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Introduction to the Philosophy of Cognitive Sciences

Tuesday, February 14, 2023
8:08 PM

Philosophy and the Sciences: Introduction to the Philosophy of Cognitive Sciences

by The University of Edinburgh

About this Course

Course Description What is our role in the universe as human agents capable of knowledge? What makes us intelligent cognitive agents seemingly endowed with consciousness? This is the second part of the course 'Philosophy and the Sciences', dedicated to Philosophy of the Cognitive Sciences. Scientific research across the cognitive sciences has raised pressing questions for philosophers. The goal of this course is to introduce you to some of the main areas and topics at the key juncture between philosophy and the cognitive sciences. Each week we will introduce you to some of these important questions at the forefront of scientific research. We will explain the science behind each topic in a simple, non-technical way, while also addressing the philosophical and conceptual questions arising from it. Areas you'll learn about will include: Philosophy of psychology, among whose issues we will cover the evolution of the human mind and the nature of consciousness. Philosophy of neurosciences, where we'll consider the nature of human cognition and the relation between mind, machines, and the environment. Learning objectives Gain a fairly well-rounded view on selected areas and topics at the intersection of philosophy and the sciences Understand some key questions, and conceptual problems arising in the cognitive sciences. Develop critical skills to evaluate and assess these problems. Suggested Readings To accompany 'Philosophy and the Sciences', we are pleased to announce a tie-in book from Routledge entitled 'Philosophy and the Sciences for Everyone'. This course companion to the 'Philosophy and the Sciences' course was written by the Edinburgh Philosophy and the Sciences team expressly with the needs of MOOC students in mind. 'Philosophy and the Sciences for Everyone' contains clear and user-friendly chapters, chapter summaries, glossary, study questions, suggestions for further reading and guides to online resources. Please note, this companion book is optional - all the resources needed to complete the course are available freely and listed on the course site.

Show less

Taught by:[Professor Michela Massimi](#), Full Professor
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From <https://www.coursera.org/learn/philosophy-cognitive-sciences/home/info>

Stone Age Minds

Tuesday, February 14, 2023
8:17 PM

Scientists agree that our brains are a product of natural selection. How did human brains and human cognitive structures evolve ?

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/home/week/1>

This week, we will explore scientific interpretations of how our minds evolved, and some of the methodologies used in forming these interpretations. We will relate evolutionary debates to a core issue in the philosophy of mind, namely, whether all knowledge comes from experience, or whether we have ‘inborn’ knowledge about certain aspects of our world.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/home/week/1>

Hi, my name's Kenny Smith,
I'm a Reader at the Language Evolution Group at the University of Edinburgh.
>> Hi, my name's Dr. Suilin Lavelle, and I'm a Lecturer in Philosophy at the School of Philosophy, Psychology, and Language Science at the University of Edinburgh.
Play video starting at ::22 and follow transcript0:22
We here today because we want to tell you a little bit about human cognition.
and in particular how human brains and human cognitive structures evolved.
Play video starting at ::32 and follow transcript0:32
There's a really old debate in philosophy which can be traced back to
Plato's Meno dialogues, possibly even earlier.
About whether we can have knowledge which isn't learned, or
whether all our knowledge comes from our experience of the world.
Play video starting at ::46 and follow transcript0:46
Much later, the philosopher John Locke argued that the mind had to be
a blank slate, and that all the knowledge that we have comes from experience,
comes from living in the world.
And he was challenged by Gottfried Leibniz, who said no,
no there have to be some structures.
Some kind of knowledge that we have that isn't learned.
Play video starting at :1:6 and follow transcript1:06
Now no one takes an extreme view of these positions these days.
No one thinks that we have, that all our knowledge isn't learned, or
that all our knowledge comes from experience.
Play video starting at :1:15 and follow transcript1:15
And what we'd like to talk you through today is how this debate has evolved.
Play video starting at :1:20 and follow transcript1:20
I'm going to introduce a view called evolutionary psychology.
Which says that we have lots of knowledge which isn't learned.
And that we can support this by appeal to theories of natural selection.
Then I'll hand over to Kenny.
Play video starting at :1:33 and follow transcript1:33
>> And I'm going to focus on social learning and culture.
And in particular, I'm going to argue that lots of interesting human behaviors,
including really important ones like language,
can be explained as a product of culture and cultural evolution.
>> Natural selection is a really complex concept.
And unfortunately, we don't have time to go through today all
the different interpretations of the view.
If you'd like to find out more about what natural selection is,
you can take a look at some of the further readings at the end of this module.
Play video starting at :2: and follow transcript2:00
For our purposes though,
we're going to think of natural selection as a process of environmental filtering.
The environment filters out those organisms which are least suited to
living in it.
Biologists frequently talk about organisms as having adaptations.
Adaptations are physical features or

behavioural traits that an organism has as a result of natural selection.
Play video starting at :2:23 and follow transcript2:23
In order for a trait to be a product of natural selection,
it needs to be the case that the trait is heritable.
Play video starting at :2:29 and follow transcript2:29
There also needs to be variation in the population,
some organisms which have the trait and some which don't.
Play video starting at :2:36 and follow transcript2:36
Finally, a trait needs to be advantageous to the organism's reproductive or
survival success in order to count as an adaptation.
Play video starting at :2:45 and follow transcript2:45
>> The reason that beavers need physical and behavioral adaptations for
living in water is, of course, that they spend a lot of time in the water.
While lots of mammals live like this,
beavers are unusual in that they create their own wet areas.
They build dams which block rivers and
expand the wet areas that they like to live in.
Dam building in beavers is the product of a suite of physical and
behavioural adaptations.
They have big, rugged teeth which they use to cut down trees.
They can then eat the leaves, bud and bark from the tree.
That's what they live on.
And they can add the tree trunk to their dam.
And they have a damming instinct.
They're stimulated to dam by the sound of water running over obstacles.
Play video starting at :3:23 and follow transcript3:23
The interesting thing about beavers is that these adaptations are a response to
an environment in which they themselves have helped to create and shape.
Their various adaptations for living in water are selected for,
in part, because they actively change their environment, flooding it.
Increasing the area that's under water and
increasing the advantages that these adaptations provide.
Play video starting at :3:43 and follow transcript3:43
As well as increasing these selection pressures,
damming reduces other selective pressures.
For instance, flooding large areas where they can forage for
food minimizes the time they have to spend out of the water,
reducing the danger they face from predators.
Like many other species, beavers therefore shape the selective pressures
Play video starting at :4:1 and follow transcript4:01
they adapt to their environment but they also change their environment.
And therefore change the pressures they adapt to.
Play video starting at :4:7 and follow transcript4:07
Later on I'll talk about humans do the same thing but on a much grander scale.
>> Some adaptations are easy to spot.
Take the mammalian heart for example.
In the 16th century, the biologist William Harvey discovered that
the heart pumps blood around the body.
Play video starting at :4:22 and follow transcript4:22
Biologists now consider the heart to be an adaptation.
Play video starting at :4:26 and follow transcript4:26

Those mammals that had hearts that efficiently pumped blood around the body,
did better than those mammals that had hearts which were less efficient at
pumping blood.
Play video starting at :4:35 and follow transcript4:35
So its uncontroversial to think of certain organs in parts of
our bodies in adaptive terms.
Play video starting at :4:42 and follow transcript4:42
So, how should we understand the evolution of our cognitive capacities?
Play video starting at :4:47 and follow transcript4:47
Cognitive traits like the ability to do sums or
the ability to read, or even the ability to recognize the face of a loved one.
Are much more difficult to determine than something like the valves of a heart.
Play video starting at :5:1 and follow transcript5:01
We can look at the physiology of the brain, but that only really tells us
a fraction of the story of how our cognitive traits evolved.
Play video starting at :5:8 and follow transcript5:08
Moreover, cognitive traits like the ability to do maths,
don't leave any mark on the fossil record.
Play video starting at :5:15 and follow transcript5:15
So, can we use the same techniques of natural selection and
adaptation that we used to understand the evolution of physical and
behavioral traits, to understand the evolution of our cognitive traits?

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/lecture/0I9Yg/1-1-stone-age-minds-part-i>

There's an ongoing debate in cognitive science about how much of
our brain is a product of natural selection and
how much of it is a product of social learning.
These are not all or nothing claims.
So no one thinks that all of the brain is a product of natural selection or
that it is all a product of social learning.
But what we're going to look at now is a view called evolutionary psychology,
which maintains that most of our cognitive capacities are there as a result of
natural selection.
Play video starting at ::35 and follow transcript0:35
The four claims of evolutionary psychology are these: first,
the human brain is a product of natural selection.
Play video starting at ::43 and follow transcript0:43
Second, the human brain adapted to solve particular problems which our
ancestors faced.
Play video starting at ::51 and follow transcript0:51
Third, the cognitive capacities which our ancestors developed that allowed them to
solve problems were heritable.
They could be transmitted biologically from parent to offspring.
Play video starting at :1:2 and follow transcript1:02
Fourth, the brains we have now are the brains which our
ancestors evolved all those years ago.
Play video starting at :1:9 and follow transcript1:09
Of course, it's possible to endorse the view that the brain is a product of

natural selection without being committed to the four claims of
evolutionary psychology.
Kenny's going to talk you through an alternative later based on
social learning.
Play video starting at :1:22 and follow transcript1:22
The argument isn't about whether natural selection was involved,
the argument is about how we should understand the role of natural
selection in shaping the human brain.
If there is to be a slogan for the evolutionary psychology movement,
it would be that our modern skulls house Stone Age minds.
This is a term that was coined by Leda Cosmides and John Tooby,
who are commonly acknowledged as the founders of evolutionary psychology.
Play video starting at :1:46 and follow transcript1:46
Evolutionary psychologists point out that the vast majority of our species' history
was spent living in small hunter gatherer groups in the African savannah.
So from about 1.8 million years ago to 10,000 years ago,
we were living in these small groups in very hot environmental conditions.
Play video starting at :2:6 and follow transcript2:06
This is what evolutionary psychologists refer to as the Environment of
Evolutionary Adaptation and
they claim that the brains that we have now evolved to
solve the problems which this environment of evolutionary adaptation threw up at us.
Play video starting at :2:21 and follow transcript2:21
The industrial revolution only happened about 200 years ago and
we've been living with, agriculture's been part of our life for about 5000 years and
so these are just tiny fractions of the human species' history.
For about 99% of our history, we were living in the conditions thrown up
by the environment of evolutionary adaptation.
Play video starting at :2:44 and follow transcript2:44
One of the effects of this, said evolutionary psychologists,
is that some of the cognitive capacities that we have now
evolved to suit the conditions in the environment of evolutionary adaptation,
but are actually mal-adaptations.
That means that they were very beneficial to us when we were hunter gatherers, but
they're not so beneficial to us in our modern urban environments.
For example, craving salt and sugar is a really good
cognitive mechanism to have if you're a hominid and you're trying to get
really calorific sources of food to feed yourself and your family.
Play video starting at :3:21 and follow transcript3:21
But living in an urban environment where sources of salt and
fat and sugar are rife, this becomes a maladaptation.
Those cravings cause us to eat far too much of those foods and
ends up being unhealthy for us.
Play video starting at :3:34 and follow transcript3:34
Stephen Pinker points this out really nicely when he says that we
have a really visceral reaction to snakes and spiders, basically things which
would have posed a huge threat for us during the environment of evolutionary adaptation but
in fact in today's world, snakes and spiders don't really kill very
many people per year, in contrast to say, driving without a seat belt.
Driving without a seat belt is a much more dangerous thing for

humans to be doing in the modern urban environment, but our reaction to
this is far less visceral than our reaction to snake bites and spiders.
Play video starting at :4:10 and follow transcript4:10
So what were the kind of problems that faced out hominid ancestors?
As mentioned before, they lived in small groups of hunter gatherers, so
a lot of the problems that faced our ancestors were to do with group living,
how to maintain a harmonious group that could live together.
So the evolutionary psychologists maintain that our brains evolved to
solve the kinds of problems that faced you if you were living in a small group.
For example, who should I cooperate with to do my hunting and gathering?
If I manage to get some food, who should I be sharing it with?
Play video starting at :4:43 and follow transcript4:43
Are there people in my group who are benefiting from my work, but
not contributing to it?
Am I feeding lazy people who don't do any hunting and gathering themselves?
These are precisely the kind of problem that
the evolutionary psychologists maintain our brains evolved to solve.
They recurred day after day for
the 1.8 million years of the environment of evolutionary adaptation.
And so it's necessary, say the evolutionary psychologists,
that our brains evolved fast and efficient ways of solving these problems.
Play video starting at :5:13 and follow transcript5:13
One of the most famous hypotheses from the evolutionary psychologist is that
the brain has a part which evolved to solve the cheater detection problem,
that is, our brains have got a part which evolved to solve the question of who
in my environment is free riding?
Who's taking stuff without putting back to the community?
Play video starting at :5:32 and follow transcript5:32
Here's how they argue for the hypothesis.
There's a logic task devised by the psychologist Peter Wason in the 60s,
which is intended to test whether people can
follow whether a particular logical rule has been broken.
Play video starting at :5:45 and follow transcript5:45
We can kind of work it through like this.
Imagine that you have a job as a quality control person in a card manufacturer
manufactures cards for games and you've been told that if a card is yellow one
one side, then there needs to be a circle on the other side.
Now, you've been reassured that every card that you're looking has a color and
a shape on each side of it and
your job is to check which cards might possibly have broken the rule.
Play video starting at :6:15 and follow transcript6:15
So here are the cards, and which ones do you think you need to
turn over to ensure that the rule has been kept?
Play video starting at :6:22 and follow transcript6:22
So the cards you need to turn over would be the yellow card because we've been
told if it's yellow, then it needs to have a circle on the other side.
So we turn over the yellow card, and
sure enough, there's a circle on the other side.
So the rule has been kept.
Play video starting at :6:36 and follow transcript6:36

Now we don't need to turn over the circle card because there isn't any rule about if it, if it's a circle then it has to have a particular color on the other side, but we do need to turn over the triangle card.
We need to turn it over to make sure that it isn't yellow on the other side, because then it will have broken the rule.
Play video starting at :6:53 and follow transcript6:53
Oh, this card is yellow on the other side.
So this card is dud.
It's broken the rule.
Let's try a different puzzle.
Play video starting at :7: and follow transcript7:00
Imagine now that you're a bouncer at a night club, and you've been told that in this particular club, you can only drink alcohol if you're aged 21 or over.
Now imagine that each of these cards represents a patron at the night club, either how old they are, or what they're drinking.
Which people do you need to check to make sure that the rule has been kept?
Well, you obviously need to check what the 16 year old is drinking to make sure that they're not drinking beer.
We should turn that card over.
They're drinking orange juice, so that's okay.
But you also need to check the age of the beer drinkers.
This person is drinking beer, so we need to make that sure they are 21 or over.
Oh, that person is 16, so they're going to get thrown out of the night club.
How did you fare on these tasks?
Most people find the first one significantly more difficult that the second, even people who have taken classes in logic.
Play video starting at :7:53 and follow transcript7:53
Cosmides and Tooby take this as evidence for the fact that we have a cognitive adaptation which evolved to allow us to detect cheaters in our environment.
We're very good at detecting when a social norm has been violated.
But because this part of the brain evolved just to detect the violation of social norms, we can't use it in other situations, even when it would be useful.
For example, we can't transfer that ability and use it in an abstract logical setting.
So Cosmides and
Tooby used this as evidence of the idea that we evolved a particular cognitive ability, the ability to detect cheaters in our environment.
Play video starting at :8:31 and follow transcript8:31
The evolutionary psychologist's claim, that the brain evolved to deal with lots of specific different problems,
commits them to a very particular view of how the mind is structured.
This is the modular view of the mind.
Play video starting at :8:45 and follow transcript8:45
It means that the mind is a series of mini-computers,
each of which is specialized to do a particular cognitive task.
And in the literature, these mini-computers are referred to as modules, or cognitive modules.
So, there's a mini-computer that allows us to detect friend from foe.
A mini-computer that allows us to do basic mathematical calculations.
A mini-computer that can kind of tell us where we are in a,

an environment, that deals with spacial cognition.
Play video starting at :9:10 and follow transcript9:10
And the evolutionary psychologists say that each mini-computer can only
do it's job.
Play video starting at :9:16 and follow transcript9:16
So, think about the body more generally.
The lungs are very good at extracting oxygen from the air.
And the blood is very good,
the heart is very good at pumping blood around the body.
But if our lungs fail for whatever reason, it's not like the heart can step in and
do the work of the lungs and the same goes for the mini computers of the brain.
Play video starting at :9:34 and follow transcript9:34
The mini computer that deals with social cognition, that allows you
to detect who might be a cheater in your environment, who might be free riding,
can't also be used to apply to say, more abstract mathematical logic problem.
Play video starting at :9:49 and follow transcript9:49
So in the evolutionary psychology view, the brain is like a Swiss army knife,
it's a series of mini computers, each of which is tailored to a specific task.
Whereas opponents to evolutionary psychology say the brain is much more like
a chef's knife, it has one kind of very good blade which allows it to do
a variety of different things and it might not do them as well as a specific tool,
but it nevertheless gets the job done.
Play video starting at :10:15 and follow transcript10:15
Another reason the evolutionary psychologists endorse the modular view of
the brain, that is, the brains consists in a series of mini computers has to do
with the complexity of the brain.
Play video starting at :10:27 and follow transcript10:27
The brain is an incredibly complex organ and
from an evolution perspective, it's unlikely that it just popped into
existence as a result of one massive adaptation.
Instead, it's likely to evolve over millions and
millions of years, changing incrementally in tiny steps.
Play video starting at :10:45 and follow transcript10:45
Let's look at the human eye as an analogy.
Our very distant ancestors, the ones who lived a really long time ago just in
the sea, didn't have eyes as we have them now.
They just have light sensors that allow them to detect the difference between
light and dark and use that information accordingly.
Play video starting at :11:3 and follow transcript11:03
Much, much later, organisms began to evolve retinas and
then later, cones and rods which allowed them to have a finer color vision.
[SOUND] Now, the human eye evolved very incrementally to the eye that we have now,
but we can break it down into the separate parts which evolved separately.
The advantage of this is that one part of the eye can break or
not work properly without the whole thing going down and that's really important for
organisms for whom perception is a really important way of life.
Play video starting at :11:33 and follow transcript11:33
This is what happens with color blindness.
The parts of the eye which detect color don't work properly, but
that doesn't mean that the person is unable to see at all.

