman and Merikle (1984, 1986) first distinguished between the subjective and objective threshold. Sceptics of unconscious processing typically prefer the objective threshold.
- Process dissociation procedure (PDP) is a procedure outlined by Jacoby, Toth, Lindsey and Debner (1992), which measures the amount of conscious information by the ability to control its use.
- One strategy for discerning the neural correlates of consciousness is to compare conscious and unconscious perception of the same stimulus.
- Goodale and Milner (1992, 2013) argued that the visual system contains two functionally different streams, the ventral stream (from early visual cortex to the temporal lobe) and the dorsal stream (from early visual cortex to the parietal lobe).
- The function of the ventral stream is to support the identification and recognition of objects; the function of the dorsal stream is to enable rapid interaction with the environment. Consciousness seems to associate more with the former than the latter.

Test Yourself

1. What are the ways in which visual stimuli can be made subliminal?
2. How can we tell perception really was subliminal?
3. What is the relation of attention of consciousness?
4. What role might subliminal perception play in everyday life?

Conscious versus Unconscious Learning

Implicit learning is the acquisition of unconscious knowledge about the structure of the environment. The term 'implicit learning' was coined by Arthur Reber in 1967. An everyday example that particularly impressed Reber was natural language. By age five children have learnt the major grammatical constructions of their native language environment; but children do not know that they are learning grammar and can describe little if any of the rules of grammar. Not even linguists have a complete grammar of any natural language. But somehow we soak up the structure of our language

so we can use it to understand or produce sentences without having explicit or conscious knowledge of what the rules are that we are using. You might think you consciously know some grammar rules. But they are just some simplistic summaries, not the real rules you use. Maybe you have tried trying to explain to a person learning your native language why their sentence is not as good as your alternative offering. But if you come up with a rule explaining why, chances are within minutes you have thought of a number of exceptions to your own rule: Your own explicit rule cannot have been the real grammatical basis of your own language use. But these observations are anecdotal. Can we rigorously show that knowledge of grammars is unconscious in the lab?

We implicitly learn more than just about grammars. Anecdotally it seems we intuitively come to discern patterns in many domains. Consider the rules of our social environment. While your parents may have explicitly taught you some rules ('If you have a runny nose, do not wipe it on your clothes'), there are more subtle nuances to polite human interaction that can confound people exposed to a new culture. The anthropologist Fox (2004) describes various rule of being English that many English people would recognize yet never think of articulating. For example, while buying a drink at a pub, one can help the bartender to remember who is next in the queue by subtly indicating, perhaps with one's hand or a glass; but never, ever should one lift one's elbow off the bar to make a larger motion. That would just be crass. Or consider the learning of musical structure. You can rapidly tell what style of music a piece is played in (Bach, Beatles or free-form jazz?) even before you know how you do it. You might know you like a type of music before you know why; but you must have intuitively determined the structure of the music to know it was the sort of structure you liked. Or consider sporting skills; often thinking about what you are doing makes the skilled performance worse. Often your performance goes up or down for reasons you cannot put your finger on. Often the best athletes find it hard to say what it is they are doing in order to coach others. In all these cases, is the difficulty in articulation because of the knowledge being genuinely unconscious? Determining the conscious or unconscious status of knowledge requires more than anecdote. Let us see if we can produce implicit learning in the lab, and explore it carefully in the test tube.

Conditioning

The simplest form of structural learning is conditioning, where one learns about a simple association or reinforcement contingency (see Chapter 8). Early work argued that unconscious conditioning was easy to obtain. For example, Greenspoon (1955) asked participants to produce words freely. Whenever participants said a plural noun they were reinforced with a warm 'Um-hmm.' On average people produced more plural nouns as a result; yet on questioning, people did not mention they were being reinforced for saying plurals. It looks as if people were unconsciously conditioned to say plurals! Dulany (1963) shows how in this and other paradigms of the time, people's behaviour can be explained by their conscious hypotheses. In the Greenspoon case, many people claimed in debriefing afterwards that they were being reinforced for saying words in the same semantic category. For example, having been reinforced for saying 'diamonds', the participant continues, 'rubies', 'pearls', and so on. In giving semantic associates, the participant happens to continue using the same grammatical form, as a side effect. The participant had a 'correlated hypothesis' as Dulany puts it, meaning they had not inferred the experimenter's exact rule, instead they inferred a different one, but one that would tend to give answers the experimenter wanted more often than not. The fact that the participant does not state the experimenter's rule on questioning does not mean the

participant unconsciously knew the experimenter's rule – the participant consciously inferred a different yet correlated rule.

Since those early days, obtaining unconscious conditioning has remained difficult (Hogarth & Duka, 2006; Lovibond & Shanks, 2002). Conditioning experiments typically use only a few salient stimuli; as soon as any unconscious conditioning has happened, attention will naturally be drawn to the key relationship, enabling conscious knowledge of the contingency. One solution is to present the stimuli subliminally. For example, Raio et al. (2012) used CFS to present one of two faces on each trial. Presentation was subliminal according to both objective and subjective thresholds. One of the faces was followed by a shock on the wrist. This face, although it was only ever presented subliminally, rapidly lead to a large physiological fear response, as indicated by skin conductance, which increases as a person sweats.

Another way to allow unconscious conditioning to show itself is to use stimuli that misdirect people's conscious' hypotheses. People are susceptible to the 'gambler's fallacy', meaning that after a fair coin has produced a run of heads, people think it is 'about time' a tail came up, and rate the probability of a tail as increasing the longer the run of heads. In fact, the probability of a tail is always 0.5 for a fair coin, no matter how the coin previously happened to land. Perruchet (1985) used this effect in a clever way. People received a puff of air to their eye after a tone 50 per cent of the time. He measured how strongly the tone made people blink after different numbers of runs, runs of either the tone alone or of the tone followed by a puff. The longer the run of a tone followed by a puff, the less people said they expected a puff on the next trial – but the more strongly they blinked! Conversely, the longer the run of a tone alone, the more people said they expected a puff on the next trial – but the less strongly they blinked. That is, the conditioned response (blinking) and conscious expectancy went in opposite directions. Even though the set-up was simple, people were consciously fooled, and unconscious conditioning showed itself. In everyday life, stimuli are rarely presented subliminally, or with carefully arranged runs. Implicit learning in everyday life may be more likely for structures more complex than simple conditioning: The richness of the environment may throw off people's conscious hypothesis testing. We will now consider paradigms involving more complex structures.

