

The great illusion of the self

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As you wake up each morning, hazy and disoriented, you gradually become aware of the rustling of the sheets, sense their texture and squint at the light. One aspect of your self has reassembled: the first-person observer of reality, inhabiting a human body.

As wakefulness grows, so does your sense of having a past, a personality and motivations. Your self is complete, as both witness of the world and bearer of your consciousness and identity. You.

This intuitive sense of self is an effortless and fundamental human experience. But it is nothing more than an elaborate illusion. Under scrutiny, many common-sense beliefs about selfhood begin to unravel. Some thinkers even go as far as claiming that there is no such thing as the self.

In these articles, discover why "you" aren't the person you thought you were.

WHAT ARE YOU? – The self: The one and only you by Jan Westerhoff

There are flaws in our intuitive beliefs about what makes us who we are. Who are we really?

THERE appear to be few things more certain to us than the existence of our selves. We might be sceptical about the existence of the world around us, but how could we be in doubt about the existence of us? Isn't doubt made impossible by the fact that there is somebody who is doubting something? Who, if not us, would this somebody be?

While it seems irrefutable that we must exist in some sense, things get a lot more puzzling once we try to get a better grip of what having a self actually amounts to.

Three beliefs about the self are absolutely fundamental for our belief of who we are. First, we regard ourselves as unchanging and continuous. This is not to say that we remain forever the same, but that among all this change there is something that remains constant and that makes the "me" today the same person I was five years ago and will be five years in the future.

Second, we see our self as the unifier that brings it all together. The world presents itself to us as a cacophony of sights, sounds, smells, mental images, recollections and so forth. In the self, these are all integrated and an image of a single, unified world emerges.

Finally, the self is an agent. It is the thinker of our thoughts and the doer of our deeds. It is where the representation of the world, unified into one coherent whole, is used so we can act on this world.

All of these beliefs appear to be blindingly obvious and as certain as can be. But as we look at them more closely, they become less and less self-evident.

It would seem obvious that we exist continuously from our first moments in our mother's womb up to our death. Yet during the time that our self exists, it undergoes substantial changes in beliefs, abilities, desires and moods. The happy self of yesterday cannot be exactly the same as the grief-stricken self of today, for example. But we surely still have the same self today that we had yesterday.

There are two different models of the self we can use to explore this issue: a string of pearls and a rope. According to the first model, our self is something constant that has all the changing properties but remains itself unchanged. Like a thread running through every pearl on a string, our self runs through every single moment of our lives, providing a core and a unity for them. The difficulty with this view of the self is that it cannot be most of the things we usually think define us. Being happy or sad, being able to speak Chinese, preferring cherries to strawberries, even being conscious – all these are changeable states, the disappearance of which should not affect the self, as a disappearance of individual pearls should not affect the thread. But it then becomes unclear why such a minimal self should have the central status in our lives that we usually accord to it.

The second model is based on the fact that a rope holds together even though there is no single fibre running through the entire rope, just a sequence of overlapping shorter fibres. Similarly, our self might just be the continuity of overlapping mental events. While this view has a certain plausibility, it has problems of its own. We usually assume that when we think of something or make a decision, it is the whole of us doing it, not just some specific part. Yet, according to the rope view, our self is never completely present at any point, just like a rope's threads do not run its entire length.

It seems then as if we are left with the unattractive choice between a continuous self so far removed from everything constituting us that its absence would scarcely be noticeable, and a self that actually consists of components of our mental life, but contains no constant part we could identify with. The empirical evidence we have so far points towards the rope view, but it is by no means settled.

Even more important, and just as troublesome, is our second core belief about the self: that it is where it all comes together.

It is easy to overlook the significance of this fact, but the brain accomplishes an extremely complex task in bringing about the appearance of a unified world. Consider, for example, that light travels much faster than sound yet visual stimuli take longer to process than noises. Putting together these different speeds means that sights and sounds from an event usually become available to our consciousness at different times (only sights and sounds from events about 10 metres away are available at the same time). That means the apparent simultaneity of hearing a voice and seeing the speaker's lips move, for example, has to be constructed by the brain.