The rest of the vision functions perfectly normally.
It's just that this one component isn't working as it normally does.
Play video starting at :11:49 and follow transcript11:49
Now let's return to the human brain.
Play video starting at :11:52 and follow transcript11:52
As mentioned before, the brain is probably the most complex organ that we have.
And so the evolutionary psychologists say that each module,
each mini computer evolved semi-independently of the whole, kind of
building on the resources of the brain but without being wholly dependent on it.
This is really advantageous because it means that if one computer breaks down,
then the whole brain doesn't break down.
Play video starting at :12:14 and follow transcript12:14
An organism can't live without a brain, but
it can without one part of its brain, one module, not working properly.
Play video starting at :12:20 and follow transcript12:20
And so the idea that we have these modules which only take in a limited amount of
information, process it and kind of spit out a limited amount of information in
turn, these little modules which are kind of blind to the overall workings of
the entire brain, isn't so implausible after all, say evolutionary psychologists.
Another advantage of thinking of the brain in this way is that natural selection can
act on one part of, one module of the brain, for example, improving our
spatial cognition without having to tinker or adjust or change the brain as a whole.
Can just work on the spatial cognition module.
Play video starting at :12:55 and follow transcript12:55
And so the complexity of the brain and
trying to explain how such a complex organ could have evolved,
is a very strong argument in favor of the modularity of the human mind.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/lecture/kPiQL/1-2-stone-age-minds-part-ii>

I just want to take a minute to point out another interesting property of
beavers and their dams, ecological inheritance.
Play video starting at ::14 and follow transcript0:14
Baby beavers inherit their various physical and
behavioral adaptations from their parents through their genes.
But they also inherit their environment, the lodge and
dam their parents have built, and the flooded land behind it.
Play video starting at ::26 and follow transcript0:26
Some beaver dams are absolutely massive and they can last for
decades, way more than the life of an individual beaver.
Play video starting at ::32 and follow transcript0:32
This, therefore, constitutes a type of nongenetic inheritance sometimes called
ecological inheritance. As well as giving you their genes,
your parents can pass on other stuff to you.
If you're a beaver, this includes a dam.
Play video starting at ::45 and follow transcript0:45
Ecological inheritance is rife in humans, of course.
Think of all the aspects of your environment that your parents shaped for

you, starting with the house that you grew up in.
But we also inherit knowledge and behaviors directly from our parents and
other people, not via our genes but via social learning.
The ability to learn, to modify your behavior in response to
your environment is very widespread in nature.
Basically, every organism can do this.
Social learning, is learning from the behavior of others, is also pretty common.
So apes and other primates do it, but other mammals do it too like rats and
birds do it, and even some fish do it.
Play video starting at :1:19 and follow transcript1:19
But humans are definitely the premier social learners.
Play video starting at :1:22 and follow transcript1:22
Think of all the things you know and the skills you have that you were taught by
another person, or you copied from someone else, or,
that you read in a book, or saw in a video on YouTube.
Play video starting at :1:31 and follow transcript1:31
On top of ecological inheritance,
social learning forms an important non-genetic mechanism for
the transmission of knowledge and behaviors in human populations, and
I think understanding social learning is crucial to understanding human evolution.
Play video starting at :1:46 and follow transcript1:46
Humans have large repertoires of behaviors which are transmitted by social learning,
and the collective term for these is culture.
So, culture informally, is often used to refer to highbrow activities like going to
the ballet or attending a piano recital.
But its technical usage just refers to any system of knowledge and behavior which is
transmitted by teaching, imitation, or other forms of social learning.
So culture in humans includes things like the clothes you wear,
the kind of house you live in, the food you eat, and the language you speak.
Play video starting at :2:16 and follow transcript2:16
And other animals have culture too, because they do social learning.
So for instance different chimpanzee populations have different
repertoires of behavior.
Play video starting at :2:24 and follow transcript2:24
So you find that some chimpanzee populations crack nuts using
a simple hammer and
anvil, and other chimpanzee populations, which are otherwise very similar, don't.
And this is a cultural difference, rather than, for instance, a genetic difference.
Animal cultures are very simple.
It look as if a single individual invents a new behaviour and then
it spreads through the population as that animal is copied by others.
So the reason that some chimpanzee populations use a hammer and
anvil to crack nuts and others don't is just because in the populations where
nobody does it, no individual has discovered that behaviour yet.
Since different innovations occur in different populations, over time
separate populations accumulate their own idiosyncratic inventory of these
certain behaviors.
Play video starting at :3:7 and follow transcript3:07
Human culture doesn't work like this.
Rather than being a collection of simple behaviors and

artifacts, human cultures and the products of human culture are enormously complex.
So think of how complex a bicycle is, or
a car, or a computer, or even your clothes with all the different fabrics and
fasteners, or think of how complex the political and
legal institutions are in your country and how they got to be that way.
Play video starting at :3:32 and follow transcript3:32
These complex objects and
behaviors weren't invented by a single individual who everyone else copied.
Rather, it represents the gradual accumulation of
modifications over hundreds or thousands of years.
Play video starting at :3:44 and follow transcript3:44
You inherit a behavior and then you modify it and improve its design.
And then you pass on that modified version.
And this process where one generation builds on
knowledge inherited from previous generations is called cumulative culture.
And the objects it produces are enormously complex and well-designed.
Play video starting at :4:4 and follow transcript4:04
So at least some interesting human behaviors and
artifacts are parts of cumulative culture rather than being biological adaptations.
Play video starting at :4:12 and follow transcript4:12
Remember the beavers and their dams.
An instinctive behavior carried out by the beavers which changed their environment,
increasing some selective pressures and reducing others.
Humans do exactly the same kind of sculpting and
shaping of their environment on a massive scale.
Unlike beavers, the things we do to shape our environment, things like
wearing clothes, building shelters, growing crops and keeping animal for food.
Living in large complex social groups, are not instinctive behaviors but
socially learned.
They're part of culture and
you learn how to do these things from the people around you.
Play video starting at :4:44 and follow transcript4:44
Nonetheless, just like beavers and their dams, all these modifications we
make to our environment massively change the selective pressures acting on us.
Our ability to insulate ourselves from hostile environments with clothing and
housing has allowed us to spread right across the planet and
inhabit hostile environments, like the high plains of the Andes, or
the Arctic Circle, which would otherwise be uninhabitable.
As well as insulating us from some selection pressures,
our cultural practices have set up new selection pressures acting on
human populations.
One of the most famous examples is the evolution of lactase persistence.
So most mammals lose the ability to process lactose,
that's the main carbohydrate in milk.
After weaning, there's essentially no need to carry on producing lactase,
That's the enzyme that the body uses to break down lactose, after you
stop drinking your mother's milk.
But in a minority of the world's human population,
adults exhibit what's known as lactase persistence.
They carry on producing lactase after the point of weaning, and this enables them to

break down lactose, and therefore, benefit from drinking animal milk.
This is a very handy ability to have cause milk's a great food source.
It's rich in protein and fat.
Play video starting at :5:51 and follow transcript5:51
Around a third of the world's adult population exhibit lactase persistence,
mainly in northern Europe and North Africa.
And the rest of the human population don't exhibit lactase persistence.
They're just like normal mammals,
losing the ability to process lactose after weaning.
Play video starting at :6:8 and follow transcript6:08
So why do some of the world's population exhibit lactase persistence?
It's clearly a genetic trait, and what's more,
it's probably an adaptation, since it's such a handy ability to have.
It's thought that lactase persistence evolved really recently,
in the last 10,000 years, in response to the cultural practice of dairying,
keeping animals, and drinking their milk.
Lactase persistence is really common in populations with a long history of
dairying, and it's scarce in populations with no dairying tradition.
So the idea is that the cultural practice of dairying set up
new selection pressures acting on dairying populations, rewarding individuals who
were able to drink milk for longer in life and reap the rewards of milk drinking.
Play video starting at :6:50 and follow transcript6:50
The genes of these dairying populations responded to this new selection pressure.
and evolved this capacity for lactase persistence.
And this biological adaptation probably fed back into the cultural practice,
further promoting the exploitation of dairy products and
setting off a mutually reinforcing spiral of gene culture coevolution.
Play video starting at :7:10 and follow transcript7:10
Lactase persistence is probably the most famous case of
human genes responding to selection pressures set up by human culture.
But it's almost certainly not the only one.
Recent estimates based on sophisticated techniques for
identifying the hallmarks of selection in human genetic databases suggest that
thousands of genes have been under recent selection in the past 40,000 years.
Probably as a result of selection pressures set up
by human cultural practices.
Play video starting at :7:37 and follow transcript7:37
So you might think that the human capacity to insulate ourselves from
our environment means that natural selection is effectively over for
humans or you might agree with the evolutionary psychologists that we
have stone age minds and modern skulls.
But in fact, this research suggests that the rate of human evolution has
actually increased in the last 40,000 years, as our genes respond to
the new environments we create for ourselves via culture.
Play video starting at :8: and follow transcript8:00
So I spent a little bit of time applying these ideas to a problem that I work on,
the evolution of language.
The human language is a uniquely powerful,
flexible communication system that has no parallel in the natural world.
Play video starting at :8:12 and follow transcript8:12

Basically every species communicates.
Flowers signal the availability of nectar to bees, and
bees communicate with other bees about the location of flower patches.
And male birds sing for female birds to advertise their availability and quality.
Play video starting at :8:27 and follow transcript8:27
And lots and lots of species have alarm calling systems.
They have specific calls that communicate to group members about the presence of specific predators.
These are all fascinating communication systems.
But compared to human language, they're incredibly rigid and inflexible.
An alarm calling monkey can't use its alarm calling system to
reminisce about a predator they saw yesterday or
to plan what they should do next time they see a predator.
In contrast, human language is incredibly flexible and powerful.
Basically, anything I can think, I can communicate to you using language.
Provided you'll be able to figure out my accent.
Play video starting at :9:2 and follow transcript9:02
Language has a bunch of structural devices which enable it
to achieve this open ended expressive power.
At the most fundamental level,
the expressive power of language comes from the fact that it has rules.
Speakers of a language know the meaning of a bunch of words and
they importantly know the rules of that language that govern how those words are combined.
And this means that as long as you know the meanings of the words and the rules of the language, then you can understand any sentence that follows those rules.
So all the things that Suilin and I have said in this lecture today have
been completely novel and one off sentences of English that have never been spoken before and will never be spoken again.
And nonetheless, because you implicitly know the rules of English,
you've been able to understand what we mean.
Play video starting at :9:41 and follow transcript9:41
Within this basic framework, language provides devices for
conveying all kinds of useful information.
Play video starting at :9:46 and follow transcript9:46
You can encode who did what to who.
In a language like English,
you convey this information using the order of words in a sentence.
In a language like Hungarian,
you do the same job by attaching markers to the ends of words.
This allows you to distinguish between, for
example, the news that the dog chased the cat or the cat chased the dog.
Play video starting at :10:5 and follow transcript10:05
You can see when an event happened in time, allowing you to convey whether
something already happened, or will happen in the future, or is happening right now.
You can convey that an event might happen, or
will happen, or might not happen, or won't happen, and you can explain why.
Play video starting at :10:19 and follow transcript10:19
You can ask questions that require a simple yes/no answers or
request more complex information.

Play video starting at :10:25 and follow transcript10:25
How have humans ended up with such a fantastically rich,
complex communication system?
One possibility is that language and all these grammatical devices for
communicating complex information are an adaptation.
This argument was made by Stephen Pinker and Paul Bloom in a well-known 1990 article
called Natural Language and Natural Selection.
Play video starting at :10:44 and follow transcript10:44
In their paper, they argued that language is a complex biological trait
that appears to be designed for communication.
The only way to explain such traits it to appeal to natural selection.
Humans live in complex social groups.
As Suilin already said, this means we spend lots of time thinking about social events,
like who is cheating on who.
But it also means we rely heavily on communicating with other people.
Play video starting at :11:5 and follow transcript11:05
Sometimes we want to exchange information about current social events or
immediate survival relevant situations.
But we also want to pass on the complex set of knowledge, skills, and
beliefs that are needed to survive in the world.
Language is obviously well-designed for doing all these things.
And therefore, so
the argument goes, the ability to learn a language must be an adaptation.
So, it could be that the complexity and
communicative power of language are the product of an evolved language instinct.
A mini-computer, or a series of mini-computers that have specialized for
language learning and language processing.
And, there's clearly something uniquely human involved in language.
No other species has a communication system that works like language.
And attempts to teach human language to non-human animals have met with
only limited success.
But in my work,
I explore an alternative possibility, the idea that some of the interesting
structural properties of language are a product of culture rather than biology.
And in particular, I explore the idea that these interesting features of
human language are a product of cumulative culture,
the gradual accumulation of modifications that I talked about earlier on.
Play video starting at :12:8 and follow transcript12:08
So we know for a fact that languages are socially learned.
The reason I sound the way I do is that I grew up around a whole group of
people who sound like this.
And I learned my particular version of English from listening to the way
those people talked, and they in turn learned their language in the same way.
So your parents were influenced linguistically by their parents and
peers who were in turn influenced by their parents and peers, and so on.
In a process of transmission that stretches back tens of thousands or
maybe even hundreds of thousands of years.
And we also know that language has changed as a result of this transmission
process because we can see it in the written record.

So, the English of today is very different from
the English spoken in Shakespeare's time.
And the English spoken 1,000 years ago would be incomprehensible to a modern speaker of English, because the language has changed so much.
Play video starting at :12:53 and follow transcript12:53
Our historical record for languages doesn't actually stretch back very far.
Writing was only invented 5,000 years ago.
And as far as we can tell, the first languages to be written down work in basically the same way as modern languages in having rules and structure of the sort that I mentioned before.
Play video starting at :13:9 and follow transcript13:09
But languages must have been around a lot longer than 5000 years.
They must have been around as long as there were humans on the planet, and maybe even longer.
So, that means that languages have a fantastically long period of time to evolve by cumulative culture.
And it could be that the complexity and communicative power of language arose as a result of cumulative cultural evolution over this timeframe.
Play video starting at :13:30 and follow transcript13:30
In order to survive, languages have to be highly learnable.
They have to make it into the minds of language learners.
Language learners simplify, and regularize, and generally tidy up languages as they learn them.
As a result, languages evolve to have rules and patterns and regularities, that language learners can identify and exploit, because those patterns make language more learnable.
Play video starting at :13:53 and follow transcript13:53
At the same time, people consciously or unconsciously modify the way they use their language in order to make the distinctions they care about and meet their communicative needs.
So for instance, you might choose the most concise or clear or funny or inventive or colloquial way you can think of to express yourself.
Play video starting at :14:11 and follow transcript14:11
So people modify their language to meet their communicative needs, in much the same way they modify tools and other cultural products to improve their function.
The only difference might be that the modifications we make to language are more subtle and perhaps less intentional.
Play video starting at :14:25 and follow transcript14:25
But over hundreds of thousands of years, these changes in conjunction with the simplifying and systematizing consequences of language learning might conspire to produce complex, expressive, rule governed languages.
This is just a hypothesis of course.
But I think its a good one.
And its one we can test.
We can't study the early origins of language directly, but we can study how languages are learned in the present and how they change over historical time.
And we can simulate these same processes of learning and change either in a computer or using real people in the experiment lab.
Play video starting at :15:1 and follow transcript15:01

If this theory is correct,
it means that some of the most important structural features of language which
makes language such a wonderfully powerful and expressive communication system,
may be a product of culture rather than a biological adaptation.
Play video starting at :15:13 and follow transcript15:13
>> We started with the premise that our brains are a product of natural selection.
Play video starting at :15:18 and follow transcript15:18
We then looked at two different ways that we could develop this claim.
Play video starting at :15:22 and follow transcript15:22
The first, evolutionary psychology says that our brains evolved during
the environment of evolutionary adaptation about 2.4 million years ago.
Play video starting at :15:30 and follow transcript15:30
The brains that we have today are a series of mini computers,
each of which involve to solve a specific problem that faced our
ancestors during the environment of evolutionary adaptation.
>> The second account suggests that the human brain's undergone significant
evolution in the last 10,000 years, as a result of our capacity for a cumulative
culture which has enabled us to shape our environment to better suit our needs.
Play video starting at :15:52 and follow transcript15:52
Culturally transmitted niche construction behavior like dairy farming have set up
new selection pressures and have driven rapid evolution in our genes.
Play video starting at :16:2 and follow transcript16:02
Evolution psychology paints a relatively passive view of evolution,
with an organism responding to challenges imposed by the environment.
Niche constructing accounts emphasize how organisms alter their environments,
set up new selective pressures.
This is of course a caricature of the two positions, but
it highlights one of the key differences between them.
Play video starting at :16:22 and follow transcript16:22
Humans are unique in our capacity for high fidelity social learning, the sheer
amount of social learning we do, and the cumulative culture that this produces.
Language clearly plays a pivotal role in setting up these systems of
social learning.
But again, we see differences in the two accounts in how they explain
the evolution of language.
Evolution psychologists will look for a series of language modules in the brain,
specialized mini computers which enable us to learn and process language.
Play video starting at :16:49 and follow transcript16:49
Researchers persuaded by the cultural account will instead focus on
how languages change and
evolve in order to be easier to learn and more expressive to use.
>> We've only been able to give a short overview of the two
main position in this MOOC.
But if you're interested, we've put some further reading on the handout for
you to look at.
Play video starting at :17:8 and follow transcript17:08
Researchers are really interested in the interaction between evolution and
culture and it remains one of the fiercest and
most stimulating debates in cognitive science at present.
Play video starting at :17:18 and follow transcript17:18
The mind may not be a blank slate but we still have a long way to go

before we fully understand the nature of knowledge that it contains.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/lecture/946Jf/1-3-stone-age-minds-part-iii>

Week 1 Quiz: Do our modern skulls house stone-age minds?

Tuesday, February 14, 2023
8:56 PM

- **Link to Philosophy and the Physical Sciences**
- **This week, we will explore scientific interpretations of how our minds evolved, and some of the methodologies used in forming these interpretations. We will relate evolutionary debates to a core issue in the philosophy of mind, namely, whether all knowledge comes from experience, or whether we have 'inborn' knowledge about certain aspects of our world.**
- **Week 1 Quiz**
- **Quiz:** Week 1 Quiz: Do our modern skulls house stone-age minds?
  10 questions
- **Additional Reading**
- **@Edinburgh**

Week 1 Quiz: Do our modern skulls house stone-age minds?

Quiz30 minutes • 30 min

Submit your assignment

Due February 19, 11:59 PM ISTFeb 19, 11:59 PM IST

Attempts 3 every 8 hours

Start assignment

Receive grade

To Pass 80% or higher

Your grade

-Not available

Like

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Report an issue

Back

Week 1 Quiz: Do our modern skulls house stone-age minds?

Graded Quiz. • 30 min. • 10 total points available.10 total points

DueFeb 19, 11:59 PM IST

1.

Question 1

What is required for a trait to be a product of natural selection? (Pick 3)

1 point

It must be heritable. [Answer]

It must be beneficial to the organism's quality of life.

There must be extremely sparse resources, not just moderate competition for fairly plentiful resources.

There must be variation in the population. [Answer]

It must help the organism to survive and reproduce. [Answer]

There must be extreme environmental pressure, such as we find in the arctic or at the bottom of the ocean.

2.

Question 2

What is interesting about the adaptations of the beaver?

1 point

They have developed in response to an environment that beavers have helped to create. [Answer]

They do not contribute to the survival or reproductive success of the organism.

They involve the behaviour of the organism, not just its physical shape, and this is a feature rarely seen in evolution.

They are passed on culturally, i.e. learnt rather then inherited genetically.

3.

Question 3
Which of the following are claims made by evolutionary psychology? (Pick 4)

1 point

Our adapted cognitive capacities are heritable. [Answer]

Our cognitive capacities have evolved, and are therefore adapted to our current environment.

The brains we have now are the brains that our ancestors evolved to have. [Answer]

All aspects of our behaviour can be explained by natural selection.

Psychologists had to evolve in order to discover evolution.

The human brain is a product of natural selection. [Answer]

We will inevitably continue to evolve and get smarter.

The human brain is adapted to challenges faced by our ancestors. [Answer]

4.

Question 4
What is the Environment of Evolutionary Adaptation?

1 point

The environment that we find ourselves in today.

The environment best suited to rapid evolutionary development.

Any environment in which evolution can take place.

The historical environment that shaped the adaptations that we have today. [Answer]

5.

Question 5
What conclusion do Cosmides and Tooby take from the Wason selection task?

1 point

We're very good at detecting when a social norm has been violated, but pretty bad at generalising this to logically equivalent situations. [Answer]

We're very good at solving abstract logic puzzles, but pretty bad at solving puzzles in social situations.

We have evolved to have better social skills because we’re bad at logic puzzles.

We're good in social situations, which means that we don’t have to bother about learning logic.

6.

Question 6
Why do evolutionary psychologists favour a modular view of the brain?

1 point

Because it is simpler for them to understand.

Because it is more plausible, in evolutionary terms, to imagine that the brain becomes more specialised as time goes on.

Because it turns out that the brain is constructed out of very distinct anatomical modules.

Because it is more plausible, in evolutionary terms, to imagine that the brain evolved to solve a series of distinct problems. [Answer]

7.

Question 7
What is ‘culture’, as that term is used in cognitive science?

1 point

Any language-based system of knowledge or behaviour that is transmitted through social leaning.

Any system of knowledge or behaviour that is transmitted though social learning. [Answer]

Any system of knowledge or behaviour that has reached a certain critical level of complexity or sophistication.

High art, including theatre, opera, art-house cinema, and literature.

8.

Question 8
What do we learn from the fact that only some chimpanzee populations use a hammer and anvil to crack nuts?

1 point

This hammers and anvils are only available in particular geographical regions.

That genetic, not cultural, differences are responsible for the behaviour of cracking nuts with anvil.

That neither genetic nor cultural differences are responsible for the behaviour of cracking nuts with an anvil.

That cultural, not genetic, differences are responsible for the behaviour of cracking nuts with an anvil. [Answer]

9.

Question 9
Why is human language so incredibly flexible?