Implicit Learning in the Test Tube: Grammars

The **artificial grammar learning** paradigm introduced by Reber (1967, 1989) was inspired by natural language as an example of implicit learning (a type of structural learning too complex to be explained by conditioning; Chomksy, 1957). A grammar most basically is a way of sequencing elements. Reber used grammars ('finite state grammars') which are rich yet still far simpler than those needed for natural language; but if one is going to study a process in the lab, best start from the beginning. To make a finite state grammar, one draws a finite number of states, or circles. Connect the circles with arrows as one pleases, as shown in Figure 6.8. Now follow the arrows through the diagram, producing the sequence of elements along each transition. So for the finite state grammar shown in the figure, the string of letters 'VTTVM' is grammatical according to the grammar. Reber asked people in an initial training phase to memorize or simply look at a number of grammatical letter strings, but without telling people they were structured in any way. After 10 minutes of exposure to them, people are informed that actually the strings they saw obeyed a complex set of rules; they are then asked to classify new strings as rule governed or not in the subsequent test phase. People could classify the new strings at about 65–70 per cent correct, depending on the grammar used, even though in free report afterwards they find it difficult to say

what the rules were, and may well apologize for mucking the experiment up because they didn't know what they were doing. Reber et al. (1980) found that when people were informed of the existence of rules prior to the training phase, their subsequent test performance was either impaired, for complex grammars, or else at least not improved. Reber concluded that the learning could not have been a conscious hypothesis testing processing. Rather, people incidentally absorbed the structure they were exposed to. The artificial grammar learning paradigm has remained a well-used paradigm for exploring implicit learning.

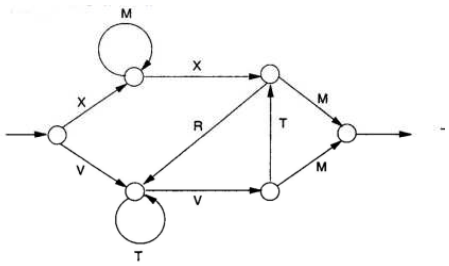


Figure 6.8 A Finite State Grammar
Any pathway following the arrows is grammatical: e.g. XMMXRVM is grammatical.
Source: From Reber, A. S. (1989). Implicit learning and tacit knowledge. *Journal of Experimental Psychology: General*, 118(3), 219–235.

In many of the original studies, the key evidence for the knowledge being unconscious is that participants did not freely report the structure when asked at the end of the experiment, or, what is better, on a trial by trial basis. Often participants could report some things about the letter strings. Reber (1989) indicates for example that people could often report what letters can start or finish a string, or what letters can immediately repeat. He speculated that people may have learned the allowable *bigrams* of the grammar. A bigram is sequence of two letters, e.g. in VTTVM, the bigrams are VT, TT, TV, and VM. He argued that only some of this knowledge was available to report; the rest was unconscious.

Free report is not a very sensitive test of conscious knowledge, as we saw in section 2.2. As we mentioned there, people may miss out saying something simply because they momentarily forgot it. Or they may not say something because they are not quite confident enough to risk saying something that might be wrong, thereby putting their credibility on the line. Finally, if people think the experimenter is interested in one sort of answer, they may indicate ignorance (for example, if the experimenter is interested in plurals, the participant may truthfully say they had no idea about plurals; Dulany, 1963). One solution is to take confidence ratings every trial, then the problems just mentioned become side stepped. If people classify above chance when they believe they are purely guessing the guessing criterion of unconscious knowledge is satisfied; and if there is no relation between confidence and accuracy, the zero correlation criterion is also satisfied (Dienes, 2008a). As we have seen, satisfying these two criteria can indicate the presence and amount of unconscious knowledge. As in the case of subliminal perception, subjective measures can be criticized as dependent on a participant's decisions as to how to use a confidence scale. Ultimately no measure proves its worth just by itself; it needs to behave sensibly in testing theoretical predictions (see Box on judgement versus structural Knowledge).

Focus Point 6.6

Judgement versus Structural Knowledge

We mentioned in Focus Point 6.3 the importance of specifying what contents define the mental state that is conscious or unconscious. When confidence ratings are used, what knowledge exactly can be claimed to be conscious or unconscious? Well, what are the sorts of knowledge contents people acquire in artificial grammar learning? In the training phase, people acquire knowledge of the structure of the strings. This knowledge may consist in part of, for example, bigrams and other chunks, or what letters can start a string. Call this structural knowledge. In the test phase, the participant makes a judgement that, for example, this string is grammatical. The content of the judgement is something one knows about; call this judgement knowledge. The structural knowledge is the knowledge that enabled the judgement, but the two have different contents (e.g. 'M cannot start a string' vs. 'MTTVT does not have the right structure'). Confidence ratings are indications of confidence in the judgement. Thus, they reflect higher order thoughts about specifically judgement knowledge. That is, confidence ratings do not directly measure the conscious status of structural knowledge.

Presumably, conscious structural knowledge leads to conscious judgement knowledge. But if structural knowledge is unconscious, judgement knowledge could be conscious or unconscious. Consider natural language: If shown a sentence one can know it is grammatical and consciously know that it is grammatical, but not know at all why it is grammatical. If both structural knowledge and judgement knowledge are unconscious, then it feels like one is just guessing. If structural knowledge is unconscious but judgement knowledge is conscious, then it feels like one is using intuition. In both cases, we have unconscious structural knowledge. But in the second case, criteria based on confidence ratings (such as the zero correlation and guessing criteria) might show all knowledge is conscious – because those criteria only assess judgement knowledge.

Dienes and Scott (2005) asked participants in the test phase of an artificial grammar learning experiment to indicate the basis of the judgement. Participants could say: 'guess' (the judgement had no basis whatsoever, may as well have flipped a coin); 'intuition' (the participant had some confidence in the judgement, but no idea why it was right); 'rules' (the judgement was based on rules acquired from the training phase that could be stated if asked) or finally 'memory' (the judgement was based on recollections of the training strings or parts of them). The first two attributions (guess and intuition) reflect unconscious structural knowledge and the second two (rules and memory) conscious structural knowledge. People used unconscious structural knowledge attributions about two-thirds of the time. For all attributions people classified significantly above chance, indicating both conscious and unconscious judgement knowledge, and conscious and unconscious structural knowledge. But, taking a sceptical stance, we can ask why should we believe that when participants give these structural knowledge attributions they are actually picking out real differences in their mind? A scientific measure can only ever prove itself by showing its sensitivity to theoretical predictions. Evidence is emerging that the attributions show such sensitivity. For

example, the accuracy of unconscious structural knowledge was unaffected by whether people were forewarned about rules in the training phase or whether people were consciously distracted by a demanding secondary task; conversely, the accuracy of conscious structural knowledge was harmed by being distracted while searching for rules. The structural knowledge attributions may pick out real divisions in the mind. An important question for any conjectured measure is under what conditions the measure picks out real differences, and this remains a matter for future research.

Finally, we will consider how flexibly can people use the knowledge they acquire of artificial grammars. Jacoby (1991) argued that unconscious knowledge was inflexible and so not responsive to one's intentions whether to use it or not. Wan, Dienes and Fu (2008) exposed people to sequences from two grammars in two separate 5 minute intervals. The test phase showed sequences from both grammars but participants were asked to pick from just one of the grammars. Can people strategically choose which grammar to use? The answer is that people can, and for every type of attribution. That is, whether or not judgement knowledge is conscious or not, or structural knowledge is conscious or not, a person can decide to use one grammar and effectively use it. Your intuition can be quite flexible, and be based on useful knowledge, whether or not you know what that knowledge is.