Our intuitive view of the result of this process resembles a theatre. Like a spectator seated in front of a stage, the self perceives a unified world put together from a diverse range of sensory data. It would get confusing if these had not been unified in advance, just as a theatregoer would be confused if they heard an actor's lines before he was on stage. While this view is persuasive, it faces many difficulties.

Consider a simple case, the "beta phenomenon" (see diagram and video above). If a bright spot is flashed onto the corner of a screen and is immediately followed by a similar spot in the opposite corner, it can appear as if there was a dot moving diagonally across the screen. This is easily explained: the brain often fills in elements of a scene using guesswork. But a tweak to this experiment produces a curious effect.

If the spots are different colours – for example a red spot followed by a green spot – observers see a moving spot that changes colour abruptly around the mid-point of the diagonal (see "Spotted trick"). This is very peculiar. If the brain is filling in the missing positions along the diagonal for the benefit of the self in the theatre, how does it know before the green spot has been observed that the colour will switch?

One way of explaining the beta phenomenon is by assuming that our experience is played out in the theatre with a small time delay. The brain doesn't pass on the information about the spots as soon as it can, but holds it back for a little while. Once the green spot has been processed, both spots are put together into a perceptual narrative that involves one moving spot changing colour. This edited version is then screened in the theatre of consciousness.

Unfortunately, this explanation does not fit in well with evidence of how perception works. Conscious responses to visual stimuli can occur at a speed very close to the minimum time physically possible. If we add up the time it takes for information to reach the brain and then be processed, there is not enough time left for a delay of sufficient length to explain the beta phenomenon.

Perhaps there is something wrong with the notion of a self perceiving a unified stream of sensory information. Perhaps there are just various neurological processes taking place in the brain and various mental processes taking place in our mind, without some central agency where it all comes together at a particular moment, the perceptual "now". It is much easier to make sense of the beta phenomenon if there is no specific time when perceptual content appears in the theatre of the self – because there is no such theatre.

The perception of a red spot turning green arises in the brain only after the perception of the green spot. Our mistaken perception of the real flow of events is akin to the way we interpret the following sentence: "The man ran out of the house, after he had kissed his wife". The sequence in which the information comes in on the page is "running–kissing", but the sequence of events you construct and understand is "kissing–running". For us to experience events as happening in a specific order, it is not necessary that information about these events enters our brain in that same order.

The final core belief is that the self is the locus of control. Yet cognitive science has shown in numerous cases that our mind can conjure, post hoc, an intention for an action that was not brought about by us.

In one experiment, a volunteer was asked to move a cursor slowly around a screen on which 50 small objects were displayed, and asked to stop the cursor on an object every 30 seconds or so.

Self-delusion

The computer mouse controlling the cursor was shared, ouija-board style, with another volunteer. Via headphones, the first volunteer would hear words, some of which related to the objects on screen. What this volunteer did not know was that their partner was one of the researchers who would occasionally force the cursor towards a picture without the volunteer noticing.

If the cursor was forced to the image of a rose, and the volunteer had heard the word "rose" a few seconds before, they reported feeling that they had intentionally moved the mouse there. The reasons why these cues combined to produce this effect is not what is interesting here: more important is that it reveals one way that the brain does not always display its actual operations to us. Instead, it produces a post-hoc "I did this" narrative despite lacking any factual basis for it (American Psychologist, vol 54, p 480).

So, many of our core beliefs about ourselves do not withstand scrutiny. This presents a tremendous challenge for our everyday view of ourselves, as it suggests that in a very fundamental sense we are not real. Instead, our self is comparable to an illusion – but without anybody there that experiences the illusion.

Yet we may have no choice but to endorse these mistaken beliefs. Our whole way of living relies on the notion that we are unchanging, coherent and autonomous individuals. The self is not only a useful illusion, it may also be a necessary one.

I am the one and only, insert box by Graham Lawton

Think back to your earliest memory. Now project forward to the day of your death. It is impossible to know when this will come, but it will.