1 point

This is a trick question. Human languages are governed by rules, and are therefore not flexible.

Languages are rule-based, so an understanding of the rules of a language and the meaning of words is usually sufficient for understanding completely novel sentences. [Answer]

Human language is flexible because it only evolved over the last 5000 years, which meant that it was originally developed in diverse environments. Had it evolved earlier, when humanity was less geographically diverse, it would have been less flexible.

Human language is flexible because, unlike the communicative practices of non-human animals, it is not governed by rules, and so can be extended in novel ways.

10.

Question 10

How can we test the cultural account of how human language evolved?

1 point

We can investigate experimentally how people learn language, and develop computer simulations of these processes. [Answer]

The cultural account of how human language evolved cannot be tested. It is what Popper called a ‘metaphysical research programme’.

Although we can’t test the origins of human language directly, we can study primitive language use in chimpanzee populations and make plausible inferences about our hominid ancestors.

We can test this hypothesis by studying the very early origins of language directly, as we have recently discovered written evidence of these languages.

Consciousness

Wednesday, February 15, 2023
11:38 AM

Why do creatures with brains like ours have consciousness? What makes certain bits of our mental life conscious and others not?

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/home/week/2>

One of the hardest problems in science is the nature of consciousness. We know that we have consciousness. We do not just blindly process information, make discriminations, take actions. It also feels a certain way to do so from the inside. Why do creatures with brains like ours have consciousness? What makes certain bits of our mental life conscious and others not? These questions form the heart of consciousness science, an exciting field to which psychologists, neuroscientists and philosophers contribute. This session will explore these questions, and introduce some recent progress that has been made towards answering them.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/home/week/2>

Explaining consciousness is one of the hardest problems in science.
This should be surprising because we all know a lot about consciousness from
our own experience.
We could say that our own consciousness is the thing in the world that we know best.
Play video starting at ::23 and follow transcript0:23
The philosopher Descartes thought that our knowledge of
our own conscious thought was more secure than the rest of natural science.
Play video starting at ::31 and follow transcript0:31
He thought that consciousness was unique, in that we know with absolute certainty
that our own consciousness exists and we're the ultimate authority on it's character.
Play video starting at ::42 and follow transcript0:42
Yet despite the seemingly excellent knowledge of our own consciousness,
consciousness is one of the most puzzling things in the world.
We don't know what it is about us as physical beings that makes us conscious.
We don't know why we have consciousness and
we don't know which creatures other than ourselves are conscious.
Play video starting at :1:7 and follow transcript1:07
Consciousness isn't just a scientific term,
it's also a word that appears in everyday life.
We might say, she wasn't conscious of the passing pedestrian,
that he was knocked unconscious in the boxing ring.
Or that our conscious experience of smelling a rose or
hearing a symphony make life worth living.

Play video starting at :1:26 and follow transcript1:26
Consciousness is what philosophers call a folk concept.
A concept that arises out of and is ingrained into our everyday interests.
A scientific understanding of consciousness should approach our
folk talk about consciousness with a great deal of care.
Play video starting at :1:44 and follow transcript1:44
What sort of things might folk mean when they
talk about consciousness in their everyday life?
Play video starting at :1:50 and follow transcript1:50
One thing we might mean by consciousness is simply sentience.
Play video starting at :1:55 and follow transcript1:55
When we say that a creature's conscious all that we mean is that it acts in
an intelligent way and it's responsive to its environment.
Play video starting at :2:5 and follow transcript2:05
We might for example say that the spider under the fridge is conscious of
our presence.
All we mean is that the spider's aware that we're here and
has sensibly taken evasive action.
Play video starting at :2:17 and follow transcript2:17
A second and distinct meaning of consciousness is wakefulness.
When we say someone is conscious, what we mean is that they are awake.
They're not asleep or otherwise incapacitated.
Play video starting at :2:29 and follow transcript2:29
This sense of consciousness suggests that consciousness is a global state,
a kind of switch that effects the whole of the mental life of the organism.
A third thing we might mean by consciousness,
is what the philosopher Ned Block has called 'access consciousness'.
A thought is access conscious if it's broadcast widely in a creature's brain.
And is poised to interact with a wide variety of
the creature's other thoughts and to directly drive its behavior.
Access conscious thoughts are usually the ones you can report if
someone were to ask you, what are you thinking now?
Play video starting at :3:5 and follow transcript3:05
Remarkably, not all of our thoughts are access conscious.
It's one of the most surprising and well confirmed findings of 20th
Century psychology that the majority of our mental life is not access conscious.
Our access conscious thoughts are only the tip of the iceberg in our mental life.
A fourth thing we might mean by consciousness is
phenomenal consciousness or qualia.
Play video starting at :3:31 and follow transcript3:31
To understand this, imagine taking a God's eye view of your mental life.
Play video starting at :3:35 and follow transcript3:35
At any given moment, there's a lot going on in your head.
You have beliefs that Paris the capital of France.
Desires to eat lunch soon.
You make plans to go to the cinema tonight.
And those plans result in motor action: turning the handle of your front door.
You perceive that there's a computer in front of you, and you make
perceptual discriminations between the screen and the keyboard of the computer.
Play video starting at :4:4 and follow transcript4:04
But in addition to all this activity, there's something else going on.

Your mental life isn't just information processing,
discriminations, forming plans, making judgements.
It's also accompanied by subjective feelings.
Play video starting at :4:22 and follow transcript4:22
Imagine that someone were to place a piece of dark chocolate on your tongue.
Play video starting at :4:27 and follow transcript4:27
Now imagine instead that, that person were to put a breath mint on your tongue.
Play video starting at :4:32 and follow transcript4:32
You could of course tell the difference between these two environmental stimuli,
you could discriminate between them.
But we could build a machine to do that too.
Play video starting at :4:43 and follow transcript4:43
There's more going on in your case.
It's not just that you can tell the difference between the two stimuli,
it's that these two stimuli elicit different conscience feelings in you.
It feels a certain way when you taste chocolate, and it feels a certain way
when you taste a mint, and those two feelings are different.
Play video starting at :5:6 and follow transcript5:06
These conscious feelings, that accompany many episodes in
our mental life, are what's meant by 'phenomenal consciousness' or 'qualia'.
Things we might mean by consciousness include sentience, wakefulness,
access consciousness, and phenomenal consciousness.
Play video starting at :5:23 and follow transcript5:23
For any of these different forms of consciousness,
one might ask the questions with which we started.
Play video starting at :5:30 and follow transcript5:30
What is it about us as physical beings that make us conscious,
why are we conscious and which creatures other than ourselves are conscious?
Play video starting at :5:39 and follow transcript5:39
Some of these questions turn out to be easier than others to answer.
For example, we're making good progress at explaining what it is about us,
as physical beings, that make us either awake or asleep.
Play video starting at :5:53 and follow transcript5:53
One set of questions, those concerning phenomenal consciousness,
have turned out to be incredibly difficult to answer.
Play video starting at :6:1 and follow transcript6:01
These questions center around what's been called the hard problem of consciousness.
Play video starting at :6:12 and follow transcript6:12
The hard problem of consciousness is to explain how creatures such as
ourselves have phenomenal consciousness.
What is it about us as physical beings that produces phenomenal consciousness?
Think of yourself from two different angles.
From the subjective point of view,
your own introspective take on your own mental life.
You know that you've got phenomenal consciousness.
You know that you've got conscious feelings, and
that those feelings come in many different kinds.
Philosophers use the expression 'what it's like' as a way of referring
to conscious experiences that are occur when we do a particular activity.
Play video starting at :6:56 and follow transcript6:56
We might say, what it's like to stub one's toe.

Or what it's like to eat a raw chili.
Play video starting at :7:4 and follow transcript7:04
In each case,
what we mean is the conscious feeling that usually comes on when we do that activity.
Reflecting on our conscious experience using what-it's-like talk,
reveals that we already know a great deal about phenomenal consciousness.
We know for example, that what it's like to taste chocolate is different from what
it's like to taste mint.
Play video starting at :7:27 and follow transcript7:27
We know that what it's like to taste a clementine,
is similar to what it's like to taste an orange.
Play video starting at :7:35 and follow transcript7:35
Phenomenal consciousness has a definite structure.
And our conscious feelings bear relations of similarity and
difference to each other.
Play video starting at :7:45 and follow transcript7:45
Reflecting on our conscious life from a subjective point of view,
via introspection, is called 'phenomenology'.
Play video starting at :7:55 and follow transcript7:55
Now imagine viewing yourself as an object from the outside.
Play video starting at :8: and follow transcript8:00
From this point of view,
it seems surprising that you have phenomenal consciousness at all.
Play video starting at :8:6 and follow transcript8:06
If we didn't know it already from our own experience,
we would never have guessed it.
Think about your brain as a physical object.
Your brain is made up of over 100 billion neurons wired in a complex web.
Play video starting at :8:20 and follow transcript8:20
We know that your brain stores information,
discriminates between stimuli, and controls your behavior, but
we have no idea how your brain produces conscious feelings.
Play video starting at :8:33 and follow transcript8:33
We know that we have phenomenal consciousness, and
that our phenomenal consciousness has a rich structure, but
we have no idea how brain activity produces phenomenal consciousness.
This is the hard problem of consciousness;
explaining how brain activity produces conscious feelings.
Why is the hard problem of consciousness so hard?
Play video starting at :8:58 and follow transcript8:58
One difficulty is
that there's a gap between our two perspectives on consciousness.
Phenomenology and brain science.
Play video starting at :9:5 and follow transcript9:05
Both seem to be legitimate sources of knowledge about our mental life.
The difficulty is linking them together.
Play video starting at :9:13 and follow transcript9:13
Science has an impressive track record at unifying our knowledge.
A common pattern in science is the unify by reductive explanation,
by explaining high level phenomena in terms of low level phenomena.
Play video starting at :9:28 and follow transcript9:28

For example, in the kinetic theory of gases, high level phenomena
involving the pressure and temperature of the gas, are explained in terms of
low level laws and mechanisms involving the constituent molecules of the gas.
Play video starting at :9:44 and follow transcript9:44
But both pressure, temperature and the movement of
the constituent molecules are all known from the third person point of view.
Play video starting at :9:54 and follow transcript9:54
The puzzle with phenomenal consciousness is to explain how our first person
conscious feelings arise out of third person accessible brain activity.
Play video starting at :10:5 and follow transcript10:05
There's no precedent in science for this kind of reductive explanation.
Play video starting at :10:11 and follow transcript10:11
in fact, a number of philosophers, including Frank Jackson, David Chalmers and
Thomas Nagel, have argued that science will
never reductively explain phenomenal consciousness in terms of brain activity.
We'll never solve the hard problem of consciousness.
Let's look at Frank Jackson's argument for this claim.
Play video starting at :10:40 and follow transcript10:40
Frank Jackson's argument is based around a thought experiment.
Play video starting at :10:44 and follow transcript10:44
Imagine that a brilliant neuroscientist, Mary is born and
grows up inside a black and white room.
Play video starting at :10:52 and follow transcript10:52
Mary's never seen colour but
she's fascinated by how the human brain detects and processes colour.
Play video starting at :10:59 and follow transcript10:59
Inside her room,
Mary's provided with encyclopaedias that describe the workings of the human brain.
Play video starting at :11:7 and follow transcript11:07
These encyclopaedias don't just contain current knowledge in neuroscience.
They include every fact that there is to know about how the human brain works.
Play video starting at :11:17 and follow transcript11:17
From her encyclopaedias, Mary learns in
exquisite detail how the human brain detects and processes colour information.
One day, Mary's released from the room.
When she goes outside, she spots a red rose and
she experiences seeing colour for the first time.
Play video starting at :11:36 and follow transcript11:36
Jackson claims that, at this moment, Mary learns something new about human vision.
Play video starting at :11:42 and follow transcript11:42
Previously, Mary knew about how the human brain processes colour.
Play video starting at :11:48 and follow transcript11:48
Now Mary also learns about the subjective feelings that accompany seeing colour.
The distinctive conscience feeling of seeing red.
Play video starting at :11:58 and follow transcript11:58
This conscience feeling is not something that Mary could have predicted based on
her books alone.
Play video starting at :12:5 and follow transcript12:05
Mary needed to go outside the room and
experience seeing colour herself to learn about this fact, about the human visual system.
Solving the hard problem of consciousness requires showing how every aspect of
phenomenal consciousness is determined by brain activity.

Play video starting at :12:22 and follow transcript12:22
Mary's predicament appears to show that we'll never achieve this.
Play video starting at :12:27 and follow transcript12:27
Mary knows all there is to know about how the human brain works, yet
the facts about phenomenal consciousness still elude her.
Play video starting at :12:36 and follow transcript12:36
This means that even if we were lucky enough, like Mary, to have a completed
neuroscience, we will would still be stuck with the hard problem of consciousness.
We would still not know how conscious feelings arise from brain activity.
Mary doesn't know this, so future neuroscientists wouldn't know it either.
Play video starting at :12:57 and follow transcript12:57
No matter how much neuroscience progresses,
we would still be stuck with the hard problem of consciousness.
Play video starting at :13:4 and follow transcript13:04
Mary's predicament appears to show that we're stuck with our
two different perspectives on conscious experience.
The project of reducing phenomenology to brain science is doomed to failure.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/lecture/LhaeE/2-1-what-is-consciousness-part-i>

Hi. I'm David Carmel,
I'm a Lecturer in Psychology, at the University of Edinburgh.
In the first part of this lecture,
Mark Sprevak talked about philosophical approaches to consciousness.
In this second part, I'll be talking about scientific investigations.
So what sorts of questions do scientists ask
when we investigate consciousness?
And how much progress have we made in turning these questions from philosophical
musings, into issues that can be investigated empirically?
Play video starting at ::34 and follow transcript0:34
The most fundamental question, is how is it that the activity of a physical system,
the brain, can create consciousness and subjective experience in the first place?
As we saw earlier, this is known as the 'hard problem' and
science is no closer than it has ever been to being able to answer it.
The problem is that we don't know what an answer would look like.
We don't have the ways of thinking, or the conceptual framework, to answer such
a question, and it may be staring us in the face, and we just don't recognize it.
Other major questions, are considered easy questions.
It's important to be clear by what we mean by 'easy' in this case.
It's not that these questions are easy to solve, but rather that it
would be easy for us to recognize an answer, if and when we ever found one.
And we have some idea of how to go about this.
The two questions that scientists are most interested in these days, both
fall under the heading 'neural correlates of consciousness' or NCC for short.
Both questions are concerned with, what kinds of neural activity correlate with,
happen at the same time as, processes related to consciousness.
The first of these, asks what neural activity determines the state or
level of consciousness that a person is in;

what kind of activity determines whether we are awake or
asleep, in a comma or in a vegetative state and so on.
The second question asks what processes determine the content of
our consciousness;
our momentary awareness of ourselves and of the world around us, at any given time.
A lot of recent research, has focused on perceptual awareness,
discovering what links the information coming in to our brain through our senses,
with what we become aware of.
Play video starting at :2:14 and follow transcript2:14
How does brain activity give rise to different states of consciousness?
Let's start by examining what states exist.
It's useful to think of ones state of consciousness, as a combination of
two factors: wakefulness, or what one's level of consciousness is;
and awareness, having conscious content.
Our level of wakefulness, determines whether we're awake or not.
Our awareness is our capacity to think, feel and
perceive our environment and ourselves.
It's what enables us to interact with the world, in a meaningful way.
It may seem strange to divide attention in to these two separate factors, but
as we'll see, it's useful.
Right now you're fully awake, or at least I hope you are.
So, you're at the high end of the scale for both wakefulness and awareness.
When you fall asleep tonight, you'll first become drowsy and then eventually fall
into a deep sleep, where both your wakefulness and awareness will be low.
Play video starting at :3:3 and follow transcript3:03
For people under anaesthesia or
in a coma, awareness and wakefulness are reduced even further.
Play video starting at :3:9 and follow transcript3:09
If these were the only states that existed, we wouldn't need two
separate axis to describe them, they'd all fall along a single line.
However, there are cases where the two axis are dissociated.
One is high, while the other is low.
The most obvious example is dreaming where wakefulness is low
because the person is asleep,
and awareness is high;
the person experiences feelings, sensations and thoughts.
In the rare condition of lucid dreaming people are even aware that
they are in a dream.
Unfortunately, there are also clinical conditions known collectively as
disorders of consciousness, where brain injury leads to high wakefulness and
low awareness at the same time.
These conditions include, the vegetative state and the minimally conscious state.
Patients in the vegetative state, have normal sleep wake cycles, but
when they're awake, with their eyes open,
they don't respond to their environment, and don't interact with it
in any way that would indicate they're aware of what's going on around them.
Sometimes these patients' condition improves, and
they are reclassified as being in a minimally conscious state, indicating that
they sometimes show, limited responsiveness to their environment.

Play video starting at :4:15 and follow transcript4:15
What sort of brain activity determines one's state of consciousness?
There's no single brain area whose activity is solely responsible for
either awareness or wakefulness.
The brain is a vastly integrated system,
and a person's state of consciousness
is the outcome of many subsystems' combined activity.
There are, however, certain brain areas,
whose activity contributes to specific aspects of consciousness.
Play video starting at :4:39 and follow transcript4:39
Wakefulness is highly dependent on activity in the subcortical structures.
So to see what I mean, here's a little model of a brain.
Play video starting at :4:47 and follow transcript4:47
The cortex is the outer layer.
And if we look at the inside, subcortical structures lie deep below the cortex.
Play video starting at :4:55 and follow transcript4:55
The areas involved in wakefulness, include the reticular formation and
the thalamus which is right here in the middle.
And these are evolutionarily ancient regions.
The reticular formation and the thalamus are involved in diverse functions,
amongst them the regulation of arousal and sleep wake cycles.
Damage to these areas, can cause disorders of consciousness such as a coma or
a vegetative state.
But those conditions can also arise from damage to a variety of other brain areas.
Unlike wakefulness, which as we said is dependent mostly on subcortical functions,
awareness is mostly dependent on activity in the cortex.
The cortex is a relatively recent evolutionary development and
is responsible for higher mental functions in humans.
Awareness can be divided into two complimentary elements.
The first is external awareness, the awareness we have whenever we
navigate through the environment and interact with it.
This awareness is largely dependent on activity, in the frontal and
parietal lobes of the cortex.
Roughly speaking, the areas that are in the upper, outer surface of the brain.
The second element of awareness is the kind that occurs when we're not focused on
the external environment, but on our internal world;
daydreaming, retrieving memories, or planning for the future.
This kind of awareness,
depends on a network of regions that are on the medial side of the brain,
that is the side where the two hemispheres of the brain face each other.
When we're awake, we're usually either focusing on something in
our external environment or direction our attention inwards.
It's rare, and some would say impossible, to be doing both things at the same time.
It's therefore unsurprising that the activity of the two networks involved in
awareness, is negatively correlated.
That is, when either one of them is high
the other is low.
Play video starting at :6:40 and follow transcript6:40
Changes in wakefulness, which, as we saw,
are governed by subcortical structures, affect activity in the cortex too.