Implicit Learning in the Test Tube: Perceptual motor skills

Implicit learning involves not only coming to judge accurately how well-formed things feel, but also being able to make fast responses in the right situation. In an early study, Nissen and Bullimer (1987) designed a **serial reaction time task**, to investigate the expression of implicit knowledge in the timing of motor responses. A stimulus can appear in one of four locations; for whatever location it appears on a trial, the participant has to press a corresponding button as quickly as possible. To the participant it appears just as a reaction time task. In fact, the sequence of locations is structured. There might be a long fixed sequence of locations (e.g. a sequence 12 locations long), or the sequence might follow a finite state grammar, with paths along the grammar randomly chosen each time. People become faster at responding; but if the sequence is switched for a different sequence, or a random one, people become slow, speeding up again when the original sequence is reinstated. So people have learnt the sequence. Yet often at the end of the experiment people are surprised to hear there even was a sequence.

The knowledge in the serial reaction time (SRT) task has been subjected to extensive testing regarding its conscious status. Objective tests have been used, with participants asked to recognize the sequence, or fragments of it, after training. Sometimes participants fail to recognize the sequence as a whole, seeming to satisfy requirements for the knowledge being unconscious by objective measures. But one always has to ask, what is the content of the knowledge that is claimed to be conscious or unconscious? For example, if people have unconsciously learnt only some fragments of the sequence, this may speed RTs, but not necessarily allow recognition of the full sequence (Perruchet & Amorin, 1992); that is, the participants may have consciously known fragments for all we know. When tested with sequence fragments, people often classify them at above chance levels. But, of course, that does not mean the knowledge was conscious according to the main theories of consciousness. So we need more than objective measures. Destrebecqz and Cleeremans (2001) trained people on an SRT task, then asked people to generate a sequence. In the

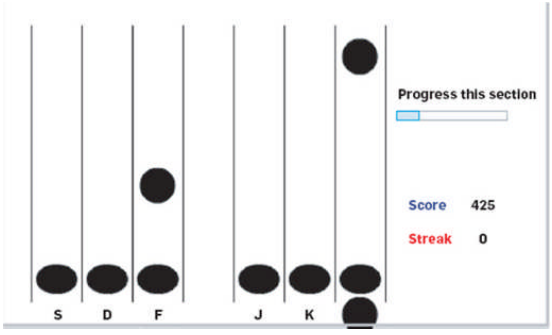
inclusion condition they were asked to generate the same sequence they were trained on; in the exclusion condition they were asked to generate a sequence different from the one trained on. In the inclusion condition people generated correct sequence fragments at above chance levels. That is, by objective measures, people were performing at above chance levels. Conscious knowledge would allow this. But so would unconscious knowledge. Crucially, on the exclusion task, people generated fragments from the sequence at above chance levels. This is opposite to what conscious knowledge would do. So the knowledge was unconscious. What knowledge does this procedure measure the conscious status of? Judgement knowledge (i.e. the knowledge that an item is in the right place in a sequence). If one confidently judges that a production of an item is grammatical one can include or exclude it. But one does not have to know why a production is grammatical. However, given that at least some of the judgement knowledge was unconscious, we can infer some structural knowledge was too (see Fu, Dienes, & Fu, 2010, for the direct demonstration of this claim).

In sum, implicit learning can be shown in the lab, showing we can make accurate decisions even when we do not know that we know anything; or when we know that we know, but we do not know what we know!

Focus Point 6.7

When You Do Not Consciously Know Your Own Password

One problem with passwords or electronic keys for entering a secure site or building is that an attacker can force you to reveal the password, or hand over a hardware key, even when you are far from the building. Bojinov et al. (2014) came up with a cute solution: You learn the password implicitly so that, as you do not consciously know it, you can never reveal it! In the current version of this system, participants are initially trained for 45 minutes on the 'serial interception sequence learning' (SISL) task. Training is done using a computer game to implicitly learn a random password. The game consists of circles gradually falling down the screen in seven columns (see illustration). The goal of the player is to intercept every circle before it hits the bottom; the speed of the circles is adjusted to keep each player just within their ability. The circles follow a fixed long sequence of letters, which can be unique for each person. Bojinov et al. showed that after training, participants could not deliberately reconstruct the trained sequence: Thus it cannot be deliberately revealed to anyone else.



The Serial Interception Sequence Learning Task
Participants have to intercept each circle before it reaches the bottom. In fact, the sequence of circles is fixed.
Source: From Bojinov et al., 2014.

Once they are trained, participants are ready to use their implicit knowledge of their personal sequence as their identification. Over about six minutes, people again perform a version of the SISL task which has a mixture of random combinations of letters and parts of the trained sequence. By performing better on the old rather than random pieces of sequence, the participant validates their identity. While the current system is too time consuming for, say, getting money out of a cash machine, but it could be used for entering a high security site in which one would work for an extended period. Or imagine you are spy in the Far East and one thing you must not do is allow a double agent to extract the ability to enter GCHQ back home!

Focus Point 6.8

Implicit Learning and Subliminal Perception

Implicit learning typically involves seeing the stimuli consciously and acquiring the structural relations unconsciously. So implicit learning and subliminal perception are conceptually different. However, in one sense, in implicit learning, one learns to see the structural relations subliminally. Further, a powerful way of showing that unconscious knowledge of structure can be acquired is by presenting stimuli subliminally. Earlier methods of making stimuli subliminal with back masking were not successful because they did not allow enough time for the learning process to occur. Thus, Atas et al. (2014) presented two sequences rendered below an objective threshold using gaze contingent crowding, which allows presentation of stimuli for much longer than back masking. One sequence was rewarded; the other punished. While people's choices to opt out of receiving the reward or punishment were not sensitive to whether they were about to get a punishment or reward, the speed with which they made the choice was. Clearly the knowledge acquired here is degraded compared to when stimuli are consciously seen, as in the above paradigms, where the implicit learning allowed accurate choices. To develop accurate intuition, it is best to consciously experience the relevant stimuli.

Implicit Learning and Education

If learning can give rise to accurate intuitions, without an explicit understanding of why those intuitions are right, what implications are there for education? Typically formal education is about making sure students have as much of an explicit understanding a possible of the structure of a domain. This need not be the only goal. For example, what we require of an athlete is the ability to perform well, whether or not they understand why their performance is so good. (Conversely, what we require of a coach is an understanding of how and why athletes perform well, regardless of whether the coach can perform well.) Further, it is not obvious that arriving at an explicit understanding is always best served by trying to approach a task explicitly from the start. Here we consider various situations in which implicit learning may play a useful educational role.