What you have just surveyed might be called your "self-span", or the time when this entity you call your self exists. Either side of that, zilch.

Which is very mysterious, and a little unsettling. Modern humans have existed for perhaps 100,000 years, and more than 100 billion have already lived and died. We assume that they all experienced a sense of self similar to yours. None of these selves has made a comeback, and as far as we know, neither will you.

What is it about a mere arrangement of matter and energy that gives rise to a subjective sense of self? It must be a collective property of the neurons in your brain, which have mostly stayed with you throughout life, and which will cease to exist after you die. But why a given bundle of neurons can give rise to a given sense of selfhood, and whether that subjective sense can ever reside in a different bundle of neurons, may forever remain a mystery.

WHEN ARE YOU? – The self: You think you live in the present? by J Westerhoff

Our brains create our own version of reality to help us make sense of things. But this means we're living outside time.

It seems obvious that we exist in the present. The past is gone and the future has not yet happened, so where else could we be? But perhaps we should not be so certain.

Sensory information reaches us at different speeds, yet appears unified as one moment. Nerve signals need time to be transmitted and time to be processed by the brain. And there are events – such as a light flashing, or someone snapping their fingers – that take less time to occur than our system needs to process them. By the time we become aware of the flash or the finger-snap, it is already history.

Our experience of the world resembles a television broadcast with a time lag; conscious perception is not "live". This on its own might not be too much cause for concern, but in the same way the TV time lag makes last-minute censorship possible, our brain, rather than showing us what happened a moment ago, sometimes constructs a present that has never actually happened.

Evidence for this can be found in the "flash-lag" illusion. In one version, a screen displays a rotating disc with an arrow on it, pointing outwards (see "Now you see it..."). Next to the disc is a spot of light that is programmed to flash at the exact moment the spinning arrow passes it. Yet this is not what we perceive. Instead, the flash lags behind, apparently occurring after the arrow has passed.

One explanation is that our brain extrapolates into the future. Visual stimuli take time to process, so the brain compensates by predicting where the arrow will be. The static flash – which it can't anticipate – seems to lag behind.

Neat as this explanation is, it cannot be right, as was shown by a variant of the illusion designed by David Eagleman of the Baylor College of Medicine in Houston, Texas, and Terrence Sejnowski of the Salk Institute for Biological Studies in La Jolla, California.

If the brain were predicting the spinning arrow's trajectory, people would see the lag even if the arrow stopped at the exact moment it was pointing at the spot. But in this case the lag does not occur. What's more, if the arrow starts stationary and moves in either direction immediately after the flash, the movement is perceived before the flash. How can the brain predict the direction of movement if it doesn't start until after the flash?

The explanation is that rather than extrapolating into the future, our brain is interpolating events in the past, assembling a story of what happened retrospectively (Science, vol 287, p 2036). The perception of what is happening at the moment of the flash is determined by what happens to the disc after it. This seems paradoxical, but other tests have confirmed that what is perceived to have occurred at a certain time can be influenced by what happens later.

All of this is slightly worrying if we hold on to the common-sense view that our selves are placed in the present. If the moment in time we are supposed to be inhabiting turns out to be a mere construction, the same is likely to be true of the self existing in that present.

WHERE ARE YOU? – Trick yourself into an outer-body experience

by Anil Ananthaswamy

Your mind isn't as firmly anchored in your body as you think. Time for some sleight of hand.

CLOSE your eyes and ask yourself: where am I? Not geographically, but existentially. Most of the time, we would say that we are inside our bodies. After all, we peer out at the world from a unique, first-person perspective within our heads – and we take it for granted.

We wouldn't be so sanguine if we knew that this feeling of inhabiting a body is something the brain is constantly constructing. But the fact that we live inside our bodies doesn't mean that our sense of self is confined to its borders – as these next examples show.

Sleight of (rubber) hand

By staging experiments that manipulate the senses, we can explore how the brain draws – and redraws – the contours of where our selves reside.