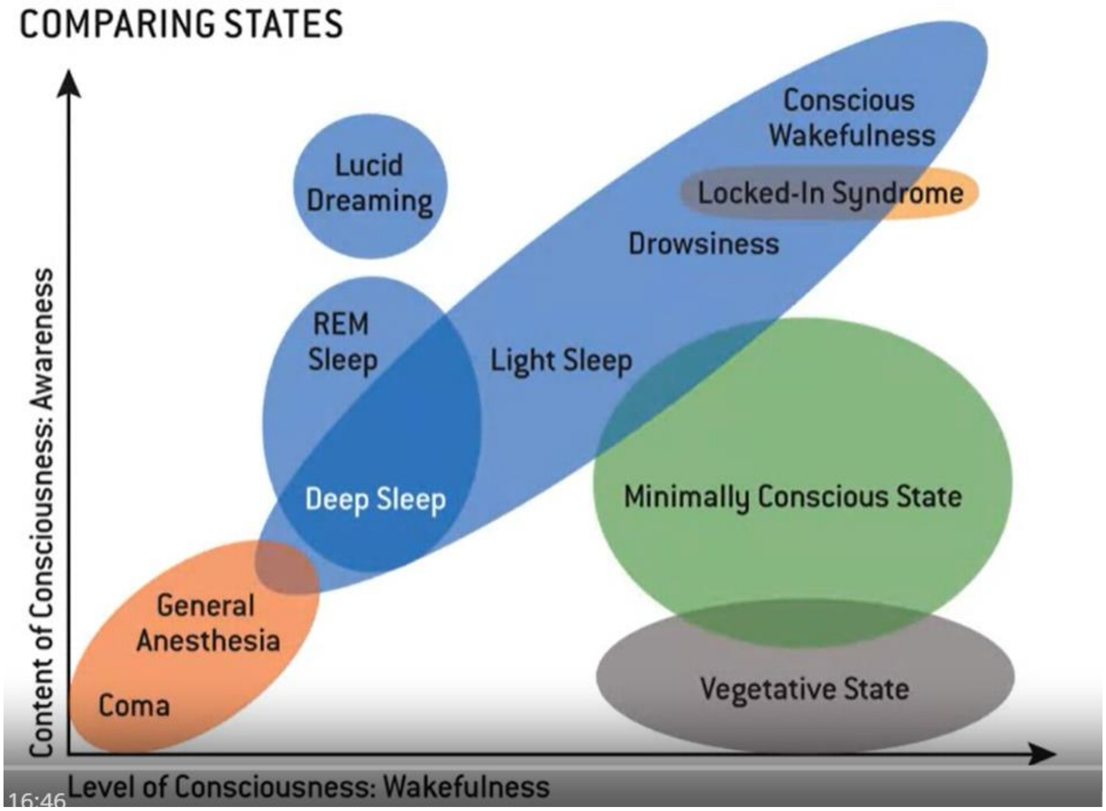
While we're awake,
different areas of the cortex busily communicate with one another.
As we fall asleep, these areas' communication with each other is reduced.
The most sharp reduction occurs between areas of the frontal and posterior, or back part of the cortex.
The physical connections between these areas still exist, but
as we fall asleep, they communicate with each other less and less.
Play video starting at :7:19 and follow transcript7:19
So far, we've focused on states of consciousness and
the brain activity that underlies them.
But as we mentioned earlier, researchers are also interested in
the processes that determine the content of our consciousness at any given time;
our perceptual awareness.
Play video starting at :7:33 and follow transcript7:33
One question we can ask,
is just how much of the world around us we're actually aware of.
Although, normally we think we're aware of many of the different things around us,
research shows that at any given time, we're actually aware of a surprisingly
small subset of the information entering our brain through our senses.
There are many great demonstrations that test the limitations of our awareness.
If you want to experience this for
yourself, click on the following YouTube videos. These include demonstrations by Daniel Simons, and Christopher Chabris. Make sure you follow the instructions.
Did those demonstrations work for you?
The phenomenon these videos demonstrate is called inattentional blindness, and
its very existence attests to the intimate link between awareness and attention.
Hundreds of studies have looked at inattentional blindness,
in an effort to figure out, what we will see, and what we will miss, and
what factors affect those things.
As we just saw, one of the relevant factors seems to be our attentional set,
what we happen to be looking for.
The chances of missing something that we're not looking for are greater.
Another relevant factor seems to be the capacity limits of our
visual working memory.
That's the store of visual information that's available for our immediate use.
Researchers have examined how many elements can appear in a picture before
people start missing things.
Now it depends on the exact object, and on the type of change that happens.
But in most cases the number isn't large at all.
It's limited to about four elements.
Play video starting at :9:2 and follow transcript9:02
We now turn to the processes that shape our awareness of the things we
do perceive.
Play video starting at :9:8 and follow transcript9:08
To investigate this, researchers often use something called 'bistable images'.
And most well-known example of a bistable image is the Necker Cube, which can be
perceived as if one side of it is in front or as if the other side of it is in front.
The Necker Cube has all three hallmarks of a bistable image.
First of all, it has two possible conscious interpretations.

Second, you can't see both interpretations at the same time.
Try it.
And third, these interpretations tend to alternate every few seconds.
Another famous example of a bistable image is the Rubin face vase,
where you can see the same image either as two faces facing each other,
or as a single vase.
Why are bistable images so useful to consciousness researchers?
Well, what we have here is a case of dissociation between
perception and awareness.
The external stimulus, the thing that's out there in the world, does not change.
Yet our perception does change.
Since the only change is happening in our own brains, if we understood the process
that causes this to happen, we would have a window into how the brain selects
content for representation and consciousness.
Several kinds of bistable image
have been used in neuroimaging research, where researchers have looked to see
which areas of the brain would be active at the same time as perceptual switches.
Repeatedly, researchers have found time-locked activity,
where brain areas were active at the same time as a perceptual switch.
Not only in visual areas of the brain,
which are in the occipital lobe, way back here.
Play video starting at :10:40 and follow transcript10:40
But also in frontal and parietal regions of the brain.
Areas we have mentioned before, as related to external awareness.
So can we conclude that this frontal and
parietal activity causes the changes in perception?
Not so fast.
Just because something happens to the brain at the same time
as a perceptual event, such as a switch in the bi-stable image,
that doesn't mean that this activity causes that change.
We know that it correlates with the change, we know that it
happens at the same time as the change, but correlation is not causation.
It could be that this brain activity is involved in noticing that
the change has occurred at the same time that it's occurring.
It could also be that something else, like activity in a completely different brain
area, is causing both the change in perception and the activity in frontal and
parietal cortex.
Play video starting at :11:29 and follow transcript11:29
If a certain brain region has a causal influence,
then actively manipulating it's activity will cause changes in perception.
That's what we need to do to infer causality.
Play video starting at :11:39 and follow transcript11:39
To do this, to manipulate brain activity, researches often use a technique called
transcranial magnetic stimulation, or TMS for short.
We do it in places like this, the University of Edinburgh's TMS lab.
TMS works by applying a brief powerful magnetic pulse to the surface of the head,
and this interferes temporarily
with the activity of the area of cortex right underneath it.
So, to demonstrate that I've got Suilin here, who's going to help me by applying TMS

to my Broca's area.
That's the area in my, the left side of my brain, that produces speech.
So we're going to see if applying TMS to my Broca's area can interfere with my speech production.
So I'm going to count up.
And when I reach five, please press the button.
One, two, three, four, five, six, seven, eight, nine, ten.
So yes, TMS interfered with my speech production and this is how we learn about brain activity, by interfering with activity in specific areas and seeing what kind of function gets interfered with.
Supplying TMS to Broca's area, the way we did just now, that has immediate functional consequences.
We can see what the activation does.
But not every bit of the brain that we apply TMS to will have immediate observable consequences.
And sometimes we want to apply TMS to an area where we won't see immediately that something jumps or something changes,
just to see what kinds of effects this has on things like, perception.
So a number of researchers have applied TMS to parietal cortex.
That's up here.
In order to see what kind of an effect this has on bistable perception.
Play video starting at :13:12 and follow transcript13:12
Surprisingly, it turns out, that different parts of parietal cortex play a different role, in bistable perception.
Applying TMS to certain part of parietal cortex makes the switching a lot slower.
And applying TMS to slightly different parts of parietal cortex has the opposite effect.
Making switches, faster.
So we now know the parietal cortex is definitely causally involved in bistable perception.
But we still need to figure out what role exactly each of these different areas within parietal cortex plays and how the neural system as a whole reaches a consensus, about what we're seeing.
Play video starting at :13:53 and follow transcript13:53
To understand consciousness we need to know the difference between processes that require awareness, and those that don't.
If we can perceive something without awareness, that tells us awareness is not necessary for that kind of perception.
Play video starting at :14:7 and follow transcript14:07
It therefore narrows down the list, of the processes that awareness is necessary for.
So how do we investigate unconscious perception?
Researchers have developed various ways of showing people things that enter the eyes, but don't reach people's awareness.
This is different from showing people things that they don't notice because they're not paying attention, as we saw earlier with inattentional blindness.
It's also different from visual illusions, which distort perception.
What we're talking about here, is showing people things, but actively suppressing them from awareness.
Play video starting at :14:39 and follow transcript14:39

Here, we'll talk about one widely used technique as an example. This technique is
backward visual masking, where one image is shown very briefly, and it's followed
immediately after by another image at the same location, presented for longer.
When this is done right, people can't report the first of the two images, and
often deny that it was there at all.
One of the first studies to use backward masking to investigate unconscious perception,
employed a method called 'masked priming'.
People were shown a single word
followed immediately by a mask that was a meaningless pattern.
After each such presentation, they were shown a string of letters and
they had to decide whether it was a real word or not.
Interestingly, people were faster to detect real words when they were
semantically related to the word that had been masked, than when it was not.
Play video starting at :15:27 and follow transcript15:27
For example, if the masked word was 'infant', people would then be faster to
recognize the word 'child' than they would to recognize the word 'orange'.
This indicated that the masked word had activated a semantic network in the brain.
And that the masked word had been processed deeply enough to
enable faster recognition of related words.
And this priming effect, was just as large without awareness as with it.
Play video starting at :15:50 and follow transcript15:50
In recent brain imaging work, researchers have shown that masked words
activate visual areas of the brain more than meaningless strings of letters do,
even when people remain unaware of the masked words.
However, unmasked words activate many more regions of the brain, and
these areas communicate with each other much more when the words are unmasked.
In this lecture we have examined several of the philosophical and
scientific current approaches to consciousness.
At this point, there is no theory, that offers a full unified account of
consciousness and how it arises from the activity of physical systems.
Current theories offer agendas for future research:
what themes and what issues we should be following if we
want to reach an understanding of consciousness.
But only time will tell which ones of these teams and
which ones of these directions will turn out to be fruitful.
And only time will tell how much progress we will make.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/lecture/0L1FC/2-2-what-is-consciousness-part-ii>



2.1 Creature Consciousness

An animal, person or other cognitive system may be regarded as conscious in a number of different senses.

Sentience. It may be conscious in the generic sense of simply being a *sentient* creature, one capable of sensing and responding to its world (Armstrong 1981). Being conscious in this sense may admit of degrees, and just what sort of sensory capacities are sufficient may not be sharply defined. Are fish conscious in the relevant respect? And what of shrimp or bees?

Wakefulness. One might further require that the organism actually be exercising such a capacity rather than merely having the ability or disposition to do so. Thus one might count it as conscious only if it were *awake and normally alert.* In that sense organisms would not count as conscious when asleep or in any of the deeper levels of coma. Again boundaries may be blurry, and intermediate cases may be involved. For example, is one conscious in the relevant sense when dreaming, hypnotized or in a fugue state?

Self-consciousness. A third and yet more demanding sense might define conscious creatures as those that are not only aware but also aware that they are aware, thus treating creature consciousness as a form of *self-consciousness* (Carruthers 2000). The self-awareness requirement might get interpreted in a variety of ways, and which creatures would qualify as conscious in the relevant sense will vary accordingly. If it is taken to involve explicit conceptual self-awareness, many non-human animals and even young children might fail to qualify, but if only more rudimentary implicit forms of self-awareness are required then a wide range of nonlinguistic creatures might count as self-conscious.

What it is like. Thomas Nagel's (1974) famous *"what it is like"* criterion aims to capture another and perhaps more subjective notion of being a conscious organism. According to Nagel, a being is conscious just if there is "something that it is like" to be that creature, i.e., some subjective way the world seems or appears from the creature's mental or experiential point of view. In Nagel's example, bats are conscious because there is something that it is like for a bat to experience its world through its echo-locatory senses, even though we humans from our human point of view can not emphatically understand what such a mode of consciousness is like from the bat's own point of view.

Subject of conscious states. A fifth alternative would be to define the notion of a conscious organism in terms of conscious states. That is, one might first define what makes a mental state a conscious mental state, and then define being a conscious creature in terms of having such states. One's concept of a conscious organism would then depend upon the particular account one gives of conscious states (section 2.2).

Transitive Consciousness. In addition to describing creatures as conscious in these various senses, there are also related senses in which creatures are described as being *conscious of* various things. The distinction is sometimes marked as that between *transitive* and *intransitive* notions of consciousness, with the former involving some object at which consciousness is directed (Rosenthal 1986).

From <https://plato.stanford.edu/entries/consciousness/>

Week 2 Quiz

Wednesday, February 15, 2023
4:30 PM

PreviousNext

- **One of the hardest problems in science is the nature of consciousness. We know that we have consciousness. We do not just blindly process information, make discriminations, take actions. It also feels a certain way to do so from the inside. Why do creatures with brains like ours have consciousness? What makes certain bits of our mental life conscious and others not? These questions form the heart of consciousness science, an exciting field to which psychologists, neuroscientists and philosophers contribute. This session will explore these questions, and introduce some recent progress that has been made towards answering them.**
- **Week 2 Quiz**
- **Quiz:** Week 2 Quiz: What is consciousness?
  10 questions
- **Additional Readings**
- **@Edinburgh**

Week 2 Quiz: What is consciousness?

Quiz30 minutes • 30 min

Submit your assignment

Due February 26, 11:59 PM ISTFeb 26, 11:59 PM IST

Attempts 3 every 8 hours

Start assignment

Receive grade

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Back

Week 2 Quiz: What is consciousness?

Graded Quiz. • 30 min. • 10 total points available.10 total points

DueFeb 26, 11:59 PM IST

1.

Question 1

What is phenomenal consciousness?

1 point

Wakefulness.

Consciousness of wonderful or ‘phenomenal’ experiences.

The ability to discriminate between flavours, such as Coca Cola or chocolate.

The subjective "feel" of something, such as the taste of Coca Cola or chocolate. [Answer]

2.

Question 2
What is the ‘hard problem’ of consciousness?

1 point

To explain how creatures like ourselves can achieve what are known as higher states of consciousness, such as those sometimes experienced during meditation.

To explain how creatures like ourselves have phenomenal consciousness. [Answer]

To explain how creatures like ourselves can respond intelligently to stimuli in the environment.

To explain how creatures like ourselves require sleep.

3.

Question 3
What is phenomenology?

1 point

The claim that our phenomenal, introspective states cannot be explained scientifically.

Using brain imaging techniques, for example employing an fMRI scanner, to assess which parts of the brain are responsible for conscious experiences.

The subjective “feel” of something such as the taste of chocolate or mint.

Using introspection to reflect on our conscious life, from a subjective point of view. [Answer]

4.

Question 4
Which of the following would be examples of reductive explanations? **(Pick 3)**

1 point

Explaining why a washing machine broke by appealing to the incompetence of the technician who maintains it.

Explaining the properties of water by appealing to its underlying chemical structure. [Answer]

Explaining the pressure and temperature of gasses by appealing to laws and mechanisms concerning the constituent molecules of the gas. [Answer]

Explaining why a window is broken by appealing to a brick which has been thrown though it.

Explaining how a person's conscious feelings arise by appealing to their brain mechanisms. [Answer]

Explaining why we fall asleep by appealing to the tiring activities of the preceding day.

5.

Question 5
What is Frank Jackson's thought experiment involving the character Mary supposed to show?

1 point

Learning everything there is to know about neuroscience is sufficient to know what it is like, subjectively, to experience colour.

The unhealthy psychological effects of prolonged solitary confinement.

Learning everything there is to know about neuroscience is not sufficient to understand the poetic connotations associated with the rose.

Learning everything there is to know about neuroscience would not be sufficient to know what it is like, subjectively, to experience colour. [Answer]

6.

Question 6
Which of the following questions have scientists researching consciousness recently been

interested in? **(Pick two)**

1 point

What neural activity is responsible for our moral decision making, i.e. our conscience?

What neural activity determines the content of consciousness, i.e. what we experience? [Answer]

What neural activity is responsible for the fact that we experience anything at all?

What neural activity determines the particular state of consciousness that we are in, i.e. awake, asleep, or in a coma? [Answer]

7.

Question 7

What is the difference between wakefulness and awareness?

1 point

Wakefulness determines whether there is any activity going on in our brain, and awareness determines whether or not we are aware of that activity.

There is no difference – both terms refer to whether or not we are conscious.

Wakefulness determines whether we are awake or asleep, whilst awareness determines whether we experience anything or not. [Answer]

8.

Question 8

What are the three hallmarks of a bistable image? **(Pick 3)**

1 point

Only one interpretation is consciously perceived at any one time. [Answer]

Two interpretations of a single image are consciously perceived at once.

Different people see a different interpretation of the same image.

An image can be interpreted in two or more different ways, but only one interpretation can ever be seen.

Two or more possible conscious interpretations. [Answer]

The interpretation that dominates awareness tends to switch every few seconds. [Answer]

9.

Question 9

What are bistable images used for in consciousness science?

1 point

They are used in order to place subjects into a trance-like state.

Investigating a case where our perceptual experience changes even though the stimulus evoking it does not. [Answer]

They are not used, as it might be distressing to experience a bistable image that our minds cannot fully comprehend.

Investigating a case where our perceptual experience stays the same even though our environment is changing.

10.

Question 10

What is backward visual masking used for in consciousness science?

1 point

Investigating whether consciousness can be used exert an influence on events that have already occurred.

Investigating whether images that we are not consciously aware of can influence our behaviour. [Answer]

Investigating whether images that we are consciously aware of can be suppressed by later experiences.

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From <https://www.coursera.org/learn/philosophy-cognitive-sciences/exam/knAqH/week-2-quiz-what-is-consciousness/attempt>

Intelligent Machines

Wednesday, February 15, 2023
6:05 PM

How does one make a clever adaptive machine that can recognise speech, control an aircraft, and detect credit card fraud?

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/home/week/3>

Recent years have seen a revolution in the kinds of tasks computers can do. Underlying these advances is the burgeoning field of machine learning and computational neuroscience. The same methods that allow us to make clever machines also appear to hold the key to understanding ourselves: to explaining how our brain and mind work. We explore this exciting new field and some of the philosophical questions that it raises.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/home/week/3>

We can build computers that do amazing things.
An exciting recent development is a new field called machine learning.
Machine learning aims to create machines that can learn from their experiences.
Play video starting at ::21 and follow transcript0:21
Remarkably, machine learning appears to hold the key to understanding how our own brains work.
Play video starting at ::29 and follow transcript0:29
In this section, we're going to explore this exciting new field and some of the questions that it raises.
Intelligent machines are all around us.
They power our search engines.
They filter our email for spam.
They suggest things that we might like to buy or like to see.
They drive cars and they even explore other planets for us.
None of these tasks is easy.