One way to acquire a skill is to know consciously how to do every step, then gradually automate the procedure. The resulting knowledge is automatic and conscious. With implicit learning, the acquired knowledge is unconscious from the start. Masters, Maxwell and Eves (2009) showed that people could implicitly learn to hit golf balls to reach a target. To train people, feedback on accuracy was provided either consciously, below a subjective threshold or below an objective threshold. When feedback was below the objective threshold, no learning occurred. When feedback was below the subjective threshold, people became progressively more accurate (though learning was not as fast as when feedback was conscious). So learning can be implicit in a sporting context, i.e. involving unconscious knowledge. Is there any benefit to learning sporting skills implicitly? Maxwell, Masters and Eves (2002) showed that when the learning of golf putting was implicit (so that people acquired few verbally reportable rules compared to explicit learning), it was more resistant to a secondary task. Stressing people with a secondary task especially interfered with the performance of people who had learnt explicitly. Further, if one has conscious knowledge of a sporting skill, put under pressure one might be more likely to 'choke' (think too much about what one is doing so that it disrupts performance) than if the knowledge is implicit. Good coaching will involve encouraging a balance of the implicit and explicit, according to the individual (Masters & Maxwell, 2008).

Comment [NN10]: Insert link to https://www.youtube.com/watch?v=SUdTxXkecr8

Focus Point 6.9

Intuition and Learning Mathematics

It might seem obvious that sporting moves and complex language structures can be learnt implicitly; but what about knowledge of mathematics? Surely mathematics can only be learnt explicitly? However, mathematicians often have the experience of answers just coming to them – the next stage after arriving at the answer is working out why it is the right answer (e.g. Poincare, 1913). Indeed, Z. P. Dienes (e.g. 1960) developed an approach to teaching mathematics to children that was based on building an intuitive understanding of mathematics before making the structures explicit. According to this method, children first play freely with structured materials that can embody a mathematical concept or structure (for example, the materials could involve coloured blocks of different sizes; for examples see http://www.zoltandienes.com/math-games/). Then children are given progressively more constrained games with the same materials until children's choices in the games mean they are following a given mathematical structure. Next the process is repeated for the same structure but with a completely different sensory motor embodiment (for example, dance steps or song; Z. P. Dienes, 1973). After the child has experienced a few such embodiments of the same structure, he or she can play the 'meta-game' that is the game of finding the correspondences between the games. When this has been achieved the child is finally ready to appreciate the structure explicitly. Thus, on this approach, a process of building up an intuitive understanding in several different concrete situations always precedes even the attempt to teach an explicit and fully abstract understanding of mathematics. The role of unconscious knowledge in this process has yet to be properly explored, but anecdotally children sometimes guess accurately in these games without being able to say why they gave the responses they did (for pedagogical evaluation, see Klein, 1987; Sriraman, 2008). So asking people to work out the structure consciously from the beginning might not be optimal, even for

learning mathematics. First it might be good to hone one's intuitions – and then use those intuitions to guide an explicit understanding. Further research is needed for how developing unconscious knowledge may or may not be useful in the classroom (cf. Sætrevik, R. Reber, & Sannum, 2006).

Finally, consider learning a second language as an adult. To what extent should one be memorizing explicit grammatical rules or rather be immersed in the language environment to soak up the rules unconsciously? Can one acquire second language rules unconsciously - or must one first always consciously notice them? There is recent evidence that adults can learn aspects of a second language unconsciously. Rebuschat and Williams (2012) presented English participants with sentences composed with English words but German syntax (grammar) determining word order. Thus, the sentences were understandable to the participants, even if they sounded funny ('Since his parents groceries needed, purchased David everything necessary'). On a later test with the structural knowledge attributions of Dienes and Scott (2005), when people gave unconscious structural knowledge attributions, they were sensitive to rules of German syntax. Further, people did not freely state any regularity relevant to key rules the participants were in fact sensitive to. That is, the rules could be acquired unconsciously. In a similar way, Leung and Williams (2011) and Chen et al. (2011) showed people could learn to use different made-up words (e.g. 'chu', 'yu') to mean 'that' depending on whether the noun was living or non-living ('chu dog' vs 'yu bag') - and structural knowledge attributions, among other measures, indicated that people made their choices without consciously realizing that the choice was based on the noun being living or non-living.
If syntax can be learnt implicitly, learning word meanings might seem to be something that can be learnt explicitly quite readily, by dictionary definitions or translations. However, words can have subtle conditions on their use not captured by dictionary definitions. For example, the word 'cause' may seem to have the simple meaning 'to bring about'. But the word is in fact largely used in contexts in which a negative rather than positive event has been brought about (one may 'cause grief' but it sounds slightly odd to 'cause happiness'): We say 'cause' has a 'negative semantic prosody'. This latter aspect of meaning is subtle and hence may not be noticed explicitly. Indeed, Guo et al. (2011), using structural knowledge attributions, showed people could learn to use certain made-up words in positive or negative contexts, without participants realizing they were choosing the word because of the context being positive or negative. That is, people gained unconscious structural knowledge of semantic prosody.

Comment [NN11]: Insert link to http://www.cam.ac.uk/research/news/unconscious-language-learning

In sum, various regularities in a second language, from syntax to semantic prosody, can be learnt unconsciously, as indicated by subjective measures. When learning a second language, make sure you listen and repeat sentences in real concrete contexts so that you soak up all the subtleties, even those which are not in grammar books, nor in dictionaries, nor even consciously noticed by yourself.

Section Summary

- Implicit learning is the acquisition of unconscious knowledge about the structure of the environment.
- Implicit learning typically involves seeing the stimuli consciously and acquiring the structural relations unconsciously.

- The artificial grammar learning paradigm introduced by Reber (1967, 1989) was inspired by natural language as an example of implicit learning. It often makes use of finite state grammars.
- Nissen and Bullimer (1987) designed Serial reaction Time Task to investigate the expression of implicit knowledge in the timing of motor responses. The knowledge in the serial reaction time (SRT) task, as in artificial grammar learning, has been subjected to extensive testing regarding its conscious status.
- Implicit knowledge can give rise to accurate intuitions, when one knows one has knowledge but not what that knowledge is; implicit knowledge can also give rise to accurate guesses, when one is not aware of even having any knowledge at all.
- Typically formal education is about making sure students have as much of an explicit understanding a possible of the structure of a domain. However, what we require of an athlete, for example, is the ability to perform well, whether or not they understand why their performance is so good. The coach needs an understanding of how and why athletes perform well, regardless of whether the coach themself can perform well.
- Many aspects of a second language can be acquired unconsciously

Test Yourself

1. What is implicit learning?
2. In what everyday situations might implicit learning play a role?
3. How can implicit learning be shown in the lab?
4. How can subjective measures be applied to testing implicit learning?

Conscious versus Unconscious Intentions: Volition and Hypnotic Response

So far we have considered how memory, perception and knowledge can be unconscious. What about other mental states – how about intentions? Can a person intend to perform an action, but think that they had no such intention? In such a case we would end up doing things we did not consciously intend. Such a notion may seem to strike deeply at a conception of ourselves as in charge of our 'selves' – and it may have relevance to certain psychiatric conditions, like schizophrenia, where people may do things that they do not experience themselves as having intended to do.