One of the simplest ways to see this in action is via an experiment that's now part of neuroscience folklore: the rubber hand illusion. The set up is simple: a person's hand is hidden from their view by a screen while a rubber hand is placed on the table in front of them. By stroking their hand while they see the rubber hand being stroked, you can make them feel that the fake hand is theirs (see diagram).

Why does this happen? The brain integrates various senses to create aspects of our bodily self. In the rubber hand illusion, the brain is processing touch, vision and proprioception – the internal sense of the relative location of our body parts. Given the conflicting information, the brain resolves it by taking ownership of the rubber hand.

The implication is that the boundaries of the self sketched out by the brain can easily expand to include a foreign object. And the self's peculiar meanderings outside the body don't end there.

Trading places

Ever wish you had someone else's body? The brain can make it happen. To show how, Henrik Ehrsson at the Karolinska Institute in Stockholm, Sweden, and colleagues transported people out of their own bodies and into a life-size mannequin.

The mannequin had cameras for eyes, and whatever it was "seeing" was fed into a head-mounted display worn by a volunteer. In this case, the mannequin's gaze was pointed down at its abdomen. When the researchers stroked the abdomens of both the volunteer and the mannequin at the same time, many identified with the mannequin's body as if it was their own.

In 2011, the team repeated the experiment, but this time while monitoring the brain activity of volunteers lying in an fMRI scanner. They found that activity in certain areas of the frontal and parietal lobes correlated with the changing sense of body ownership.

So what's happening? Studies of macaque monkeys show us that these brain regions contain neurons that integrate vision, touch and proprioception. Ehrsson thinks that in the human brain such neurons fire only when there are synchronous touches and visual sensations in the immediate space around the body, suggesting that they play a role in constructing our sense of body ownership. Mess with the information the brain receives, and you can mess with this feeling of body ownership.

Yet while Ehrsson's study manipulated body ownership, the person "inside" the mannequin still had a first-person perspective – their self was still located within a body, even if it wasn't their own. Could it be possible to wander somewhere where there is no body at all?

Into thin air

Your self even can be tricked into hovering in mid-air outside the body. In 2011, Olaf Blanke at the Swiss Federal Institute of Technology (EPFL) in Lausanne and colleagues asked volunteers to lie on their backs and via a headset watch a video of a person of similar appearance being stroked on the back. Meanwhile, a robotic arm installed within the bed stroked the volunteer's back in the same way.

The experience that people described was significantly more immersive than simply watching a movie of someone else's body. Volunteers felt they were floating above their own body, and a few experienced a particularly strange effect. Despite the fact that they were all lying facing upwards, some felt they were floating face down so they could watch their own back (see "Leaving the body"). "I was looking at my own body from above," said one participant. "The perception of being apart from my own body was a bit weak but still there."

"That was for us really exciting, because it gets really close to the classical out-of-body experience of looking down at your own body," says team member Bigna Lenggenhager, now at the University of Bern in Switzerland. Further support came by repeating the experiment inside an MRI scanner, which showed a brain region called the temporoparietal junction (TPJ) behaving differently when people said they were drifting outside their bodies. This ties in neatly with previous studies of brain lesions in people who reported out-of-body experiences, which also implicated the TPJ.

The TPJ shares a common trait with other brain regions that researchers believe are associated with body illusions: it helps to integrate visual, tactile and proprioceptive senses with the signals from the inner ear that give us our sense of balance and spatial orientation. This provides more evidence that the brain's ability to integrate various sensory stimuli plays a key role in locating the self in the body.

According to philosopher Thomas Metzinger of the Johannes Gutenberg University in Mainz, Germany, understanding how the brain performs this trick is the first step to understanding how the brain puts together our autobiographical self – the sense we have of ourselves as entities that exist from a remembered past to an imagined future. "These experiments are very telling, because they manipulate low-level dimensions of the self: self-location and self-identification," he says. The feeling of owning and being in a body is perhaps the most basic facet of self-consciousness, and so could be the foundation on which more complex aspects of the self are built. The body, it seems, begets the self.