To solve them, a machine needs to not only follow rules, but
also recognize patterns and react quickly to new information.
Play video starting at :1:1 and follow transcript1:01
Our machines are able to do this courtesy of a brilliant idea, computation.
Play video starting at :1:7 and follow transcript1:07
A computation is a way of solving a problem by following a set of
instructions, or a recipe, called an algorithm.
An algorithm tells a machine how to solve its problem by taking a series of
small steps.
The steps are usually very simple, such as adding one or
checking if two numbers are the same, but when many small simple steps are joined
together, the result can be behavior that's both complex and intelligent.
Play video starting at :1:37 and follow transcript1:37
The father of our modern idea of computation is Alan Turing.
Alan Turing was an English mathematician who lived from 1912 to 1954.
Turing was obsessed with the project of trying to create an intelligent machine.
Turing discovered what he thought was the key to this in
his most famous mathematical paper.
Play video starting at :2: and follow transcript2:00
In that paper,
Turing discovered what's now known as a universal computing machine.
A universal computing machine is a machine that,
if given the right instructions, can replace any of our computer.
Play video starting at :2:15 and follow transcript2:15
That might sound like an incredible proposal.
A single machine that could replace any other computing machine, not just on
the planet now, but any other computing machine that could possibly be built.
Play video starting at :2:28 and follow transcript2:28
You might guess that if a universal computing machine exists at all,
it would have to be a fantastically complex device.
Alan Turing showed something that nobody had guessed.
It's relatively easy to build a universal computing machine.
Play video starting at :2:44 and follow transcript2:44
The universal computing machine that Turing described is known today as
the universal Turing Machine.
Play video starting at :2:51 and follow transcript2:51
The universal Turing Machine consists of a long paper tape and a head that can scan
along the tape and read and write symbols, guided by a simple set of instructions.
Play video starting at :3:3 and follow transcript3:03
If given the right set of instructions, the right algorithm,
a universal Turing machine can mimic,
can reproduce the behavior of any possible computing machine.
Play video starting at :3:15 and follow transcript3:15
So it seems that the problem of producing intelligent behavior is now
reduced to simply the problem of finding the right kind of algorithm.
But what kind of algorithm produces intelligent behavior?
Play video starting at :3:29 and follow transcript3:29
For many years, attention focused on algorithms that involved
language-like symbols and rules, the sort of thing that you might see if you
try to write down in English instructions on how to create intelligent behavior.
Play video starting at :3:43 and follow transcript3:43

More recently, attention's focused on algorithms that do
not involve language-like rules and symbols.
These algorithms manipulate distributed patterns of activity in a network
inspired by the human brain, so-called connectionist networks.
Play video starting at :4: and follow transcript4:00
Today, the algorithms that hold the most promise for
generating intelligence behavior are probabilistic algorithms.
Probabilistic algorithms allow a system to represent not only a range of
different outcomes, but also the system's uncertainty about those outcomes.
The system may represent not only that there's a tiger lurking around the corner,
but also how uncertain the system is about this.
Play video starting at :4:25 and follow transcript4:25
One of the great virtues of probabilistic algorithms, as we'll see later,
is that they allow a system to learn from experience using a simple
principle called Bayes' rule.
The idea of computing allows us to build intelligent machines, but
it also suggests a new way of thinking about ourselves.
If performing the right computation is the way to make a machine intelligent,
perhaps that's also what makes us humans intelligent.
Play video starting at :4:53 and follow transcript4:53
Perhaps computation is not just a useful engineering tool, but
also the key to explaining how the human brain works.
Let's unpack the idea that computation could help us to explain the human brain.
Play video starting at :5:7 and follow transcript5:07
In the 1970s, a brilliant young cognitive scientist called David Marr said that
computation could help us to answer three different questions about the brain.
First, which task does the brain solve?
Second, how does the brain solve that task?
Third, why is that task important for the brain to solve?
Play video starting at :5:29 and follow transcript5:29
Marr grouped these three questions into three different levels of
computational description.
Let's look at each of these levels of description in turn.
Play video starting at :5:40 and follow transcript5:40
Rather confusingly,
Marr called his first level of description the computational level.
The computational level for Marr covers two things.
First, which task does the brain solve?
And second, why is that task important for the brain to solve?
Play video starting at :5:58 and follow transcript5:58
Let's use a thought experiment to understand the computational level better.
Imagine that one day, you discover in your granny's attic a mysterious device.
The device has buttons, dials and levers, and you don't know what any of it does.
Play video starting at :6:13 and follow transcript6:13
However, you remember that granny used the device when she
was balancing her checkbook.
Play video starting at :6:19 and follow transcript6:19
You play around with the device and you notice a pattern.
Play video starting at :6:22 and follow transcript6:22
If you dial two numbers into the device,
it appears to display something that stands for their sum.

Play video starting at :6:30 and follow transcript6:30
Balancing a checkbook requires adding numbers.
Play video starting at :6:34 and follow transcript6:34
Therefore, it seems reasonable to think that the task granny's device
solves is that of computing the addition function.
Play video starting at :6:43 and follow transcript6:43
In Marr's terms, this is a computational level description of granny's device.
It's a description of which mathematical function, addition, subtraction,
multiplication, the device computes.
Play video starting at :6:57 and follow transcript6:57
Notice that in order to answer this which question,
we have to answer a why question.
Why was granny using the device?
Without some guess as to a device's intended purpose, in this case,
balancing a checkbook, we would have no way of picking out from the vast number of
physical things a device does which are relevant to solving its tasks.
Play video starting at :7:22 and follow transcript7:22
This is why Marr groups his which and why questions together.
Both fall under what he calls the computational level description of
the device.
Marr's second level of description is called the algorithmic level.
The algorithmic level concerns how the device solves its task.
Play video starting at :7:41 and follow transcript7:41
There are many different algorithms that compute the addition function.
Without further investigation,
all we know is that granny's device is using one of them.
Play video starting at :7:50 and follow transcript7:50
Different algorithms would involve the device taking different steps or
taking its steps in different orders.
Some algorithms are faster than others and some use less memory.
How do we know which algorithm granny's device is using?
Play video starting at :8:6 and follow transcript8:06
A good start is to try and find out the basic steps that granny's device can take,
how long it takes to execute a single step, and how much memory it has.
Once we know these basic building blocks,
we can start to form hypotheses about which algorithm it's using.
Play video starting at :8:23 and follow transcript8:23
We can then probe granny's device by giving it lots of addition problems.
We can look at its performance profile, how fast it solves problems, and
the errors it's susceptible to make.
Play video starting at :8:35 and follow transcript8:35
By looking at its performance profile,
we can test our hypotheses about which algorithms it's using.
Marr's third level is called the implementation level.
Play video starting at :8:46 and follow transcript8:46
Even if we're sure of which algorithm granny's device uses,
we still wouldn't know how the physical parts inside granny's device map onto
steps in that algorithm.
Play video starting at :8:58 and follow transcript8:58
Imagine we open granny's device up.
Inside, we might find all sorts of different things,

little gears, cog wheels, pins, and hammers.
Play video starting at :9:8 and follow transcript9:08
An implementation level description would describe the role each one of
these physical parts plays in implementing the device's algorithm.
How do we go about finding this implementation level description?
Play video starting at :9:23 and follow transcript9:23
Well, one strategy would be to keep granny's device open and
watch what changes inside it when it solves an addition problem.
We could then try mapping those physical changes inside the device onto steps in
its addition algorithm.
Play video starting at :9:39 and follow transcript9:39
Another strategy would be to intervene on the device.
Play video starting at :9:43 and follow transcript9:43
We might try rewiring or moving one of its components and
seeing how that affects its performance.
This will give a clue as to the role of that component in
implementing its algorithm.
Play video starting at :9:55 and follow transcript9:55
Marr provides us with three ways in which computation can help us to
explain a mysterious device.
Play video starting at :10:2 and follow transcript10:02
One might use computation to offer a computational level description of
the device.
Which function does it compute and why?
An algorithmic level description.
How does it compute that function?
Or an implementation level description.
How do the physical components of that device map onto steps in its algorithm?
Play video starting at :10:23 and follow transcript10:23
The puzzles we face with granny's device are not a million miles away from
the problems that cognitive scientists face when confronted by the human brain.
Play video starting at :10:33 and follow transcript10:33
Cognitive scientists want to know which computation the brain performs,
which algorithm it uses for performing that computation, and which
physical bits of the brain are relevant for implementing that computation.
The techniques that cognitive scientists use to answer these
questions are also structurally similar.
Play video starting at :10:54 and follow transcript10:54
Cognitive scientists try to understand the purpose of a particular piece of behavior.
What does our piece of behavior aim to achieve for the brain?
Play video starting at :11:3 and follow transcript11:03
They fit hypotheses about algorithms that the brain is
running to data about human reaction times and susceptibility to error.
Play video starting at :11:12 and follow transcript11:12
And they watch and
intervene on the brain using a variety of experimental techniques to try and isolate
the role that various physical bits of the brain play in generating behavior.
The big difference between granny's device and
the human brain is that brains are vastly more complex.
The human brain is one of the most complex objects in the universe.
It has over 100 billion neurons and

a mind-bogglingly complex web of close to a quadrillion connections.
The brain performs not one, but many different computations simultaneously,
each one a great deal more complex than the addition function.
Unraveling a computational description of the brain is a daunting task, yet
it's a project on which significant progress has already been made.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/lecture/iMbEJ/3-1-intelligent-machines-part-i>

As you probably know,
there's been a lot of research recently trying to understand how the brain works.
And in particular, the types of computations it might perform.
A new hypothesis has emerged.
The brain might be working like a probabilistic machine.
At the origin of this idea is the recognition that we live in a world
of uncertainty.
Our environment is often ambiguous or noisy and
our sensory receptors are limited.
Often multiple interpretations are possible.
In this context, the best our brain can do is to try to
guess what's present in the world and what best action to take.
Hermann Von Helmholtz is often credited for understanding this.
Studying the human eye,
Von Helmholtz judged it to be a very imperfect optical instrument.
He then proposed that vision perception resulted from what he called the process
of unconscious inference through this automatic process the brain
would be able to complete missing information using previous information and
construct hypotheses about the world.
This hypothesis would then be automatically accepted
as our immediate reality.
The brain would be a very sophisticated guessing machine.
This idea has been formalized in recent years,
taking ideas from machine learning and statistics.
It is proposed, that the brain works by constantly forming hypotheses or
beliefs about the environment and the actions to take.
Play video starting at :1:31 and follow transcript1:31
Those hypotheses can be described mathematically as conditional
probabilities denoted p of the hypothesis given the data.
Which means the probability of the hypothesis given the data,
where data represents the signals available to our senses.
Play video starting at :1:50 and follow transcript1:50
For example,
suppose you are trying to figure out whether it's going to rain today.
Play video starting at :1:55 and follow transcript1:55
The data available might be the dark clouds that you can observe by the window.
Play video starting at :2: and follow transcript2:00
Statisticians have shown that the best way to compute these probabilities is to use
Bayes' Rule, named after Thomas Bayes.
Play video starting at :2:9 and follow transcript2:09

Bayes' Rule states that we can get the probability p of the hypothesis given
the data which we call the posterior probability by multiplying two other
probabilities.
Play video starting at :2:20 and follow transcript2:20
First, P of the data given the hypothesis.
Our knowledge about the probability of the data given the hypothesis for
example, how probable is it that the clouds look the way they do now
when you actually know it is going to rain which is called the likelihood,
Play video starting at :2:36 and follow transcript2:36
times P of the hypothesis which we call the prior probability.
This represents our knowledge about the hypothesis before we collect any new
information.
Play video starting at :2:46 and follow transcript2:46
Here for example, the probability that it's going to rain in a day
independently of the shape of the cloud.
A number which will be very different whether you live in Edinburgh or
Los Angeles.
The denominator, P of the data is only there to ensure the resulting probability
is comprised between zero and one and can often be disregarded in the computation.
Play video starting at :3:7 and follow transcript3:07
In the visual system, in the same way, the hypothesis could be about the presence of
a given object for example, there's an animal following me.
Play video starting at :3:15 and follow transcript3:15
The value of a given stimulus for example, the speed of
this animal is 30 kilometers per hour while the data is the noisy vision input.
Play video starting at :3:25 and follow transcript3:25
The prior and the likelihood from an internal model of the world, a model of
the world inside the brain which is used to interpret our extended environment.
Play video starting at :3:35 and follow transcript3:35
So how can we test if the brain is doing something like Bayesian inference?
This has been the focus of a lot of experimental and
theoretical research in the last 15 years.
Our first test is to look at how the brain combines information from different
sensory modalities.
Suppose for example, that you are walking in the forest and fear that someone or
an animal is following you.
Play video starting at :3:58 and follow transcript3:58
You can dimly see and hear some movement of the leaves on the ground.
Play video starting at :4:3 and follow transcript4:03
How do you figure out where the animal is located?
Do you use one sensory modality more than the other for
example, only vision or both?
Play video starting at :4:12 and follow transcript4:12
How does this depend on the reliability of the information available to each of
the senses?
Bayesian inference predicts that the optimum way to do this
is to combine information from both modalities but
weighting the information according to its reliability.
For example, if the vision information is much clearer than the auditory
information, it should have much more impact on your experience.
This can lead to illusions in situations where there is a conflict between the two

modalities.
Play video starting at :4:40 and follow transcript4:40
In a lot of situations,
it seems that the Bayesian predictions are qualitatively correct.
Have a look at this.
Ba, ba, ba, ba, ba, ba,
ba, ba, ba, ba, ba, ba, ba, ba, ba.
But now, look what happens if we changed the video.
Da, da, da, da, da.
What do you hear?
Da, da, da, da.
That sound has not changed.
Da, da, da, da.
This effect is known as the McGurk effect and it was discovered by accident.
McGurk and his research assistant MacDonald were conducting
a study on language perception in infants.
They asked a technician to dump the sound of a phoneme
over a video that was showing lips movement for another phoneme.
Play video starting at :5:36 and follow transcript5:36
Even if we know about this effect, we continue perceiving da.
This shows that our brain automatically and unconsciously combines the visual and
the auditory information in our perception of speech, creating a new mixture
that might be very different from the initial sources of information.
Play video starting at :5:52 and follow transcript5:52
Sometimes though,
if the visual information is much more reliable than the auditory information,
it can completely dominate our perceptual judgments.
This can be seen in the compelling illusion of ventriloquism.
Ventriloquism is a case of visual capture.
Play video starting at :6:8 and follow transcript6:08
Because the origin of the sound is uncertain but the lips and
expression of the puppet can be clearly perceived.
One attributes the origin of the sound to the visual inputs,
that is to the mouth of the puppet.
So in everyday life, the brain combines information from different modalities
in the way that depends on the uncertainty.
Play video starting at :6:27 and follow transcript6:27
In the laboratory, researchers can make very precise measurements
to test the validity of the base and prediction.
Play video starting at :6:34 and follow transcript6:34
For example, they can measure the smallest differences one can perceive when
comparing the size of different objects based on vision alone or touch alone.
Play video starting at :6:44 and follow transcript6:44
And then compare the predictions of the Bayesian model with performance when both
vision and touch can be use simultaneously.
Such experiments have found that human participants behave in way very similar to
the Bayesian predictions.
And I've concluded that human performances are statistically optimal.
Play video starting at :7:1 and follow transcript7:01
These results are commonly interpreted

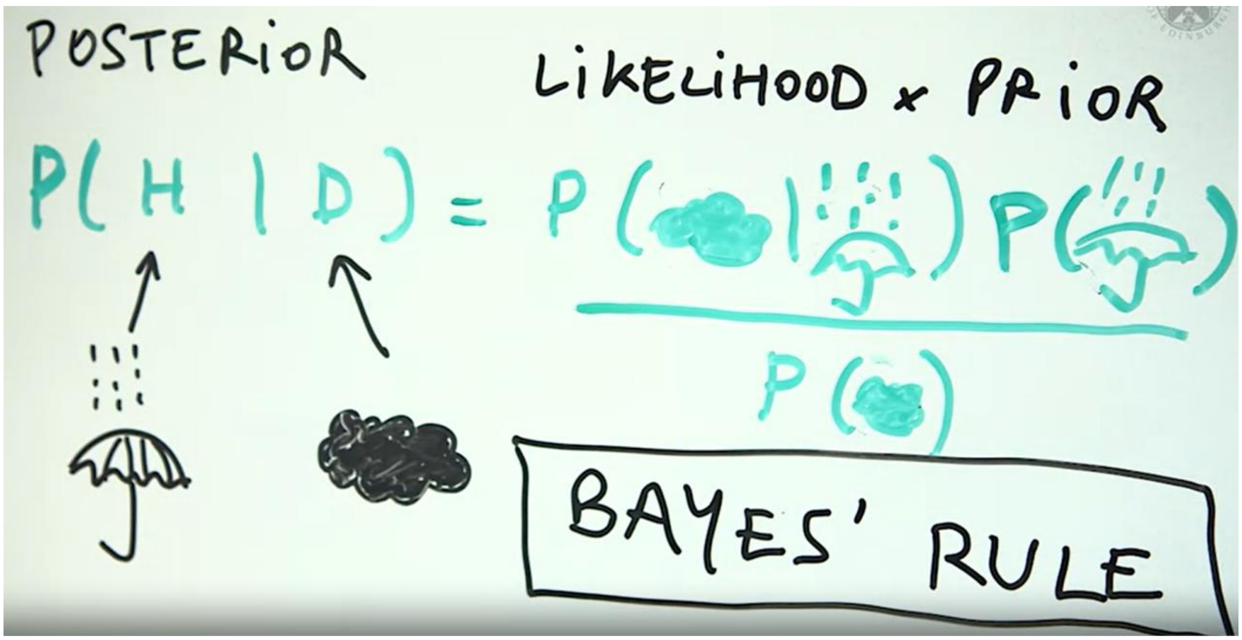
as showing that the brain works in a way similar to a Bayesian machine.
The Bayesian model predicts not only how to combine different pieces of information
but also how to incorporate prior knowledge.
Such prior knowledge should be combined in terms of a prior distribution
which serves as a summary of all previous experience and
which should be multiplied with incoming information.
Recently a lot of researchers are exploring this idea.
If the brain uses prior beliefs, what are those and
how do they influence perception?
Instinctively, it's in situation of strong uncertainty or
ambiguity that we rely maximally on our previous experience.
For example, if we wake up in the middle of the night and
need to walk in total darkness, we are going to rely on our
previous experience of the environment to guide our path.
Play video starting at :7:51 and follow transcript7:51
Similarly, Bayesian indicates that prior distributions should impact our perception
maximally in situations of strong uncertainty.
Play video starting at :7:59 and follow transcript7:59
Therefore, a very good way to look at the brain's expectations of us,
our assumptions is to look at situations of strong uncertainty.
Play video starting at :8:7 and follow transcript8:07
Such studies reveal that our brains make assumptions all the time.
I am the same height here as I am over here, but here I look much taller.
How does that work?
Play video starting at :8:19 and follow transcript8:19
When trying to estimate size, you make the assumption that the room is cubic and
the ceiling is parallel to the floor.
This assumption makes sense because most rooms are designed this way but here,
this is not the case.
The room is actually trapezoidal and the ceiling is not parallel to the floor.
The reality that we perceive is consistent with our expectations, but
not really actually physical world.
We make these assumptions all the time.
For example, we expect that lights come from above us and
interpret shadows as such.
Objects to be symmetrical to change smoothly in space and
time, orientations to be more frequently horizontal or vertical and
angles to look like perpendicular corners.
Play video starting at :9:4 and follow transcript9:04
We also expect objects to build outward more than inward,
that background images are colored in a uniform way, that objects move slowly or
not at all, that the gaze of other people is directed towards us and
that faces correspond to convex surfaces.
Play video starting at :9:22 and follow transcript9:22
This is illustrated by this classical illusion known as
the hallow-mask illusion.
What you see here is a concave mask of the face of Albert Einstein,
that is the interior of the mask.
However, we perceive it as a convex face
with a nose bulging outward instead of inward.

Our expectations that faces bulge outward is so
strong that it counters 3D cues and depth cues.
As for the McGurk effect, knowing about the illusion doesn't help.
The interpretation chosen by the brain is automatic and unconscious and
can't be modulated voluntarily.
Play video starting at :9:57 and follow transcript9:57
Why would the brain use such assumptions?
These assumptions make sense because most objects in the world
can form those expectations.
Light comes from above, noses always stick out, objects are often static or
move slowly.
In that sense,
using these assumptions would lead us to the best guess about the environment.
And we can think about them as being optimal.
Play video starting at :10:18 and follow transcript10:18
However, in situations of strong uncertainty, when the objects don't
confirm the average statistics using these expectations can lead to illusions.
We will then tend to perceive reality as being more similar to what we expect
than it really is.
Objects will be seen as being slower, more symmetrical or
maybe smoother in space and time, etc.
The Bayesian approach helps formalizing these ideas in a quantitative way.
The idea has emerged that visual illusions were not due to the limitations of
a collection of imperfect tags that the brain would use but
rather to the result of a coherent computational strategy.
That is optimal under reasonable assumptions.
Play video starting at :11: and follow transcript11:00
For some researchers because they correspond to the brain
making very sensible assumptions in a situation of uncertainty.
Visual illusions could be viewed paradoxically as optimal precepts.
A lot of very important questions remain, where do those prior beliefs come from?
How do we learn them?
Are they the same for everybody?
How do they depend on our previous experience?
And can we learn for example, that light shines from above or
that noses stick outward and not inward?
Play video starting at :11:31 and follow transcript11:31
Such questions, are the focus of current research.
Experimental work shows that our brains create
prior expectations automatically and unconsciously all the time.
We collect information about our environment and
try to use it to predict what could come next.
Play video starting at :11:47 and follow transcript11:47
Current work also shows that our brain can update even its more natural assumptions,
such as the assumption that life comes from above.
Play video starting at :11:55 and follow transcript11:55
This shows that our brain constantly revises its assumptions and
updates its internal model of the world.
The idea that the brain would work like a probabilistic machine is not restricted to
perception but has been applied to all domains of cognition.