Choice Blindness

Johansson, Hall, Sikström, and Olsson (2005) showed people pairs of pictures of female faces, and asked them to choose which one they found most attractive. That sounds straight forward, but the experimenters were trained conjurors and they secretly swapped one face for the other. On these trials, the outcome of the choice became the opposite of what the person intended. Nonetheless, on only a quarter of trials did people notice the swap. On the remaining trials people were perfectly willing to give justifications for their 'choices'. The authors called this phenomenon 'choice blindness'. (Interestingly, people in the long run come to prefer the choices they believed they had made, but hadn't really (Hall et al., 2014); remember Focus Point 6.2 on dissonance reduction, where this effect is predicted by dissonance theory.) Hall et al. (2010) showed the same effect with tasting foods: They invited shoppers at a supermarket to try different varieties of jam and tea and indicate their preference. When the choice had been swapped, and even for rather different tastes

like Cinnamon-Apple versus bitter Grapefruit, on a majority of occasions people did not notice and were quite willing to give justifications for their 'choice'. Amazingly, people are also often prepared to justify political views they thought they had indicated as their own, but actually had rejected (Hall et al., 2013).

Comment [NN12]: Link to https://explorable.com/choice-blindness

These examples indicate how the reasons we give for our actions cannot always be the actual basis of our actions. We may well believe the explanations we provide to the world, but in many cases the justifications are post hoc rationalizations for actions whose actual basis we are no longer aware – if we ever knew them in the first place. This does not mean we never act on prior conscious intentions: People were not choice blind on all trials. But it does mean we can easily fool ourselves. In choice blindness, we are aware of intentionally making a choice, it is just we actually made one choice and believe we made another. Next we consider if we can intentionally perform an action while believing it was not intentional at all.

Ideomotor Action and Hypnotic Response

Tie your keys to a piece of string to make a pendulum, and hold the string between thumb and forefinger, with the keys free to swing. Imagine the keys going around and around. After some seconds of such imagining, many people will find the keys begin moving around, as if by themselves. You can tell that it is you yourself making the motion though, because if you imagine the keys circling in the opposite direction, or in a straight rather than a circular motion, you will likely find the keys moving in just that way. This effect of imagination on movement is known as **ideomotor action**, and the use of a pendulum to illustrate it is known as Chevreul's pendulum (after the French Chemist, Michel Chevruel, 1786–1889, who first showed the pendulum's movement is governed by psychological and not supernatural principles; see Wegner, 2002). Ideomotor action is partly based on the fact that when we imagine actions, small contractions of the corresponding muscles happen. The pendulum can magnify these small movements. Such magnification could also be produced by, for example, a dowsing rod, or the combination of several people gentle pushing on a cup on a Ouija board. The effects of these magnifiers of small motions can be so compelling that many lay people throughout history have thought a supernatural explanation was necessary, not purely the effect of imagination. (A fourth-century Roman called Hilarius had previously used Chevreul's pendulum - and was as a consequence tortured by the Emperor for using magic; Wegner, 2002. Next time someone tells you that the direction of a pendulum you hold indicates your allergies or the gender of your baby, just know that they are being Hilarius.) However, we still need to say more about some ideomotor actions that are too large or complex to be simply accounted for by small muscular movements.

On every continent, and all through human history, people have had the experience of being possessed by spirits. When possessed, the person can engage in complex tasks or arguments, while it seems to them that it was not them doing it – it was the spirit. Nonetheless, the outcomes are often favourable to the possessed person, in terms of gaining goods or status (Lewis, 2003). That is, spirit possession often seems to be a goal-directed activity where a person is not aware of the intentional nature of their own actions. As possession often seems beneficial, it is possible we evolved a mechanism that allowed it to happen – a mechanism that allowed us to convince others of there being a spirit possessing us by first convincing ourselves with self-deception (Dienes & Perner, 2007). The phenomenon comes to us in several forms. For a contemporary case of spirit possession, consider the State Oracle of Tibet, a monk who channels a protector deity that gives important advice of state to the Tibetan Government (now in exile), which the monk experiences as not

produced by himself. The same phenomenon appears as people being influenced by inner energy or ki being projected at a distance, throwing people around or knocking them out. Consider also people talking in tongues, possessed by the Holy Spirit, in Evangelical churches. These experiences are typically subjectively compelling to those that have them. But can we study them in the lab to investigate what is really going on?

Fortunately one version of the phenomenon comes to us in an easily reproducible way. In the 18th century when possessions and exorcisms were common in Europe, the convulsions involved apparently became the model for how to behave when Anton Mesmer (1734–1815) decided to manipulate magnetic fields around people (by 'mesmerizing' them) (Lynn & Kirsch, 2006). Later one of Mesmer's pupils mesmerized a peasant on his estate, Victor Race, but Victor was not part of high society and did not know that convulsing was the thing to do. Instead, for reasons known only to himself, Victor decided that the proper thing to do was to act like he was somehow asleep. The idea caught on. And hence hypnosis was born: The notion of a sleep-like state in which one performs actions one did not intend to do (for summaries of recent research on hypnosis, see http://hypnosis.tools). In fact, hypnosis has nothing to do with sleep; physiologically speaking, person is not in any way in a sleep-like state, and people can respond to hypnotic suggestions just as effectively while riding a stationary bike as when feeling drowsy (Banyai & Hilgard, 1976). But hypnotic response does involve experiencing actions as if they were involuntary, just as in spirit possession.

Hypnotic actions can be as complex as one wishes to suggest, given only that the voluntary version of the action is within the normal repertoire of the subject: From an arm rising by itself to automatic writing. As many as 90 per cent of people can experience the easier hypnotic suggestions, and about 10 per cent of people are highly hypnotizable. This means that hypnotic response can be easily studied in the lab. Why does it seem to people that the hypnotic action is involuntary? One type of theory is that hypnotic actions feel involuntary because they are involuntary, that is, they are not produced by normal intentional processes (Kirsch, 1985; Woody & Sadler, 2008). For example, according to response expectancy theory (Kirsch, 1985), strongly expecting an action to happen (e.g. your arm rising by itself) is sufficient to make the action happen. One does not need to intend to lift one's arm; there can just be the expectation of it lifting. In effect, hypnosis is a type of placebo. The theory is elegant in being simple, but unfortunately, hypnotic response is not completely accounted for by expectations (e.g. Benham, Woody, Wilson,& Nash, 2006). Another type of theory argues that hypnotic actions are produced intentionally but feel involuntary because we are not aware of those intentions (e.g. Hilgard, 1977; Spanos, 1986). Dienes and Perner (2007) called the common component of the latter type of theory 'cold control', and suggested considering it as the single mechanism of hypnotic response. That is, according to the theory, hypnotic response involves executive control (the intentional performance of a cognitive or motor action) without accurate higher order thoughts (HOTs) of intending; indeed, with inaccurate HOTs ('I am not intending this action'). Hypnotic response is control without accurate HOTs – cold control.

Spanos (e.g. 1986) and Hilgard (e.g. 1977) provided evidence for the strategic and intentional nature of hypnotic response (for a recent counter argument that hypnosis can involve automatization, see Lifshitz et al., 2013). In one example, Spanos et al. (1987) gave highly hypnotizable subjects ('highs') the post-hypnotic suggestion that they would rub their eyebrow whenever they heard the word 'experiment', over the next 48 hours. Indeed, highs almost without exception rubbed their eyebrow at the end of the first session when told that the experiment was over, and again in two days when they came back to the hypnosis lab for the next experiment.