WHY ARE YOU? – Why are you like you are? by Michael Bond

You're so vain, you probably think your self is about you. The truth is slightly more complicated.

THE first time a baby smiles, at around 2 months of age, is an intense and beautiful moment for the parents. It is perhaps the first sure sign of recognition for all their love and devotion. It might be just as momentous for the baby, representing their first step on a long road to identity and self-awareness.

Identity is often understood to be a product of memory as we try to build a narrative from the many experiences of our lives. Yet there is now a growing recognition that our sense of self may be a consequence of our relationships with others. "We have this deep-seated drive to interact with each other that helps us discover who we are," says developmental psychologist Bruce Hood at the University of Bristol, UK, author of *The Self Illusion* (Constable, 2012). And that process starts not with the formation of a child's first memories, but from the moment they first learn to mimic their parents' smile and to respond empathically to others.

The idea that the sense of self drives, and is driven by, our relationships with others makes intuitive sense. "I can't have a relationship without having a self," says Michael Lewis, who studies child development at the Robert Wood Johnson Medical School in New Brunswick, New Jersey. "For me to interact with you, I have to know certain things about you, and the only way I can get at those is by knowing things about me."

There is now evidence that this is the way the brain works. Some clues come from people with autism. Although the disorder is most commonly associated with difficulties in understanding other people's nonverbal social cues, it also seems to create some problems with self-reflection: when growing up, people with autism are later to learn how to recognise themselves in a mirror and tend to form fewer autobiographical memories. Tellingly, the same brain regions – areas of the prefrontal cortex – seem to show reduced activity when autistic people try to perform these kinds of tasks, and when they try to understand another's actions. This supports the idea that the same brain mechanism underlies both types of skills.

Further support for the idea comes from the work of Antonio Damasio at the University of Southern California, who has found that social emotions such as admiration or compassion, which result from a focus on the behaviour of others, tend to activate the posteromedial cortices, another set of brain regions also thought to be important in constructing our sense of self (PNAS, vol 106, p 8021).

The upshot is that my own self is not so much about me; it's as much about those around me and how we relate to one another – a notion that Damasio calls "the social me". This has profound implications. If a primary function of self-identity is to help us build relationships, then it follows that the nature of the self should depend on the social environment in which it develops. Evidence for this comes from cultural psychology. In his book *The Geography of Thought* (Nicholas Brealey, 2003), Richard Nisbett at the University of Michigan presented lab experiments suggesting that Chinese and other east Asian people tend to focus on the context of a situation, whereas Westerners analyse phenomena in isolation – different outlooks that affect the way we think about ourselves.

Researchers examining autobiographical memory, for example, have found that Chinese people's recollections are more likely to focus on moments of social or historical significance, whereas people in Europe and America focus on personal interest and achievement. Other studies of identity, meanwhile, have found that Japanese people are more inclined to tailor descriptions of themselves depending on the situation at hand, suggesting they have a more fluid, less concrete sense of themselves than Westerners, whose accounts tend not to rely on context in this way.

Such differences may emerge at an early age. Lewis points to anthropological reports suggesting that the "terrible twos" – supposedly the time when a child develops an independent will – are not as dramatic in cultures less focused on individual autonomy, which would seem to show that culture sculpts our sense of self during our earliest experiences.

These disparities in outlook and thinking imply that our very identities – "what it is that I am" – are culturally determined. "I'm a male, I'm an academic, I'm a senior, I'm married, I'm a father and grandfather: all of these things that I define myself as are really cultural artefacts," says Lewis. Clearly there is no single pan-cultural concept of selfhood. Yet Hazel Markus, who studies the interaction of culture and self at Stanford University in California, points out that human personalities do share one powerful trait: the capacity to continually shape and be shaped by whatever social environment we inhabit.

While the evidence for "the social me" continues to mount, not everyone is convinced that it is always helpful for our well-being. To the writer and psychologist Susan Blackmore, the self may be a by-product of relationships. It may simply unfold "in the context of social interaction and learning to relate to others, which may inevitably lead you to this sense that I am in here" while bringing some unfortunate baggage along with it. She points out that the self can compel us to cling neurotically to emotions and thoughts that undermine our overall happiness.