In particular, patient models could be very useful for psychiatry.
It's very early days for understanding mental illness.
However, recent research shows that Bayesian models could be very useful for quantifying differences between groups.
For example, patients versus controls and for
understanding whether those differences come from different internal models.
For example, different prior beliefs or differences in learning or
decision strategies.
Ultimately, this may help drug discovery.
In the study of schizophrenia for example, recent work shows that
patients differs from controls in some probability inference tasks.
One such task is called the beads task.
In this task, you have two jars.
One jar contains 85% green beads and 15% blue beads.
In the other jar, there are 85% blue beads and 15% green beads.
Your task is to tell me from which jar come the beads that I'm drawing at random.
So now, I'm going to cover the jars.
Mix them.
And I'm going to draw a bead at a time from the same jar.
Play video starting at :13:20 and follow transcript13:20
Your task is to tell me when you think you have received enough information
to tell me from which jar those beads come from.
Play video starting at :13:28 and follow transcript13:28
Now?
Play video starting at :13:30 and follow transcript13:30
And one more bead.
Play video starting at :13:33 and follow transcript13:33
Another one.
Play video starting at :13:36 and follow transcript13:36
What can you decide now?
Play video starting at :13:39 and follow transcript13:39
Schizophrenic patients are more likely than controls to make a decision after
a very small number of observations like one or two draws and
to report being certain about their decision after only one draw.
This tendency to jump to conclusions is thought to be crucial for
understanding delusions and paranoia.
Play video starting at :13:58 and follow transcript13:58
Researchers use mathematical models of decision tasks like this
to understand patients decision processes.
A common idea in psychiatry is also the internal models used by patients
in particular, their prior beliefs or expectations
could be different from those of healthy subjects or maybe too strong or too weak.
Play video starting at :14:18 and follow transcript14:18
This could explain why the patients experience the world differently.
Ultimately, Bayesian modeling might have diagnoses.
Mental illness is usually measured using questionnaires or
classifications such as DSM-5 which is used by clinicians and psychiatrists.
Play video starting at :14:35 and follow transcript14:35
Computational modeling coupled with behavioral measurements such as in the bid
task or other games, offer a different way to quantify differences between patients

and healthy controls and the internal beliefs people's brains are working with.
So finally,
you must be wondering how our brain can do the sophisticated computations.
Play video starting at :14:56 and follow transcript14:56
Bayesian models are very useful for describing perception and
behavior at the computational level as Mark explained.
How those algorithms are implemented in the rain is still very unclear.
In fact, it is still quite debated whether Bayesian models can make predictions for neurobiology.
In terms of which areas of the brain would be involved and
how Bayes' Rules of the terms of this equation would be implemented.
This is the focus of current research.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/lecture/4OmBv/3-2-intelligent-machines-part-ii>



4.4 Computational neuroscience

Computational neuroscience describes the nervous system through computational models. Although this research program is grounded in mathematical modeling of individual neurons, the distinctive focus of computational neuroscience is *systems* of interconnected neurons. Computational neuroscience usually models these systems as neural networks. In that sense, it is a variant, off-shoot, or descendant of connectionism. However, most computational neuroscientists do not self-identify as connectionists. There are several differences between connectionism and computational neuroscience:

- Neural networks employed by computational neuroscientists are much more biologically realistic than those employed by connectionists. The computational neuroscience literature is filled with talk about firing rates, action potentials, tuning curves, etc. These notions play at best a limited role in connectionist research, such as most of the research canvassed in (Rogers and McClelland 2014).

- Computational neuroscience is driven in large measure by knowledge about the brain, and it assigns huge importance to neurophysiological data (e.g., cell recordings). Connectionists place much less emphasis upon such data. Their research is primarily driven by behavioral data (although more recent connectionist writings cite neurophysiological data with somewhat greater frequency).
- Computational neuroscientists usually regard individual nodes in neural networks as idealized descriptions of actual neurons. Connectionists usually instead regard nodes as *neuron-like processing units* (Rogers and McClelland 2014) while remaining neutral about how exactly these units map onto actual neurophysiological entities.

From <https://plato.stanford.edu/entries/computational-mind/>

Predictive coding – also known as 'predictive processing', 'free energy minimisation', or 'prediction error minimisation' – is an exciting novel account of human cognition. It claims to offer a complete and unified theory of cognition that stretches all the way from cellular biology to phenomenology. However, the exact content of the view, and how it might achieve these ambitions, is not clear. This series of articles examines predictive coding and attempts to identify its key commitments and its argumentative strategy. The present article begins by focusing on possible confounds with predictive coding: claims that are often identified with predictive coding, but which are not predictive coding. These possible confounds include the idea that the brain employs an efficient scheme for encoding incoming sensory signals; that our perceptual experience is shaped by our prior beliefs; that cognition involves minimisation of prediction error; that the brain is a probabilistic, approximately Bayesian, inference engine; and that the brain learns and employs a generative model of the world. These ideas have garnered widespread support in cognitive neuroscience over many years, but it is important not to conflate them, or empirical evidence that confirms them, with predictive coding.

From <https://marksprevak.com/publications/predictive-coding-i-introduction-40b2/>

Week 3 Quiz: From intelligent machines to the human brain

Wednesday, February 15, 2023
7:21 PM

Skip to Main Content

- **Recent years have seen a revolution in the kinds of tasks computers can do. Underlying these advances is the burgeoning field of machine learning and computational neuroscience. The same methods that allow us to make clever machines also appear to hold the key to understanding ourselves: to explaining how our brain and mind work. We explore this exciting new field and some of the philosophical questions that it raises.**
- **Week 3 Quiz**
- **Quiz:** Week 3 Quiz: From intelligent machines to the human brain
  10 questions
- **Additional readings**
- **@Edinburgh**

Week 3 Quiz: From intelligent machines to the human brain

Quiz30 minutes • 30 min

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Due March 5, 11:59 PM ISTMar 5, 11:59 PM IST

Attempts 3 every 8 hours

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Week 3 Quiz: From intelligent machines to the human brain

Graded Quiz. • 30 min. • 10 total points available.10 total points

DueMar 5, 11:59 PM IST

1.

Question 1
What is an algorithm?

1 point

A complicated way of encoding basic instructions.

Any mathematical function that is computable.

A set of instructions for solving a problem broken down into simple steps. [Answer]

A groovy new kind of music.

2.

Question 2
What is a universal computing machine?

1 point

A computer that is optimised for use by anyone.

A machine that can carry out the same task as any other computing machine, given sufficient time and space. [Answer]

A computer that is the size of the universe.

An electronic calculator.

3.

Question 3
What features of a system does Marr's computational level of description pick out?

1 point

Any part of the system that might develop into an artificial intelligence.

Any problems that occur whilst the system is running.

The problem that the system is designed to solve, i.e. its function or job. [Answer]

The set of instructions that the system uses in order to carry out its job.

4.

Question 4
What features of a system does Marr's algorithmic level of description pick out?

1 point

Any noises that occur whilst the system is running.

The problem that the system is designed to solve, i.e. its function or job.

A record of the instructions that the system has carried out so far.

The set of instructions that the system uses in order to carry out its job. [Answer]

5.

Question 5
What features of a system does Marr's implementation level of description pick out?

1 point

Any physical aspect of the system that is irrelevant to how it operates, i.e. the colour of its case.

The designer of the system, i.e. the one that has implemented it.

An input into the system that starts it off, i.e. the instructions given by a human operator.

The actual physical structure of the system that allows it to carry out its job. [Answer]

6.

Question 6
What is unconscious inference?

1 point

The unconscious process of constructing hypotheses about the distal causes of perceptual stimuli. [Answer]

The unconscious process of memory consolidation that is thought to happen whilst we dream.

Any mental process that goes on whilst one is unconscious.

The process of inferring that someone is unconscious rather than simply asleep.

7.

Question 7
In Bayes' theorem, what do the following sets of symbols represent? (Pick the three correct answers)

1 point

P (H l D) = the probability (P) of receiving the available data (D) assuming that an event (H) has occurred.

P (H) = the probability of an event (H) occurring, after receiving any data.

P (D l H) = the probability (P) of receiving the available data (D) assuming that an event (H) has occurred. [Answer]

P (H) = the probability of an event (H) occurring, prior to receiving any data. [Answer]

P (D l H) = the probability (P) of an event (H) given the available data (D).

P (H l D) = the probability (P) of an event (H) given the available data (D). [Answer]

8.

Question 8
What is the McGurk effect, and what does it tell us about Bayesian inference?

1 point

An illusion where what we hear influences what we see, which demonstrates how combining sensory modalities can influence our hypotheses.

An effect where people are spontaneously able to speak a foreign language, which demonstrates how little we understand about prediction.

An illusion where what we are seeing influences what we hear, which demonstrates how combining sensory modalities can influence our hypotheses. [Answer]

An illusion where what we are seeing influences what we hear, which demonstrates how bad we are at making predictions.

9.

Question 9

When will our prior beliefs most influence our actions?

1 point

When we are 100% confident that our prior beliefs are accurate.

In situations of low uncertainty, where we cannot rely heavily on our prior beliefs.

In situations of strong uncertainty, where we cannot rely heavily on perceptual data. [Answer]

When the same event is happening for the second or third time.

10.

Question 10

In what sense can visual illusions be seen as cases of optimal perception?

1 point

They present us with amusing experiences, and thus contribute to our wellbeing.

They are the result of optimal predictions given the data available, and based on prior assumptions based on the statistics of the environment. [Answer]

This is a trick question: visual illusions are clearly a case of non-optimal or erroneous perception.

When professional magicians perform them.

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From <https://www.coursera.org/learn/philosophy-cognitive-sciences/exam/DODKE/week-3-quiz-from-intelligent-machines-to-the-human-brain/attempt>

Embodied Cognition

Wednesday, February 15, 2023
7:59 PM

Embodied cognition is all about the huge difference that having an active body and being situated in a structured environment make to the kind of tasks that the brain has to perform in order to support adaptive success.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/home/week/4>

Cognitive Science has recently taken a strongly 'embodied turn', recognizing that biologically evolved intelligence makes the most of the opportunities provided by bodily form, action, and the material and social environment. This session explores the way this impacts our vision of minds, brains, and intelligent agents, and asks whether there can be a fundamental science of the embodied mind

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/home/week/4>

Hi. My name's Andy Clark,
I'm a professor of Philosophy working at the University of Edinburgh
in the school of Philosophy, Psychology, and Language Sciences.
Play video starting at ::18 and follow transcript0:18
My own particular interests lie in the Philosophy of Cognitive Science.
That's to say the sciences and study of the mind, are within that area,
in what's known as the study of embodied cognition.
Play video starting at ::30 and follow transcript0:30
Embodied cognition is all about the huge differences that having an active body,
and being situated in a stable environment, make to the kind of
tasks that the brain has to perform in order to support adaptive success.
Play video starting at ::44 and follow transcript0:44
This kind of work provides a useful antidote to the increase in
the neurocentric vision that we encounter in contemporary media.

For example, it often seems as if we've learned all we need to know
about spatial navigation, or perhaps about falling in love, when we learned which
bits of the brain are doing what, when we exhibit those kinds of capacities.
Play video starting at :1:5 and follow transcript1:05
In fact, though, for most interesting capacities that biological agents exhibit,
they turn upon a complex interplay between what the brain's doing and
what the body is doing.
Bringing new perceps into the processing arena and
what we do out there in the world.
Play video starting at :1:23 and follow transcript1:23
Given that my interest lies squarely in body cognition in these ways,
I'm very fortunate to be working here at the University of Edinburgh
where we have an internationally famous robotics program.
Play video starting at :1:35 and follow transcript1:35
Robotics course is one of the key places where brain, body, and
world come together.
Play video starting at :1:41 and follow transcript1:41
Within that program, a leading figure,
my co-presenter in this particular session, Professor Barbara Webb.
Play video starting at :1:48 and follow transcript1:48
>> Hi I'm Barbara Webb, and I work in the Institute for Perception,
Action and Behaviour.
And my group is interested particularly in minimal minds in how much or, indeed,
how little brain might be needed to make a robot do intelligent things or
to explain adaptive behavior in humans or other animals.
Play video starting at :2:8 and follow transcript2:08
And, in fact, when we start to look at this in a robot perspective,
we sometimes find that you don't need a brain at all.
A classic example of this are the passive dynamic walking machines built at
Cornell University.
Play video starting at :2:23 and follow transcript2:23
>> This robot has no motors or controllers.
Rather, its motion is begun by falling forward on this slight slope.
Play video starting at :2:32 and follow transcript2:32
This makes one of its legs swing forward by pendulum motion.
The foot contacts the ground, the other leg swings forward and so on.
And as you can see, this produces a very natural walking gate,
much more like a human walking gate than many well known humanoid robots.
There are other physical tricks that contribute to this smooth walking.
Just like humans theres a knee structure that stops the leg bending forward but
allows it to bend backwards.
Providing foot clearance during the swing.
Play video starting at :3:2 and follow transcript3:02
The feet themselves are curved to make each step smooth.
And there is a counterbalancing swing of the arms.
>> So understanding and actually building the physical system tells us more about
how we walk than trying to introspectively think about how we move our legs,
swing the foot forward, etc.
And, in fact, trying to think about how you walk tends to make you walk worse.
You should try that for yourself.

So the first message,
really, is that taking the physical into account is always important, but
on the other hand, obviously, there is something going on inside us when we walk.
There's lots of unconscious sensory processing, picking up the visual cues,
the feedback from our feet about what we're walking over so
that we can handle difficult terrain, go up steps, avoid obstacles.
But of course, there's also, inside of us, some intention.
We're walking somewhere, for some reason.
So are we then more than just machines?
>> As a philosopher working in this area, I feel like it's my duty at this point
just to pause to remind ourselves of how strange and interesting the mind and
the mantle really are.
Play video starting at :4:11 and follow transcript4:11
If you think about the volcano when it erupts It just does what it does.
It's just part of a physical order behaving in a way that doesn't seem to
require us to think about what it believes, what it hopes, what it desires.
Not even what it perceives.
When the volcano erupts and interrupts my family vacation,
I don't think that the volcano planned to erupt on that day, believed that I was
starting the vacation that day, desired to interrupt my vacation.
Play video starting at :4:37 and follow transcript4:37
On the other hand when I go to the fridge to get a beer,
you may watch my behavior and say Andy believed there was a beer in the fridge,
desired to drink the beer, and so went to the fridge.
Play video starting at :4:49 and follow transcript4:49
Similarly, when I observe the behavior of my cat chasing a mouse I think hey, my
cat perceived the location of the mouse, in some sense desired to catch the mouse,
and then engaged in a very successful piece of predatory behavior.
So even at those low levels, it seems as if to understand perception and
action in the natural order,
we need to understand how creatures can exhibit seemingly sensible bits of
behavior on the basis of information that they take in from the world.
In that sense they seem to be fundamentally unlike volcanoes,
and therefore its not quite so clear how many unique tricks we need to understand,
to understand how that kind of behavior can be produced.
Play video starting at :5:30 and follow transcript5:30
>> Indeed, most humans, animals, and
robots do use perception of the world to perform their complex tasks.
But we should resist the urge to assume that that means
something really complicated is going on inside the animal, that it has to make
an explicit plan about what's out there in the world and what it needs to do.
Very often we find it's still the case that embodiment can solve much of
the problem and simplify the problem that the mind is left with to solve.
So already we have the example that when walking to the fridge
Andy doesn't have to remember anything about how to swing his legs back and
forth or how to get through doorways.
That's done mostly on his physical system.
Play video starting at :6:12 and follow transcript6:12
And for the cat in fact, it's physical
Play video starting at :6:17 and follow transcript6:17

perception system is tuned specifically to look for fast, small moving objects,
and if you try with a laser pointer they find that more attractive than a mouse,
even though it's not going to be any good to eat in the end.
Play video starting at :6:31 and follow transcript6:31
So another example that's weve been looking at in our own research is
the behavior of desert ants that don't follow chemical trails but
nevertheless can navigate through complex environments.
Play video starting at :6:42 and follow transcript6:42
>> These ants forage in very hot climates and
need to move rapidly They use a combination of navigation strategies,
that include dead-reckoning and visual memory.
Play video starting at :6:54 and follow transcript6:54
In this example, the ant is using its previous experience of returning along
this route, through the complex vegetation, to find its way back to its
nest, which is just a small hole in the ground that could be tens of meters away.
Play video starting at :7:7 and follow transcript7:07
Up till now, it has been assumed that ants and other creatures
would have to recall each of the positions along a route to decide where to go next.
Play video starting at :7:16 and follow transcript7:16
But in fact, the behavior can be mimicked by a robot that never goes where it is.
Play video starting at :7:21 and follow transcript7:21
Instead, it simply alters the size of its zig-zag proportionally
to how unfamiliar its current heading appears.
Play video starting at :7:30 and follow transcript7:30
In other words, if things look familiar it is probably heading the right way and
can continue straight on.
If they don't look familiar, it should swing around until it sees some
view that it saw before, and head that way.
Play video starting at :7:43 and follow transcript7:43
In fact it doesn't even distinguish individual objects as objects, but
just processes its low resolution vision as a direct
holistic memory simply classifying everything it sees at the moment as,
yes I've seen this before or no this is unfamiliar.
Play video starting at :8:1 and follow transcript8:01
Note that this whole method exploits the fact that ants walk forwards.
And so the direction in which it views a scene and stores that scene in memory
is the same direction that it needs to take to repeat the route.
>> Actually, the ant has a number of other adaptations
that allow it to find its way efficiently.
For example the top part of its eye is sensitive to polarized light.
And this allows it to detect the polarization pattern that's in
the skylight.
From this it can actually deduce the position of the sun,
even when the sun is not visible if it's hidden by clouds for example.
And uses a very reliable compass cue so
that it can go in the direct that is has recalled and learnt.
Play video starting at :8:44 and follow transcript8:44
Biology's actually full of examples like this where the physical structure is
actually designed to solve the problem for us and
we can use those things in robotics as well.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/lecture/FPGgO/4-1-embodied-cognition-part-i>