Comment [S13]: Link to https://www.youtube.com/watch?v=l2oQM92om14

Comment [S14]: Link to https://www.youtube.com/watch?v=gEDaCIDvj6I

Comment [ZD15]: Link to: http://digitalstories.wellcomecollection.org/pathways/1-mindcraft/1-mesmer/index.html

Comment [NN16]: Link to: NO TV HYPNOSIS PLEASE! (It is mainly faked). Use this one instead: https://www.youtube.com/watch?v=BJHgtYTzimQ

However, in between, a confederate with photos of the subjects, managed to find each subject and bump into them on campus, asking for the way to 'professor Smith's physics experiment'. None of the subjects rubbed their eyebrow. That is, they only responded to the suggestion when it served a personal purpose. That does not mean highs were faking when they did respond; it means a response that genuinely felt involuntary was constructed to occur so as to fit in with the subject's overall goals. In one sense, then, the person responding hypnotically is still in charge of themselves, even if it feels to them like they are not.

In sum, while there is not yet consensus about the mechanism of hypnotic response, a common type of theory is that hypnotic response involves having intentions that the person is not aware of having. The person feels their actions and experiences have a cause other than themselves. This may have been useful in a historical, and perhaps evolutionary, context to convince oneself and hence others that one is in contact with a higher power. In modern times, this phenomenon has surfaced as hypnosis – and the higher power is often presented as 'the unconscious'. In a therapeutic setting, being convinced that one is in touch with special powers, and the therapy will therefore be very effective, may indeed increase the effectiveness of therapy (Kirsch, Montgomery, & Sapirstein, 1995).

Section Summary

- The idea that we would end up doing things we did not consciously intend conflicts with the concept that we are in charge of our selves.
- It may have relevance to certain psychiatric conditions, like schizophrenia, where people may do things that they do not experience themselves as having intended to do.
- The reasons we give for our actions cannot always be the actual basis of our actions.
- Sometimes we think we want A but when we are mistakenly led to believe that we had actually chosen B, we make up all kinds of reasons for why B is a much better alternative and how we actually wanted it all along. This is called choice blindness.
- The effect of imagination on movement is known as ideomotor action.
- Ideomotor action is partly based on the fact that when we imagine actions, small contractions of the corresponding muscles happen
- Some ideomotor actions that are too large or complex to be simply accounted for by small muscular movements can be explained by the fact that the outcomes are often favourable to the possessed person.
- When responding hypnotically, we perform actions it seems as if we did not intend. As many as 90 per cent of people can experience the easier hypnotic suggestions, and about 10 per cent of people are highly hypnotizable.
- Theories of hypnosis can be divided into those that postulate that the subject did not intend the hypnotic action; and those that postulate that the subject did intend, but was not aware of the intention. The latter sort of theory is called cold control.
- According to response expectancy theory the strong expectation of an involuntary action is sufficient to make the action happen, with no intentions needed.
- According to cold control theory, hypnotic response involves more than response expectancies; it also involves executive control.

- In a therapeutic setting, being convinced that one is in touch with special powers, and the therapy will therefore be very effective, may increase the effectiveness of therapy.

Test Yourself

1. What is choice blindness?
2. What is ideomotor action?
3. What is cold control theory?

Interactivity 6.6 – Before you go on

Conscious versus Unconscious Attitudes and Emotions

If You Have Attitude, Must You Know It?

An 'attitude' to a social psychologist is a positive or negative evaluation. We saw previously how subliminal presentation of a stimulus can make someone like that stimulus more – the 'mere exposure' effect (Bornstein & D'Agostino, 1992). In that case, the initial perception was unconscious and the consequent liking was conscious. Could the liking, or attitude, itself be unconscious? Some evidence for this was provided by Adams, Wright, and Lohr (1996). They divided heterosexual men according to a questionnaire that measured homophobia. All participants were exposed to sexually explicit erotic films, and changes in penile circumference were monitored (with a device called a 'penile plethysmograph') to provide an objective measure of the extent of any erection. Both homophobic and non-homophobic men obtained erections looking at film clips involving sex with women. But the homophobic men were considerably more aroused by male homosexual clips than the non-homophobic men. One plausible theory is that homophobes have unconscious positive feelings about gay sex. Or maybe homophobes are reacting to their purely conscious feelings, feelings they just didn't want to explicitly inform people about. Further research is needed.

To obtain evidence for an unconscious attitude we need a way of measuring attitude that is not based on self-report; indeed, a measure that can contradict self-report in order to show that the attitude is unconscious. The implicit association test (IAT) provides one possibility (see Banaji and Greenwald, 2013, for a popular summary). On this test, a sequence of words appears on the screen. The aim is to classify the words by pressing a left or right button – the left button for pleasant words (like gentle, enjoy, and so on) and the right button for unpleasant words (poison, death, and so on). The trick is that in addition one makes another classification using the same keys – for example, names of black people with the left button and white people with the right button. The task is repeated with all possible combinations of responses (e.g. black and unpleasant on the right and white and pleasant on the left). The question is, is a person faster when white rather than black is paired with pleasant rather than unpleasant? If so, that would indicate prejudice for white people and against black people. And the prejudice would be implicit if people explicitly believed in racial equality. The task can be used to measure prejudice for all sorts of groups, for example, old versus young, fat versus slim, and so

Activity 6.1

Try yourself out on a number of these IAT tasks by visiting the Harvard website given in the link below.

Comment [NN17]: Link to: https://implicit.harvard.edu/implicit/.

An initial key finding was that a greater proportion of people were measured as prejudiced by the IAT task than by their explicit reports for many types of prejudice (Banaji & Greenwald, 2013). But does this mean that people's negative attitudes to certain groups were unconscious? Maybe; or maybe, like having homosexual desires, people explicitly under-report socially difficult attitudes they are nonetheless aware of. Or the IAT may indeed measure automatic tendencies – that one is aware of. According to Gawronski and Bodenhausen (2006), attitudes as measured by the IAT reflect spontaneous reactions, regardless of whether one thinks that these reactions are valid or invalid. Conversely, self-reported attitudes result from working out one's beliefs based on consistency with any other relevant belief (e.g. that all people should be treated equally, regardless of race). Thus, a person might decide that an initial reaction to a person of a different race is inconsistent with their general values and commitments – and thus give different explicit reports than their IAT indicates. A person could be entirely aware of his or her implicit attitude, but quite rightly and honestly not report it as an explicit attitude. Hahn, Judd, Hirsh, & Blair (2014) directly tested this idea by asking people to predict their IAT scores for a range of groups they could be prejudiced to; their predictions correlated about 0.6 with their actual scores. That is, people seemed quite aware of what their automatic attitudes were. This occurred despite explicit reports of prejudice having a small correlation with the IAT – that is, one's considered opinion need not be the same as an immediate reaction. The IAT may measure automatic evaluative associations, but that doesn't mean the attitudes are unconscious. Whether the IAT, or similar measures, can pick up on unconscious attitudes in some contexts remains a tantalizing topic for future research.