Letting it all go, however, would mean undoing the habit of a lifetime.

PSYCHOLOGICAL DISORDERS – When the self breaks

by Anil Ananthaswamy and Graham Lawton

That seamless sense of who you are can be disturbed by many things, including illness, injury or drugs.

Depersonalisation disorder

Many people experience brief episodes of detachment, but for others "depersonalisation" is an everyday part of life. The Diagnostic and Statistical Manual of Mental Disorders IV defines it as "a feeling of detachment or estrangement from one's self... The individual may feel like an automaton or as if he or she is living in a dream or a movie. There may be a sensation of being an outside observer of one's mental processes, one's body, or parts of one's body." There is some evidence that this state is caused by a malfunction of the body's emotion systems (Consciousness and Cognition, vol 20, p 99).

The petrified self

A crucial building block of selfhood is the autobiographical self, which allows us to recall the past, project into the future and view ourselves as unbroken entities across time. Key to this is the formation of memories of events in our lives.

Autobiographical memory formation is one of the first cognitive victims of Alzheimer's disease. This lack of new memories, along with the preservation of older ones, may be what leads to the outdated sense of self – or "petrified self" – often seen in the early stages of the disease. It could also be what causes a lack of self-awareness of having the illness at all (Consciousness and Cognition, vol 8, p 989).

Body integrity identity disorder

Imagine a relentless feeling that one of your limbs is not your own. That is the unenviable fate of people with body integrity identity disorder. They often feel it so intensely that they end up amputating the "foreign" part.

The disorder can be viewed as a perturbation of the bodily self caused by a mismatch between the internal map of one's own body and physical reality. Neuroimaging studies by Peter Brugger of University Hospital Zurich in Switzerland have shown that the network of brain regions responsible for creating a sense of bodily self is different in people with the condition (Brain, vol 136, p 318).

Psychedelics

One of the most reliable – and reversible – ways to alter your sense of self is to ingest psychedelic drugs such as LSD or psilocybin, the active ingredient in magic mushrooms.

Alongside sensory distortions such as visual hallucinations, a common psychedelic experience is a feeling that the boundary between one's self and the rest of the world is dissolving. A team led by David Nutt of Imperial College London recently discovered why: psilocybin causes a reduction in activity in the anterior cingulate cortex, a part of the brain thought to be involved in integrating perception and the sense of self. It was assumed that psychedelics worked by increasing brain activity; it seems the opposite is true (PNAS, vol 109, p 2138).

Cotard's delusion

Of all the disturbances of the self, the eeriest and least understood is Cotard's syndrome. Symptoms of this very rare syndrome range from claims that blood or internal organs have gone missing to disavowal of the entire body and a belief that one is dead or has ceased to exist. People with the delusion – who are often severely depressed or psychotic – have been known to plan their own funerals.

THE END? – What are we to do? By Richard Fisher

Our perception of our self might be an illusion, like free will. But that doesn't mean we can't learn from it.

"LET yourself go" now has a whole new meaning, but there are fewer things harder to let go of. Our concept of ourselves as individuals in control of our destinies underpins much of our existence, from how we live our lives to the laws of the land. The way we treat others, too, hinges largely on the assumption that they have a sense of self similar to our own.

So it is a shock to discover that our deeply felt truths are in fact smoke and mirrors of the highest order. What are we – whatever it is we are – to do?

First of all, keep it in perspective. Much of what we take for granted about our inner lives, from visual perception to memories, is little more than an elaborate construct of the mind. The self is just another part of this illusion.

And it seems to serve us well. In that respect, the self is similar to free will, another fundamental feature of the human experience now regarded by many as an illusion. Even as the objective possibility of free will erodes, our subjective experience of it remains unchanged: we continue to feel and act as though we have it.

The same will surely be true about the self. The illusion is so entrenched, and so useful, that it is impossible to shake off. But knowing the truth will help you understand yourself – and those around you – better.