So in many ways, it's no surprise that nature has been able to
find these interesting efficient solutions to problems.
After all, brains and the bodies that they in some sense control have coevolved.
It's not the case that the brain has to evolve a control strategy for
a body that is just parachuted in from nowhere.
Play video starting at ::27 and follow transcript0:27
instead, the reliable properties of the body are always present
during the evolutionary time period in which the brain is evolving.
Play video starting at ::36 and follow transcript0:36
It's interesting in the same sort of way to start to
think about the reliable properties of the environment because, after all,
those are present while the brain and the body are evolving in just the same way.
Play video starting at ::48 and follow transcript0:48
So, a favorite example of mine,
an example that shows the kind of delicate matching between brain, body and
environment, is the swimming capacities of the bluefin tuna.
Play video starting at :1: and follow transcript1:00
The bluefin tuna is a prodigious swimming machine that can go very fast,
can turn rapidly, can blast off very successfully from a standing start.
Play video starting at :1:11 and follow transcript1:11
But it turns out that when you examine the actual pure physical capacities of
the fish.
I must say I'm not entirely sure how these get to be measured.
But somehow, when you measure the actual capacities of the fish to do
things like turn and blast off through the water,
it turns out that the fish itself is too weak by a factor of about seven to turn as
fast as it does, to blast off as quickly as it does, and so on.
Play video starting at :1:37 and follow transcript1:37
So in a series of interesting studies starting at MIT,
Massachusetts Institute of Technology, and continuing at Olin College,
scientists have been looking at the swimming capacities of the tuna.
Play video starting at :1:50 and follow transcript1:50
It turns out that what the tuna does is to make the most of its watery environment.
A tuna will make the most of currents so
they're available, stepping into currents to go faster.
But more interestingly than this, it will actively flap its tail to create small
vortices in the water, which it then steps into in order to blast off more efficient,
more efficiently, to turn more quickly, and so on.
So these kinds of story about how the tuna works have been tested at MIT and
now at Olin using robot tuna coated with, with Lycra and
performing in large watery environments.
And some of this work has now lead to a new generation of
submarines that exploit properties like this.
>> Notice that the tuna is making very short-term changes to
its immediate environment to improve its
swimming to get energy back from its environment to work better.
But in fact, many creatures make long-term,

far-reaching changes to their environments, and this can structure
the world to make their interaction with the world more successful.
So let's look at an example of this,
another example with ants, this time of collective behavior.
So these ants are just moving to a new nest, normally a crack in a rock,
but in this case, made by two slides so we can see what they're doing.
They start by bringing in the eggs from their previous nest,
and each of the eggs exudes an odor.
So the more they place eggs at the rear of the nest, the more the odor is spread and
the gradient is clearer, and it becomes easier for more ants to bring more eggs.
And so, they very quickly build up this collection of eggs.
But they also have to build a little wall across the entrance to the nest to guard
themselves, and this is made of lots of particles that the ants are picking up.
So, how do they build this wall?
Well, again, they just use simple cues.
Play video starting at :3:47 and follow transcript3:47
Each ant running around will pick up a particle if it runs into it.
If it's then running with a particle, crosses the nest entrance, going towards
the gradient of this odor from the eggs, it will drop the particle where it is.
Other ants running around with particles will run into a particle on the ground,
and they'll just drop the particle when they run into another particle.
So, between these two behaviors, these two simple rules,
they'll actually start to build a wall because the first rule
will seed the wall in a particular place just near the nest entrance.
And the second rule will mean that as a wall is built,
the wall will get bigger because there's just a feedback of the particles already
there causing more particles to be deposited.
So the ants will continue until they have a wall and can add no more.
And in fact, we can show that this really works by programming some simple robots to
do just these two behaviors.
So, in this case, the robots use a gradient of light instead of an odor.
And they can detect a line on the ground instead of the nest entrance, but
otherwise, they're doing just what the ants were doing.
They're picking up the particles when they run into them.
They drop the particle if they cross the line going towards the light.
And they drop the particle if they run into another particle already
on the ground.
And as you can see through this, sort of time-lapse of the robots running around,
they very quickly build a successful wall, just like the ants did.
Play video starting at :5:12 and follow transcript5:12
So, we can see this kind of behavior even in larger,
interesting structures such as the mounds built by termites or complex birds' nests.
And in general, it's a principle that this interaction with
the world structures the world itself and makes any kind of complex task easier.
>> So so far, a lot of the complexity that we've been
observing has been in the system's interactions with the world.
But the reasonable question at this point will be,
how does all this to scale up to higher cognition?
How does it scale up to thinking,

reasoning, planning, having concepts that give you a grip upon your world?
Play video starting at :5:51 and follow transcript5:51
In one way, we can see that the structured human-built environment provides many of
the same opportunities as the simpler environments that we've been looking at.
The environment for the ants, for example.
Think of Wikipedia entries.
In the case of Wikipedia, we create structure in the world,
different people add to the structure, and the way that they add to
the structure changes the way that other people add to the structure.
Play video starting at :6:14 and follow transcript6:14
At the same time though, there's a real question about how all that kind of
knowledge gets into us in the first place.
Play video starting at :6:20 and follow transcript6:20
Fortunately, there's also substantial evidence that embodied
interactions simplifies learning.
Play video starting at :6:26 and follow transcript6:26
A nice example is the Babybot work coming out of Genoa from the lab of
Giorgio Metta and colleagues.
So in the case of Babybot,
Babybot uses its own actions to help it learn about the world.
It can see its own arm in its field of vision, and it's good at detecting motion.
It sweeps its arm across the field of vision, and if it encounters an object,
then the typical, the sort of unique signature of motion, of increased motion,
that that is produced at that moment is a cheap way of knowing that Babybot
has encountered an object, that these are boundaries of the object, and so on.
So you can imagine the sort of the change in the,
in the motion flow when you encounter an object, and on it goes.
Another example in the same sort of area is just a general use of
robotic interactions with the world to create rich,
time-locked patterns of multimodal self-stimulation.
So, if I poke and pull and
shove at the world, then I can make objects move around.
Sometimes I can make them make noises.
Sometimes I can, I can bring them close to my face so that I can smell them.
These time-locked patterns of multimodel response from the objects in
the world are a good clue, again, that we are precisely encountering objects,
the kind of thing that it's probably worth bringing into our conceptual repertoire.
So, the general hope hereabouts is that patterns of embodied interaction with
the world provide a kind of way in, a sort of, a sort of developmental trajectory,
in which concepts, the building blocks of higher cognition,
can begin to come into focus.
Play video starting at :8:1 and follow transcript8:01
>> To illustrate these ideas about concepts,
we can think about what it might take to allow a robot to recognize a chair.
Play video starting at :8:10 and follow transcript8:10
Chairs come in so many different sizes, colors, constructions that there's
no simple list of properties that we could make that allow us to have
a visual system, simply know that something is a chair or not a chair.
But nevertheless, we can look at an object and
almost instantly assess, is this a chair or is it not a chair?

Play video starting at :8:30 and follow transcript8:30
James Gibson in the 1950s argued that
what we're really understanding by a chair is the concept of sitability.
It's about understanding the object as something that we can interact with in
a particular way.
This object is something that will support our weight and
allow us to bend in the right places to be able to sit on it.
And that we acquire this concept through thousands of interactions with the world,
with real chairs and other objects that we find we're capable of sitting on.
Play video starting at :9: and follow transcript9:00
So, if we follow this line of argument,
it means that to make a robot recognize a chair in the same way that we do,
it would have to have the same capability to sit on things, the same ability
to find out through its own experience what will or will not support its weight,
what will or will not allow it to bend in the appropriate places to sit.
Play video starting at :9:23 and follow transcript9:23
Now, importantly, I'm not arguing that when we recognize something is a chair,
we have to actually go through this process of sitting on it.
But rather that through our experience, we build up an internal model of
the actions, the interactions that occur when we actually sit on something.
And that we can then in our imagination, when looking at some new object,
decide if this is something that we think we should be able to sit on or not.
And this is the, the essence of what these concepts are.
Play video starting at :9:53 and follow transcript9:53
If we now look perhaps more generally at robots and
robots getting around in the world.
Take, for example, the urban challenge robots, which were robots embedded in
cars who had to drive around a real urban environment, interacting with other cars,
dealing with intersections, with road signs, and so forth.
Play video starting at :10:14 and follow transcript10:14
Their success was really supported by a key factor,
and that is having multilayer control systems, where the lowest levels
of the control system involved this direct interaction with the world,
keeping the wheels on the road, detecting if a collision is about to occur,
tracking moving objects, and making appropriate evasive actions.
All those things were happening at this lowest level, and
that frees up the higher levels, the conceptual levels, for the robot to
then think about more abstract important plans such as how to get from A to B.
So, in planning a route from one part of the city to another,
we don't want to have to take in to account the possible location of every
single moving object around us and whether that might intersect with our path.
We don't even want to have to think about the exact curvature of
the roads that we're following.
But rather, we want to have an abstract map of where we want to go, and
we rely on the fact that at the lowest levels, when we want to drive down a road,
we have sensory systems that allow us to do the immediate interaction that keeps us
on the road and allows us to see a moving object and avoid it.
So, it's this idea of abstracting away
Play video starting at :11:28 and follow transcript11:28
the internal model from the real world interaction that's really key.

But of course, it can't be too abstract.
It has to be grounded in the world, in our experience with the world,
in learning from the world, so that we stay in sync with the world, so to speak.
Play video starting at :11:44 and follow transcript11:44
>> So, one more time, the philosopher feels that they have to come in and
raise the specter of higher cognition.
So you've been hearing a lot about maintaining an ongoing interaction with
the world, structuring that ongoing interaction across many layers.
But when we think about at least the caricature representations of
cognition that we encounter in the media or just
in art, what we typically see is a representation of somebody just thinking.
So, think about Rodin's Thinker, kind of sitting there like that or
something, cartoon characters where
suddenly the little light bulb goes off over their head, or
just a general image of you sitting in the bath having a sudden moment of revelation.
Play video starting at :12:27 and follow transcript12:27
Nonetheless, I think if we actually pause to reflect on what most of
real-world higher cognition looks like, it actually doesn't look like that at all.
That's not to say that those things don't happen, but
in general, when we're engaged in higher cognitive processing, thinking, reasoning,
planning our, our family vacation, thinking about the unfolding of the,
the economy over the next ten or 20 years, what we do is we sit in
crowded offices surrounded by, surrounded by desktop machines,
smartphones of one kind or another, pen, paper, graphs, all kinds of equipment.
And it's the human brain and the human organism immersed in that sea of
equipment which seems to be, in most daily cases, the real thinking machine.
Play video starting at :13:16 and follow transcript13:16
A nice simple example is just the use of pen and paper to do long multiplication.
In a case like that, using routines that we've acquired at school,
we basically reduce a complicated piece of problem solving to a sequence
of smaller pieces of problem solving that brains like ours can easily comprehend.
So you take the long multiplication, you turn it into lots of
short multiplications with results stored in a, an external buffer on the page.
This seems to me to be quite a good model of how an awful lot of
human cognition actually operates in the wild.
Play video starting at :13:51 and follow transcript13:51
In this kind of way, you might think that the structures that we place
around ourselves are for us something like the watery environment for the tuna.
These, this is the environment with which we interact and
those interaction simplify the problems that brains like ours need to
solve even in the domain of higher cognition.
Play video starting at :14:11 and follow transcript14:11
So I think the moral of all of this, really, is that we do need to avoid,
even in the case of higher cognition, what you could think of as the naked brain
fallacy, the fallacy of assuming that all the interesting cognitive action
is always going on in the brain, rather than being spread in delicate and
often hard to understand ways between what the brain's doing, what the body's doing,
and what the manipulable external world makes available.
>> So, where does that leave us?
Our conclusion is that we should not think of minds as disembodied computers in

charge of meat machines, but rather as completely integrated and
intermingled with our physical capacities and our interactions with the world.
And that means to create artificial minds, we'll have to build
systems that are embodied, and that develop and learn inside robot bodies.
So that's my job.
And for philosophers like Andy,
the essential message is to keep the body in mind.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/lecture/viAdy/4-2-embodied-cognition-part-ii>

Although it has been traditional to study the various senses independently, most of the time, perception operates in the context of information supplied by multiple **sensory modalities** at the same time. For example, imagine if you witnessed a car collision. You could describe the stimulus generated by this event by considering each of the senses independently; that is, as a set of **unimodal** stimuli. Your eyes would be stimulated with patterns of light energy bouncing off the cars involved. Your ears would be stimulated with patterns of acoustic energy emanating from the collision. Your nose might even be stimulated by the smell of burning rubber or gasoline. However, all of this information would be relevant to the same thing: your perception of the car collision. Indeed, unless someone was to explicitly ask you to describe your perception in unimodal terms, you would most likely experience the event as a unified bundle of sensations from multiple senses. In other words, your perception would be **multimodal**. The question is whether the various sources of information involved in this multimodal stimulus are processed separately by the perceptual system or not.

From <https://courses.lumenlearning.com/waymaker-psychology/chapter/multi-modal-perception/>

Week 4 Quiz: Embodied cognition and the sciences of the mind

Thursday, February 16, 2023
7:36 PM

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- **Cognitive Science has recently taken a strongly 'embodied turn', recognizing that biologically evolved intelligence makes the most of the opportunities provided by bodily form, action, and the material and social environment. This session explores the way this impacts our vision of minds, brains, and intelligent agents, and asks whether there can be a fundamental science of the embodied mind**
- **Week 4 Quiz**
- **Quiz:** Week 4 Quiz: Embodied cognition and the sciences of the mind
  10 questions
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Week 4 Quiz: Embodied cognition and the sciences of the mind

Quiz30 minutes • 30 min

Submit your assignment

Due March 12, 11:59 PM ISTMar 12, 11:59 PM IST

Attempts 3 every 8 hours

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To Pass 80% or higher

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Week 4 Quiz: Embodied cognition and the sciences of the mind

Graded Quiz. • 30 min. • 10 total points available.10 total points

DueMar 12, 11:59 PM IST

1.

Question 1

How does the desert ant find its way home?

1 point

By building a mental map that it can use to navigate with, without any need to observe its environment.

By aiming towards environmental features that it recognises, rather than by using a mental map of any kind. [Answer]

By asking a local for directions.

By looking for environmental features that it recognises, and then cross-referencing these with a mental map.

2.

Question 2

Why is it unsurprising that the brain makes use of the body to scaffold cognition?

1 point

Because Aristotle predicted this thousands of years ago.

Because it makes evolutionary sense for the brain to take advantage of any stable features of its environment, such as the body. [Answer]

Because without a body the brain would be unable to survive.

This is a trick question: the brain does not make use of the body to scaffold cognitive processes.

3.

Question 3

How do we explain the impressive swimming capacities of the Bluefin tuna?

1 point

It latches on to larger, faster fish and hitches a ride.

It is equipped with an outboard motor.

It is able to exploit features of its environment, such as currents and vortices, including those that it has created itself. [Answer]

It is extremely muscular and very talented at swimming.

4.

Question 4
How do ants build their nests?

1 point

They do not build nests, but instead occupy the abandoned nests of other species of insect.

By instinctively depositing small pebbles a certain distance from their larvae, and then continuing to deposit pebbles next to those previously deposited, naturally forming a wall. [Answer]

By carefully planning the structure of the walls before building the nest out of small pebbles.

They mindlessly follow the instructions of the queen ant, which is the only one who knows what they are doing.

5.

Question 5
How does Babybot learn about the world?

1 point

It asks its Motherbot a series of increasingly complicated questions.

It crawls around until it finds something, and then spends a long period of time (hours or even days) studying what it has found.

It moves its limbs around and catalogues the patterns of interactions that it experiences. [Answer]

It comes pre-equipped with a complete set of facts about the world.

6.

Question 6
What is a “rich, time-locked pattern of multimodal stimulation”.

1 point

An integration of input concerning multiple objects over an extended period of time, allowing for the formation of a representation capturing a whole scene.

An integration of input from a single sense over an extended period of time, allowing for the formation of a complex model of an object.

An integration of simultaneous input from multiple senses, allowing for the formation of a complex, multisensory model of an object. [Answer]

> Explanation: Multimodal means simultaneous perception through multiple sense (e.g. for a car collision, we see it crash, hear the crash sound and smell the some burning, all together!)

7.

Question 7

What is difficult about identifying a chair?

1 point

They typically consist of only straight lines, which are hard for visual systems to perceive.

Whilst there is a stable set of features that provide necessary and sufficient conditions for being a chair, it exists only in the platonic realm of forms, which we cannot access.

They often blend in with their backgrounds, as directed by the principles of interior design.

There is no stable set of features that can provide necessary and sufficient conditions for being a chair. [Answer]

8.

Question 8

What might a robot need to be able to do in order to identify a chair?

1 point

Be able to use a chair, and thus identify chairs as those objects that it can use as chairs. [Answer]

Grasp the necessary and sufficient conditions for being a chair.

Integrate input from multiple sensory modalities.

Possess a complex enough language to ask someone what a chair is.

9.

Question 9
What is a multilayer control system?

1 point

It is a control system that consists of many very simple processes that combine into a greater whole.

It is a control system that leaves immediate processes, such as avoiding oncoming traffic, to operate on their own, whilst higher level processes focus on longer term planning. [Answer]

It is a control system that devotes most of its processing power to immediate processes, such as avoiding oncoming traffic, whilst delaying long term planning until it has time to rest.

10.

Question 10
What is the naked brain fallacy?

1 point

An approach to cognitive science that treats the brain as an embodied, rather than isolated, system.

An approach to cognitive science that treats the brain as an isolated, rather than embodied, system. [Answer]

An approach to cognitive science that denies the existence of the brain.

An approach to cognitive science that denies the existence of the external world.

Coursera Honor Code [Learn more]

I, **Lekhraj Sharma**, understand that submitting work that isn't my own may result in permanent failure of this course or deactivation of my Coursera account.

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From <https://www.coursera.org/learn/philosophy-cognitive-sciences/exam/WgWXu/week-4-quiz-embodied-cognition-and-the-sciences-of-the-mind/attempt>

Essay: Philosophy of Cognitive Science

Sunday, February 19, 2023
11:45 PM

In what way can cognitive science inform issues in the philosophy of mind? Give a clearly argued answer, using at least one example from the lectures. Write an essay up to 750 words that will be marked by the participants in the course. To receive essay feedback you will need to provide feedback on 3 other essays.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/peer/poMem/write-an-essay-philosophy-of-the-cognitive-sciences>

We are still struggling to find answer to hard question in philosophy of mind about consciousness "We don't know what it is about us as physical beings that makes us conscious. Mainly what gives rise to subjectivity?". Cognitive science tells us that understanding advances in machine learning and computational neuroscience may hold the key to understanding ourselves: to explaining how our brain and mind work. Its idea of embodied cognition argues that mind does not operate in isolation. Rather it has strong interplay with the body and surrounding environment.

In this essay I would like to share some insights from Buddhist literature and associated meditation practice (e.g. Vipassana) which offer a framework that has glimpses of cognitive science ideas and more to try to answer question of consciousness and the way mind works.
Taking embodied cognition trail further, mind and body can be seen as a fused together formation that highly influences each other and work almost like one composite unit to operate efficiently in its environment. Body sense organs (mainly: eye, ear, nose, tongue/mouth, skin) process sense signals (light for seeing, sound for hearing, odor for smell, taste for tongue, touch for skin) from its environment and feed it to brain where it runs appropriate machine learning (ML) models (using computationatioanl neurons layer stack). Each of these ML models (called "knowing/identifying": Vinnana) handle a specific sense signal (e.g. loud mechanical vibration) and help it to classify as output (e.g. sound of a lawn mower) which then are fed to another neuro computational computer module to fetch and co-relate with any related experiences (e.g. our experiences of hearing a lawn mowers so far) stored in our content addressable memory (called "impressions": Sankhara). This co-relation is than classified as beneficial (good), not-beneficial (bad) or neutral by another ML model in mind (called "reacting/judging": Sanna) which is connected with subjective image we keep layering for ourselves (called "I": Self). This judgement (e.g. lawn mowers are loud and cause me hearing and allergy problem, so it gets classified as bad!) signal then activates a chemical/other ways to cause appropriate sensations (called: Vedana) in our body as reaction (e.g. sensation of irritation). These sensations (good, bad or neutral) make us react with craving (I want more of this), aversion (I do not want it!) or neutral (do not care!) feelings in mind. This reaction (e.g. aversion: I do not like sound of lawn mower as it causes me hearing problem and allergy) amplifies our corresponding sensations further (e.g. sensation of

irritation). Interesting this "sensation" gets fed into our past impressions (Sankhara) to start recalling past experiences which led to these kind of sensations (e.g. irritation caused by humid weather), which then further aid fuel to sensation stream causing it to multiply further. This generated/reacted experience further adds to our existing impressions (Sankhara) and our habit of reacting (Sanna). This means initial reaction gets prolonged causing further chain of events (e.g. we getting angry at person mowing the lawn). These chain of events in our mind and body pair is quite subjective as our store of past impressions (Sankhara), our training of mind (Sanna) vary from person to person, causing us to react to same stimuli (sensory input) differently. Besides external stimuli, internal stimuli (i.e. recall of our past experiences) also caused similar chain of events. In case of internal stimuli (E.g. in dreams or when we just a thought crosses our mind), while mind is the source of sensory signal (e.g. hearing a lawn mower in our dreams) but it initiates the same cycle of identification-connecting with past impressions-classifying it as good/bad/neutral-causing reaction sensations to flow on body! That is why "mind" itself is accepted as another sense organ in this framework!

This "mind-body sensation and our reaction" framework, which has some elements of machine learning and computational neuroscience, is one way of explaining our mind's subjectivity, i.e., hard problem of consciousness.

References

Wednesday, February 15, 2023
11:31 AM

Evolutionary psychology

For an introductory reading on evolutionary psychology take a look at:

Cosmides, L. and Tooby, J. (1997). *Evolutionary psychology: a primer*. Available at: http://www.cep.ucsb.edu/primer.html

For an overview of philosophical issues in evolutionary psychology, take a look at these articles at the Stanford Encyclopedia of Philosophyand the Internet Encyclopedia of Philosophy.

You can post below if you want to discuss this reading, or go to the main course discussions if you prefer to discuss one of the other readings.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/discussionPrompt/cTwYa/evolutionary-psychology>

The evolution of language

For more on the **evolution of language**, see the homepage of the Centre for Language Evolution, the world's largest dedicated research group studying language origins and evolution.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/Jwdv6/the-evolution-of-language>

Niche Construction

For more on **niche construction**, see this website dedicated to "the neglected process in evolution".