Berridge and Robinson (1995) argued that liking and wanting are separate; and in particular a drug addict comes to crave – to want – their fix more and more even as they like its effects less and less. Further, they argued that this wanting could be unconscious. For example, heroin addicts asked to press lever to obtain solutions of morphine, rated a very small dose of morphine as worthless and containing no drug, but worked very hard to get it by lever pressing – in fact as hard as for moderate doses they explicitly rated as worthwhile (Lamb et al., 1991). Further, addicts given a certain drug, Disipamine, said the drug took away all their craving for cocaine – but they continued to work for the drug just as hard (Fischman & Foltin, 1992). In these cases, unconscious wanting exerted just as powerful an effect on people as conscious wanting. In sum, the evidence for unconscious liking is not yet substantial. The evidence for unconscious wanting is intriguing – we will see if these effects can be replicated. In both cases, conscious liking and wanting is measured with subjective measures: Expressions of higher order thoughts of liking or wanting.

Unconscious Emotions

It might seem strange to conjecture that emotion could be unconscious. Is not the whole point of an emotion how we consciously feel? Could we really be happy and not know it?? But the issues are just the same as for perception. Normally when we say that Bill saw the dog we mean that he consciously saw it. But such everyday usage of 'see' does not mean that subliminal perception does not exist. Similarly, we can disentangle those aspects of an emotion that could be unconscious from the conscious experience. An emotion involves an appraisal of a situation: fear would not be fear if it did not involve expecting something bad to happen imminently; anger would not be anger if one did not believe an insult or injustice had been committed; and so on. Emotion also involves systematic

cognitive changes (e.g. narrowing of attention, focus on certain sorts of information), physiological changes (in heart rate, blood pressure, breathing, hormone levels), and behavioural changes (e.g. acting out revenge in the case of anger; changes in facial expressions, etc). There is no logical reason why the appraisals and cognitive, physiological, and behavioural changes need be conscious as such (for reviews from different perspectives, see Barrett, Niedenthal, & Winkielman, 2005). Indeed, reports of people realizing that they had been in love all along, or that they had not been in love for some time, or that they were anxious, or no longer anxious, or they notice that they had a spring in their step, are not uncommon in literature and biographies.

A strategy for demonstrating unconscious emotion is to induce in people behavioural or other objectively measurable changes associated with the emotion under conditions in which the person reports no change in their emotion. The area has not been thoroughly investigated but there are some promising results (for discussion, see Winkielman, Berridge, & Sher, 2011). According to Winkielman, Berridge, and Wilbarger (2005), when in a positive rather than negative mood, people will value and consume more of, for example, a (non-alcoholic) beverage. Consumption can then be used as one index of mood – even if the mood were unconscious. Winkielman et al. exposed participants to several subliminal emotional facial expressions (either happy, neutral, or angry). Exposure to a given emotional expression did not significantly change participant's rated emotion. However, people exposed to the happy rather than angry face consumed more of a novel beverage and rated it more highly. Further, Tong, Tan, and Tan (2013) found that the subliminal prime of 'unfair' rather than 'fair' produced a more angry facial expression - without significant change in rated emotion.

In sum, the body of evidence for unconscious emotion is not yet substantial, but, as in the previous section, the evidence is intriguing. Note that, also as in the last section, the conscious status of the mental state (in this case, emotion) is measured with subjective measures: Expressions of higher order thoughts of being in a certain state.

Section Summary

- To obtain evidence for an unconscious attitude we need a way of measuring attitude that is not based on self-report.
- One way of doing this is by using the implicit association test (IAT).
- An initial key finding from the use of the IAT was that a greater proportion of people were measured as prejudiced than by their explicit reports for many types of prejudice (Banaji & Greenwald, 2013).
- According to Gawronski and Bodenhausen (2006), attitudes as measured by the IAT reflect spontaneous reactions, regardless of whether one thinks that these reactions are valid or invalid.
- Berridge and Robinson (1995) argued that liking and wanting are separate; and in particular a drug addict comes to crave – to want – their fix more and more even as they like its effects less and less. Further, they argued that this wanting could be unconscious.
- It might seem strange to conjecture that emotion could be unconscious. However, reports of people realizing that they had been in love all along, or that no longer anxious, are not uncommon in literature, so it is conceptually possible to not be aware of what emotion one is in. Further, there is beginning to be evidence for the existence of unconscious emotions.

Test Yourself

1. What is the Implicit Association Test? Does it measure unconscious attitudes?
2. What sort of evidence could show that an emotion was unconscious?

FUNCTIONS OF CONSCIOUSNESS

Expert opinion on the function or functions of consciousness spans the full spectrum of possibilities illustrated in Figure 6.9. On one end is the view that the unconscious does not exist; any mental state is conscious and therefore consciousness is required for any mental functioning (e.g. Dulany, 1991). This view requires dismissing the evidence we have reviewed for the existence of unconscious memories, perceptions, knowledge, intentions, desires, and emotions. (As the evidence has largely relied on subjective measures, the sceptic is often drawn to denying the validity of subjective measures.) At the other end of the spectrum, are those that deny consciousness has a function, or maybe just the function of post hoc rationalization (e.g. Wegner, 2002). This view requires dismissing evidence for differences found between conscious and unconscious processing, particularly those finding that conscious states are especially effective.

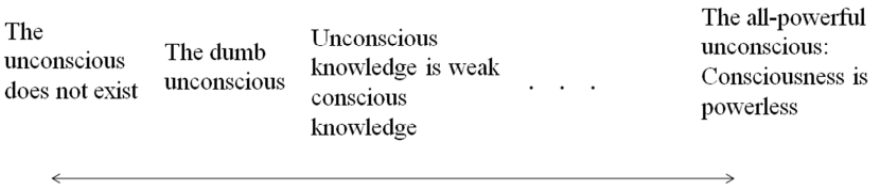


Figure 6.9 The Functions of Consciousness

The main theories of consciousness suggest different sorts of function (Seth, 2009). According to higher order theory, in principle anything that can be achieved by mental states that have content only about the world can be achieved unconsciously. For example, detecting that things are present, picking them up, retrieving information about the past, and intending to perform actions could all be achieved unconsciously. Thus, the higher order view tends to put the function of consciousness towards the right of Figure 6.9. Nonetheless, higher order theories require conscious mental states for any control or regulation that is dependent on knowing one is in a certain state. For example, fear might be best dealt with by running as fast as one can; or by judging that the fear was irrational and one should confront or reappraise the situation to overcome the fear. Conscious emotion enables this judgement. Integration theory associates consciousness with the process of efficiently combining integration and differentiation; thus conscious decisions will be more optimal than unconscious decisions when there are many discriminations to be integrated (Seth et al, 2011). On this account, we can perceive unconsciously but conscious perception will be richer. Thus, the integration view tends to put the function of consciousness towards the left of Figure 6.9.