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/y8jKu/niche-construction>

Chimpanzee culture social learning

Follow this link for an overview of some recent research into **why chimpanzees might be less 'cultured' than humans.**

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/KYlNQ/chimpanzee-culture-social-learning>

Related work by Philosophy staff at the University of Edinburgh
Summary of key points relating to staff research

- According to evolutionary psychology, evolutionary pressures would most likely produce a 'modular' mind.

- Language most likely developed through a combination of biological and cultural evolution.

Relevant research

Suilin Lavelle's research focuses on philosophical questions associated with evolutionary psychology, which is the core topic of this week's lecture. One central question in this area is whether, and to what extent, evolution would have produced a 'modular' mind, i.e. one that is composed of a series of separate, task-specific processors. In a 2015 paper ('Is a modular cognitive architecture compatible with the direct perception of mental states?'), she asks whether a mind of this sort would be able to 'directly perceive' mental states. If not, and if evolutionary psychology is committed to the idea of a modular mind, then direct perception accounts in social cognition would seem to be incompatible with the apparent evolutionary evidence.

Lavelle's work also explores the relationship between culture and evolution. In a 2016 book chapter ('Cross-cultural considerations in social cognition') she discusses similarities and differences in how people from different cultures understand, explain, and predict each other's behaviour. Given our shared evolutionary origins, such differences can be difficult to account for in purely biological terms, and so Lavelle's exploration of this topic aims to cast light on how to make sense of these differences. By explaining how and why cultural variation in social cognition could arise in biologically similar communities, Lavelle's research aims to contribute to the development of evolutionary psychology.

The relationship between niche construction and the evolution of language is explored by **Andy Clark** in his 2008 book Supersizing the Mind, as well as elsewhere in his research (see bibliography; niche construction is a recurring theme in much of Clark's work). Clark argues that language, once evolved, forms a 'cognitive niche', i.e. a constructed cultural environment that contributes to the adaptive success of the organisms that constructed it, but also constrains future evolutionary developments. For Clark, then, language is something like the beavers' dam, a cultural artefact that is passed down from generation to generation, providing both benefits and constraints on future behaviour. Clark's work in this area has been very influential, and the idea of a 'cognitive niche' is now common in discussions of cultural evolution.

Open Access Resources and Further Reading

- Research talk on 'Nativism and mindreading debate' by Suilin Lavelle
- Public lecture by Andy Clark on 'Natural-born cyborgs'
- Clark, A. 2005. "Word, Niche and Super-Niche: How Language Makes Minds Matter More." Theoria 54: 255-68.
- Clark, A. 2006. "Language, embodiment, and the cognitive niche." Trends in Cognitive Science, 10/8: 370-4.

- Wheeler, M. & Clark, A. 2008. “Culture, embodiment and genes: unravelling the triple helix.” Philosophical Transactions of the Royal Society B, 363/1509.

Additional Resources (not open access)

- Clark, A. (2008). Supersizing the Mind. Oxford: OUP.
- Lavelle, J. S. (2015). Is a modular cognitive architecture compatible with the direct perception of mental states? Consciousness and Cognition. 36: 508-18.
- Lavelle, J. S. (2016). Cross-cultural considerations in social cognition. In The Routledge Handbook of the Philosophy of the Social Mind (ed. Kiverstein). Routledge.
- Lavelle, J. S. & Smith, K. (2015). Do our modern skulls house stone-age minds? In Philosophy and the Sciences for Everyone (ed. Massimi). Routledge.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/Ag3Ga/related-work-by-philosophy-staff-at-the-university-of-edinburgh>

The hard problem of consciousness

Here you can find an interesting video about David Chalmers explaining the hard problem of consciousness. We recommend you to watch the video and join the discussion:

https://www.youtube.com/watch?v=kdbs-HUAxC8

(If you don't have access to youtube you can try any of the other additional resources. This video is not part of the assessments)

For an interesting reading about the hard problem versus the easy problems of consciousness you can follow this link **:** Pinker, S. (2007) 'The brain: the mystery of consciousness', Time

You can post below if you want to discuss this reading, or go to the main course discussions if you prefer to discuss one of the other readings.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/discussionPrompt/z1HdQ/the-hard-problem-of-consciousness>

Access/phenomenal consciousness distinction

Here you can find a link to Daniel Dennett's recent lecture in which he criticizes the access/phenomenal consciousness distinction**:**

['Consciousness about access and consciousness', Consciousness Online]

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/L2RZJ/access-phenomenal-consciousness-distinction>

Overview of philosophical problems concerning consciousness

Great overview of philosophical problems concerning consciousness with many suggestions for further readings:

[van Gulick, R. (2014) 'Consciousness', in E. N. Zalta (ed.) Stanford Encyclodedia of Philosophy (Spring 2014 edn)]

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/n7Myj/overview-of-philosophical-problems-concerning-consciousness>

Limitations of perceptual awareness

Here you can find some articles about limitations of perceptual awareness:

[Simons, D. (2010) 'The monkey business illusion']

[Simons, D. and Chabris, C. F. (uploaded by Simons, D. 2010) 'Selective attention test']

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/67uix/limitations-of-perceptual-awareness>

Related work by Philosophy staff at the University of Edinburgh
Summary of key points relating to staff research

- It is often unclear what ‘consciousness’ means, and we should take care when using folk terms like ‘consciousness’ in science.
- The scientific study of consciousness is concerned with several different phenomena, including attention, wakefulness, and phenomenal experience itself, which are not always connected.
- There is a gap between two ways in which we know about consciousness (first-person and third-person) and this complicates the study of consciousness.
- One paradigm for studying the neural correlates of consciousness is studying ‘bistable’ perception. In these experiments, a human is presented with a fixed external stimulus and their subjective visual experience flips between two perceptual images.

Relevant research

Mark Sprevak, in his 2016 paper ‘Philosophy of the psychological and cognitive sciences’, argues that philosophical work on consciousness has been a success story. One role a philosopher can play in science is to contribute to making diffuse and unclear concepts more precise. This ‘precisification’ is exactly what has taken place on scientific work on consciousness. One consequence has been to describe precisely what is now called the ‘hard’ problem of consciousness and limit its influence to only ‘phenomenal’ consciousness. In a forthcoming chapter Liz Irvine and Mark Sprevak examine a possible solution to the hard problem of consciousness called ‘eliminativism’. An eliminativist says either that phenomenal consciousness does not exist (in some sense it is an ‘illusion’), or that talk of consciousness should be removed from serious science (scientists should not aim to study it). Both kinds of claim are counter-intuitive and face serious objections. Nevertheless the attractions of eliminativism should not be underestimated. At stake is a solution, or dissolution, of the hard problem.

In a 2009 paper, **Andy Clark** argues against the possibility of ‘extended’ conscious experience – against the physical mechanisms underlying conscious experience extending outside the brain and into the world. Clark argues that limitations on bandwidth (the speed of information transfer) between brain, body, and world render such ‘extended consciousness’ accounts implausible. According to our most promising scientific theories, consciousness is likely to be constrained to the brain or central nervous system. **Dave Ward** (2012) has responded to Clark’s argument by clarifying that, according to an ‘enactivist’ extended account of consciousness, consciousness should be reconceived as a fundamentally relational phenomenon, meaning that consciousness is necessarily extended. Clark (2012) replies in turn, offering an account of how internally-generated experience might seem extended in the ways described by Ward. (This account draws on the predictive processing literature discussed below.)

More recently, Clark has worked on how conscious experience could be explained by the emerging ‘predictive processing’ framework in cognitive science (see Clark 2012, 2013, 2015, 2017a, 2017b). This framework explains cognitive processing as a matter of successfully predicting incoming sensations, or else adapting one’s (internal) model of the world in response to prediction errors. The bistable image paradigm mentioned in the online lecture has been used to support this work. Clark advocates a broadly Dennettian approach to consciousness (which is one flavour of eliminativism described above), suggesting that the phenomenal properties of conscious experience are best understood as dispositions to behave in ways that best make sense of our sensory data, and thus reduce prediction error.

Open Access Resources and Further Reading

- Blog post where Andy Clark touches on some aspects of how predictive processing might apply to consciousness
- Clark, A. 2013. "Whatever next?" Behavioral and Brain Sciences.
- Clark, A. 2009. "Spreading the joy?" Mind 118/472: 963-93.
- Sprevak, M. & Irvine, E. Forthcoming. "Eliminativism about consciousness." In the Oxford Handbook of the Philosophy of Consciousness (ed. Kriegel). Oxford University Press: Oxford. [draft]
- Sprevak, M. 2016. "Philosophy of the psychological and cognitive sciences." in the Oxford Handbook for the Philosophy of Science (ed. Humphreys). Oxford University Press: Oxford. [draft]

Additional Resources (not open access)

- Clark, A. 2018. "Prediction and the Explanation of Conscious Experience." In Huebner (ed.), The Philosophy of Daniel Dennett. Oxford: OUP.
- Clark, A. 2017a. "Predictions, precision, and agentive attention." Conscious and Cognition, S1053-8100/17: 30134-4.
- Clark, A. 2017b. "Beyond the 'Bayesian Blur': Probabilistic Brains and the Nature of Subjective Experience." Journal of Consciousness Studies. (no webpage)
- Clark, A. 2015. Surfing Uncertainty. Oxford: OUP.
- Clark, A. 2012. "Dreaming the whole cat." Mind 121/483: 753-71.
- Sprevak, M. & Carmel, D. 2015 "What is consciousness?" In Philosophy and the Sciences for Everyone (ed. Massimi). Routledge: London.
- Ward, D. 2012. "Enjoying the spread." Mind 121/483: 731-51.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/gqiYY/related-work-by-philosophy-staff-at-the-university-of-edinburgh>

Computational theory of mind and connectionism.

Here you can find Stanford Encyclopedia of Philosophy articles on the computational theory of mind and connectionism.

These articles are recommendable as an introductory reading.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/oRkSW/computational-theory-of-mind-and-connectionism>

The predictive brain

Here you can find an article by Edinburgh's own Andy Clark discussing the predictive brain, and responding to comments.

You can post below if you want to discuss this reading, or go to the main course discussions if you prefer to discuss one of the other readings.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/discussionPrompt/hAfRL/the-predictive-brain>

The McGurk effect video

Here you can find a **YouTube** video illustrating the McGurk effect, from the BBC.

If you can't access to YouTube please note that this is not an assessed task. You can try any of the other recommended resources.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/jTmXX/the-mcgurk-effect-video>

Motion perception

Here you can find a wikipedia article on motion perception, and some of the illusions associated with it.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/ANUbr/motion-perception>

The rotating mask illusion video

Here you can find a **YouTube video** illustrating the rotating mask illusion, by eChalk Scientific.

If you can't access to YouTube please note that this is not an assessed task. You can try any of the other recommended resources.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/nPwKo/the-rotating-mask-illusion-video>

Related work by Philosophy staff at the University of Edinburgh

Summary of key points relating to staff research

- Alan Turing's discovery that many computations can be performed by a simple machine (a 'universal Turing machine') has inspired much research into computational theories of mind.
- Contemporary computational theories of mind have taken inspiration from technological innovations in machine learning, suggesting that the human brain might function as a kind of Bayesian learning system.

Relevant research

Mark Sprevak has published several articles on Turing's approach to computation and the impact that this approach has had on cognitive science and philosophy of mind (2016, 2017). He has a book titled *The Computational Mind* (Forthcoming A) and has edited two recent volumes on these topics (Sprevak & Colombo 2018; Copeland, Bowen, Sprevak & Wilson 2017). In "Turing's model of the mind" (2017), Sprevak describes how Turing's thoughts on artificial intelligence and human psychology relate to each other. Turing discussed how computation could create an artificially intelligent machine. Turing also thought computation was relevant to human psychology. He rarely discussed the relationship between these two projects – AI and what later became known as cognitive science. Sprevak traces the connections, both in Turing's work and in how his work has been used by others.

Andy Clark has written many books and papers on computational approaches to cognitive science, including a recent revised edition of his introductory book, *Mindware* (2013). Recently, he has explored the philosophical implications of the Bayesian approaches discussed in the second half of the online lecture. In *Surfing Uncertainty* (2016), Andy Clark presents a new way of understanding the brain as a 'prediction-error minimisation' system, which aims to predict incoming sensory stimuli as efficiently as possible, and correct error either by revising its predictions ('passive inference'), or by acting on the world so as to make them come true ('active inference'). This 'predictive processing' framework is meant to offer a unified computational account of action, perception, and cognition.

In "Computational thought from Descartes to Lovelace" (2018), **Alistair Isaac** surveys historical precursors to the computational theory of mind, ranging from Descartes, Hobbes, and Leibniz in the 17th century, to Boole, Babbage, and Lovelace in the 19th century. He describes how these thinkers anticipated various aspects of the computational theory of mind by thinking of mental activity as something that might be partially mechanical or otherwise 'automatic'. In a forthcoming paper, Isaac explores the role that analogue computations could play in our understanding of mind and cognition. He argues that analogue computational systems, such as the hydrodynamical MONIAC, provide a model of computation more suited to the 'embodied' approach in philosophy of mind, which has sometimes been hostile to the idea of a computational theory of mind.

Open Access Resources and Further Reading

- New York Times article by Andy Clark discussing the predictive mind, and responding to comments on this article.
- Sprevak, M. 2017. "Turing's model of the mind." In *The Turing Guide: Life, Work, Legacy* (eds. Copeland, Bowen, Sprevak, & Wilson). Oxford University Press: Oxford. [draft]
- Sprevak, M. 2016. "Philosophy of the psychological and cognitive sciences" in the *Oxford Handbook for the Philosophy of Science* (ed. Humphreys). Oxford University Press: Oxford. [draft]

Additional Resources (not open access)

- Clark, A. 2013. *Mindware: An Introduction to Cognitive Science*. Oxford University Press, Oxford, 3rd edition.
- Isaac, A. Forthcoming. "Embodied Cognition as Analog Computation." *Reti, saperi, linguaggi*, *Italian Journal of Cognitive Sciences.* (no webpage)
- Isaac, A. 2018. "Computational Thought from Descartes to Lovelace." In Sprevak & Colombo (eds.), *The Routledge Handbook of the Computational Mind.* Abingdon: Routledge.
- Sprevak, M. Forthcoming A. *The Computational Mind* Routledge: London.
- Sprevak, M.& Colombo, M. 2018. *The Routledge Handbook of the Computational Mind.* Abingdon: Routledge.
- Copeland, J, Bowen, J, Sprevak, M., & Wilson, R. (eds.) 2017. *The Turing Guide: Life, Work, Legacy*. Oxford University Press: Oxford.
- Sprevak, M. & Seriès, P. 2015. "From intelligent machines to the human brain." in *Philosophy and the Sciences for Everyone* (ed. Massimi). Routledge: London.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/8gAtM/related-work-by-philosophy-staff-at-the-university-of-edinburgh>

Embodied cognition further reading

Here you can find the **Stanford Encyclopedia of Philosophy** article on **embodied cognition**

Here you can find **A general tutorial on embodiment**, from the **European Network for the Advancement of Artificial Cognitive Systems, Interaction and Robotics**

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/NWJ7a/embodied-cognition-further-reading>

A Tale of Two Robots

A Tale of Two Robots compares the **different approaches to walking** taken by **traditional** and **embodied** robotics.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/discussionPrompt/e3qY9/a-tale-of-two-robots>

Passive-dynamic walkers

Here you can find **A video about passive-dynamic walkers**

If you can't access to YouTube please note that this is not an assessed task. You can try any of the other recommended resources.

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/0bybE/passive-dynamic-walkers-video>

The current crop of robots

Here you can find a reading about The current crop of robots from the **Cornell University Biorobotics and Locomotion Lab**

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/d8MNe/the-current-crop-of-robots>

Design your own robot (Super Cool: Give it a try!)

Here you can find **An interactive exercise** that lets you design your own **embodied robot**

From <https://www.coursera.org/learn/philosophy-cognitive-sciences/supplement/XVdgi/design-your-own-robot>

Related work by Philosophy staff at the University of Edinburgh

Summary of key points relating to staff research

- Cognition doesn't just need to be 'in the head' - cognitive processing can be supported or supplemented by bodily and environmental resources.
- Simple behaviours (like moving around an environment) are often guided by perception, and don't necessarily require anything like an explicit plan or goal.
- 'Embodied' explanations of cognition can be scaled up to higher (human) cognition once we factor in the role played by our cultural and linguistic environment.

Relevant research

Andy Clark has published widely on the topic of embodied cognition (see e.g. his 2008 book Supersizing the Mind), most famously arguing that the mind literally 'extends' out into the body and environment. One of the main topics he explores is the idea that human language and culture might provide a form of environmental 'scaffolding' that supports higher cognitive processing (see e.g. Clark 2005a, 2005b, 2006a, 2006b; Wheeler & Clark 2008). More recently he has also been investigating the relationship between embodied cognition and the emerging predictive processing paradigm in cognitive science (see e.g. Clark 2015b, 2017; Miller & Clark 2017).

Mark Sprevak has recently been involved in a large AHRC project ('A History of Distributed Cognition') which aims to map out historical precedents for contemporary research into embodied and distributed cognition. The project considers examples such as the theory of the humours, according to which cognition would involve various fluids circulating throughout the body, and the classical belief that the psyche is extended throughout the body and world. As part of this project Sprevak has helped to edit two forthcoming collections (Distributed Cognition from Victorian Culture to Modernism and Distributed Cognition in Classical Antiquity), and has also co-authored a general introduction titled "Distributed cognition in the humanities", which provides an overview of different approaches falling under the general category of distributed and embodied cognition, and discusses how these might be of value to the humanities.

Alistair Isaac (forthcoming) explores the possible role that analog computations could play in our understanding of mind and cognition. He argues that analog computational systems, such as the hydrodynamical MONIAC, might provide a model of computation more suited to the ‘embodied’ approach in philosophy of mind, which has sometimes been hostile to the idea of a (typically digital) computational theory of mind.

Open Access Resources and Further Reading

Clark, A. 2015b. “Embodied prediction.” In Metzinger & Windt (ed.), Open MIND. Frankfurt am Main: MIND Group.

Clark, A. 2008b. “Pressing the Flesh: A Tension in the Study of the Embodied, Embedded Mind?” Philosophy and Phenomenological Research 76/1: 37-59.

Clark, A. 2006a. “Material Symbols.” Philosophical Psychology 19/3: 291:307.

Wheeler, M. & Clark, A. 2008. “Culture, embodiment and genes: unravelling the triple helix.” Philosophical Transactions of the Royal Society B: Biological Sciences 363/1509: 3563-75.

Mark Sprevak is Co-Investigator on the ‘A History of Distributed Cognition’ AHRC Gateway to Research Project.

Additional Resources (not open access)

Anderson, M., Cairns, D., & Sprevak, M. (eds). Distributed Cognition in Classical Antiquity. Edinburgh University Press: Edinburgh. (no webpage)

Anderson, M., Garrett, P., & Sprevak, M. (eds). Distributed Cognition from Victorian Culture to Modernism. Edinburgh University Press: Edinburgh. (no webpage)

Clark, A. 2017. “Busting out: Predictive brains, embodied minds, and the puzzle of the evidentiary veil” Nous 51/4: 727-53.

Miller, M. & Clark, A. 2017. “Happily entangled: Prediction, emotion, and the embodied mind.” Synthese, online first.

Clark, A. 2015a. “Embodied Cognition and the Sciences of the Mind.” in Philosophy and the Sciences for Everyone (ed. Massimi). Routledge: London.

Clark, A. 2008a. Supersizing the Mind: Embodiment, Action, and Cognitive Extension. Oxford: OUP.

Clark, A. 2006b. “Language, embodiment, and the cognitive niche.” Trends in Cognitive Science 10/8: 370-4.

Clark, A. 2005a. “Beyond the Flesh: Some Lessons from a Mole Cricket.” Artificial Life 11/1-2: 233-44.

Clark, A. 2005b. "Word, Niche and Super-Niche: How Language Makes Minds Matter More." THEORIA. An International Journal for Theory, History and Foundations of Science 20/3: 255-68.

Isaac, A. Forthcoming. "Embodied Cognition as Analog Computation." Reti, saperi, linguaggi, Italian Journal of Cognitive Sciences. (no webpage)

Sprevak, M., Anderson, M., & Wheeler, M. "Distributed cognition and the humanities". In Distributed Cognition in Classical Antiquity (eds. Anderson, Cairns, & Sprevak). Edinburgh University Press: Edinburgh (no webpage)