And what does the evidence say? With not enough to draw firm conclusions we leave you to draw your own conclusions – and invite you to read the revised version of this chapter in 10 years' time to find the answer!

FUTURE DIRECTIONS

Research into conscious versus unconscious processes is an increasingly active area, involving researchers from disciplines from neuroscience to social psychology. Multi-disciplinary work is in progress motivated by both main approaches to consciousness. A key issue for integration theories is refining measures of how the brain jointly integrates and differentiates information. Current work on such measures is proving promising in distinguishing different levels of consciousness (e.g. Fecchio et al, 2015), though difficulties remain in putting the different measures into practice and properly testing them. Can we come up with measures that would indicate when an unresponsive or paralyzed person is still having conscious mental states? Or measures that would indicate when a baby is conscious? Or an animal? A key issue for higher order theories is also developing better ways of measuring mental states about mental states, so as to ascertain which animals can have higher order thoughts (e.g. Couchman et al 2012) or when mental states are conscious or unconscious (Sherman, Barrett, & Kanai, 2015). Current developments in neuroscience (under the name of "the Bayesian brain" or "predictive coding") are modelling the way brain works in terms of predictions or expectations from the centre forming the basis of perceptions (Clark 2013, Seth 2014). Such models involve feedback loops (top down and back again; or perhaps better phrased, inside from the centre out and back again) of the sort that could potentially link to higher order, integration or re-entry theories of consciousness. Work still needs to be done on understanding the neural basis of both integration and higher order states (which, we speculate, will involve understanding how those processes involve the Bayesian brain). Once we begin to understand the physiological processes underlying consciousness, both in terms of well integrated first order states and the higher order states about them, implementing those processes in artificial intelligence should prove a useful test bed of theories.

Chapter Summary

This chapter has considered how we can define the notion of consciousness. We did this by first outlining the major theories of consciousness: higher order theories and integration theories. We then moved on to a consideration of the evidence for unconscious mental states. We started by examining unconscious memory and the role it plays in perception, liking, and controlling our behaviour. We moved on to explore subliminal perception and how it can shed light on attention, advertising, the neural correlates of consciousness and control. We then discussed implicit learning and concluded with a consideration of how intentions, desires and emotions can be unconscious and the impact of this on theories about the function of consciousness.

Key Terms

anchoring: A form of irrational priming in whichpeople given a number for any reason, subsequently bias their estimates of a quantity (date, price, temperature, and so on) towards the given number.

artificial grammar learning (AGL): A method for exploring implicit learning in the lab inspired by natural language as a prominent everyday case of acquiring unconscious knowledge. An artificial grammar is a set of rules for sequencing items.

backward masking: A masking stimulus is shown very shortly after the target stimulus; the mask may interfere with conscious processing so that the resulting perception is subliminal.

blindsight: People with blindsight have had damage (usually due to a stroke) to a part of their visual cortex called V1, the first area of the cortex that visual information reaches. They consider themselves blind in that part of their visual field but can be persuaded to guess about the properties of objects in their blind field.

conscious content: What a conscious mental state is about. For example, if one consciously feels an itch, the conscious content is the itching.

conscious level: The degree of consciousness one has, from the lowest level of being in a coma, though sleep, to fully alert and having a rich complex experience.

content: What a mental state is about. For example, if you were thinking about unicorns, the content is unicorns.

continuous flash suppression (CFS): A method for allowing a subliminal stimulus to be displayed for considerably longer than 100ms, relying on the phenomenon of *binocular rivalry* to keep one image suppressed

creature consciousness: Term introduced by the New York philosopher, David Rosenthal, corresponding roughly to one everyday definition of consciousness, namely that 'the creature' (or person) is awake, responsive to the world, rather than asleep or knocked out.

gaze contingent crowding (GCC): A method for exploring subliminal perception that relies on the fact that stimuli in the periphery can be processed unconsciously.

global workspace: A processing space which makes all information within it available to any processor which might use that information. That is, the contents of the workspace are broadcast globally to be used in any way the system knows how.

higher order thought (HOT): A thought which asserts that one has a (lower order) mental state, thereby making one aware of having that mental state. The higher order thought "I see the grass is yellow", makes one aware of seeing that "the grass is yellow."

ideomotor action: The effect of imagination on movement.

implicit learning: A term coined by Arthur Reber in 1967 to describe the acquisition of unconscious knowledge about the structure of the environment.

information integration: A process by which different elements of a system (e.g. neurons in brain) come to share information, thereby unifying the processing all the elements do. In a system complex enough to support consciousness, elements will both share information and also contribute their own unique information.

mere exposure effect: A term coined by Zajonc (1968,1980), which refers to how exposure to a novel stimulus can lead people to like it more.

neural correlates of consciousness (NCC): Processes in the brain which are correlated with conscious awareness.

objective threshold: The point where people are objectively at chance.

objective measures: Measures that involve asking the person to discriminate what state the world is in. See also *subjective measures.*

priming: The increase in accuracy or speed in performing a task because the stimulus has been presented before.

process dissociation procedure (PDP): A procedure outlined by Jacoby, Toth, Lindsey and Debner (1992), which attempts to separate consciously controlled and automatic processeses by asking participants either to choose the same response as would be automatically produced, or to choose the opposite response as would be automatically produced. The question is the degree to which people can overcome their automatic habits.

re-entrant processing: A theory of conscious content which says that a mental state becomes conscious when it elicits a wave of 'feedback' or 're-entrant' neural processing (Lamme, 2010).

serial reaction time task (SRT): A structured reaction time task designed to investigate the expression of implicit knowledge in the timing of motor responses.

stimulus onset asynchrony (SOA): In empirical research exploring conscious versus unconscious perception, the SOA is the time from the beginning of the target to the beginning of the pattern mask. Typically measured in milliseconds (thousandths of a second), the critical SOA is different for different people.

subjective threshold: The point at which a person believes that they are performing at chance.

subjective measures: Measures that involve a person determining what mental state they are in. See also *objective measures.*

Web Links

Links to articles on disorders of consciousness:
http://onlinelibrary.wiley.com/doi/10.1002/wcs.1270/abstract
http://jnnp.bmj.com/content/82/3/332.short

Links to prominent research groups in consciousness science:
http://www.sussex.ac.uk/sackler
http://www.unicog.org

Other resources on consciousness:
http://www.newscientist.com/special/consciousness
http://www.scholarpedia.org/article/Category:Consciousness
http://www.neurobanter.com/

Field Code Changed

Essay Questions

1. What would count as evidence for subliminal perception on integration theories of consciousness? How strong is such evidence for subliminal perception?

2. What role do unconscious processes play in learning?

3. Advanced (for final year students): Consider the findings in an empirical paper published in the journal *Consciousness and Cognition* or *Psychology of Consciousness: Theory, Research, and Practice, Frontiers in Consciousness Research, or Neuroscience of Consciousness* that establishes whether a mental state is conscious or unconscious, and discuss how these findings would be explained by (1) a higher order theory of consciousness, and (2) a global integration theory of consciousness.

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