

The Stuff Meaning is Made of

With some Examples from Temple Grandin

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Contents

Common Sense Semantics	3
<i>A Glimpse of a Different World</i>	3
<i>Words and Images</i>	3
<i>Exploring The Bridge between Language and World</i>	4
<i>Investigating the Bridge between Language and World</i>	5
Setting the Stage	7
<i>The Stage: Brain-Made Awareness</i>	7
<i>Reality on Stage</i>	7
<i>Enjoying the Show</i>	9
<i>Backstage</i>	10
<i>Reconstructions</i>	10
<i>Grasping the World</i>	11
Verbal Communication: an Image under Construction	12
<i>Synchronising the Image</i>	12
<i>System and Flexibility</i>	12
<i>The Magic of Language</i>	13
<i>Words as Access Points</i>	15
The Stuff Meaning is Made of	16
<i>The Meaning We Attribute to Words</i>	16
<i>Temple Grandin: A Struggle for Meaning</i>	17
<i>Words and Reality: Meeting Point</i>	19
<i>Information and Meaning</i>	20
<i>Notes</i>	22

Common Sense Semantics

A Glimpse of a Different World

In *Thinking in Pictures (and Other Reports from my Life with Autism)*, Temple Grandin describes how she thinks.¹⁾ Her book does not focus on language, still I think it gives a rare insight into the connection between language and world. I will come to that.

But first: it is remarkable what Temple Grandin has accomplished: discovering herself different from the majority of people, she systematically studied their alien ways in order to be able to fit in.²⁾ In *Thinking in Pictures*, she reverses the roles, with many concrete examples explaining to 'neurotypical' people what her world is like and what it is like to think in detailed, full-colour movies.

This is no small achievement. Limited as we all are to what our own brain is capable of bringing to our own mind, we would need someone else's brain at work in our own head really to be able to experience the other's reality. We may every now and then imagine ourselves in someone else's shoes but this only goes as far as it goes: the accuracy of the mirror experience depends on the degree of similarity between the individual brains, and it is only thanks to the fact that most people have their brain built according to the same general design that they are more or less able to understand each other.

For Temple Grandin, this is really different; the circuitry of the brain she was born with to explore the world right from the start differed from the 'typical' brain, and it is fascinating to learn what she sees from her perspective. We usually take our world for granted, assuming it is just there for everyone to see, but in fact, as neuroscience has shown, the world around us is an ingenious construction of our own brain turning the signals picked up by our senses into awareness of their origin, and it is good every once in a while to realize that had our brain been different our world would have been different. Temple Grandin's book offers us a glimpse of such a different world . To me, reading her book felt like stretching the limits of my own mind, trying to imagine what it would be like to look through her eyes at a world jam-packed with details and think with her highly visual mind.

Words and Images

Temple Grandin has this extraordinary capacity to recall in detail her rich sensory experience and she thinks by re-creating in her mind whatever it is she thinks about as if she had it in fact in sight;

In (1), *a tomcat* refers to a specific (albeit unspecified) tomcat, in (2) it does not, (3) is about any tomcat and (4) defines the meaning of *tomcat*. Parallel examples can be given for definite noun phrases, proper names, 'mass terms', etc.

Also (even simple) negative sentences can be used to give very different information. For example

(5) *A sister is not interested.*

Can, among others, be used, parallel to (1), to say about some sister that she is not interested, or, parallel to (2), not referring to some sister, to say that no sister is interested.

Vagueness.

For virtually every single word there is an enormous and diverse range of things it can be used for. Take a simple down-to-earth word like *cat*: it can be used for our domestic animals, which already come in rich variety, for big cats, naturalistic and abstract paintings and sculptures of these animals, but also for spiteful women or for funny-shaped teapots and whiskered soft toys. No doubt to a large extent which of these is meant depends on context and situation of its use. And then I did not yet mention those words that systematically under-specify what they are used for, like pronouns.

How does it work? As said, intuitively, it is mental images that bridge the gap. Now, from a scientific perspective, they may seem at first only to add to the problems, as words by far do not determine the images they call up: not only can we, given a word, given time, imagine about the whole range of what we would recognise as fitting, but also, depending on the occasion, word-triggered images vary in quality, they may remain dim or become rich in detail or anything in between, and they perpetually change their appearance, their shape, their size, their colour, etc. Also often enough the first image that comes to mind turns out to have all the wrong detail; hearing *cat* you may instantly get the picture of your dear old fat lazy tortoiseshell, while in fact the speaker was talking about this haughty prize-winning Persian (which you nevertheless on occasion still recognise as fitting the speaker's *cat*). And no doubt, from person to person, word-triggered images will differ both in quality and in appearance. I need only to compare my fragmentary images to what Temple Grandin tells about hers to see the problem.

Investigating the Bridge between Language and World

Given this ambiguity and this vagueness, it is remarkable that language works at all but it does very well: we do use it to get information across, we do instantly get the picture, we do connect it to reality, we do share our fictional worlds. If only we could find out how. Now I think the closest we

can come to witnessing all this is when a hearer, given a speaker's sequence of sounds, understands what they are talking about and in the presence of the real thing recognises it as fitting the information. The question to ask is what is actually happening here. This is an empirical question that can be guaranteed to have an answer in the reality of verbal communication. To find the answer we should trace exactly what happens in the head of the hearer, word by word, form by form, and construction by construction. And if indeed language is ambiguous, if it is vague, the problems should be dealt with where they occur, right in the process of verbal communication.

How to investigate these processes? As a hearer myself, I have direct access to what shows up in my own mind, I recognise words in the speaker's sounds and I am aware of what they call up. Now the actual metamorphosis from word to image has kind of a magical quality which escapes my introspection, but I can very well try to break up what I hear the speaker saying into its separate informative forms and isolate what they each contribute to the image under construction; the aim is to design a theory that represents exactly this process, the whole distance from forms recognised in the speaker's sounds to the real thing recognised as fitting.

There are some criteria for the theory to be met:

1. In the first place, it should be introspectively satisfactory, as this is the key to understanding how we actually make sense of language. For example, take the supposedly ambiguous negative example given above:

(5) *A sister is not interested.*

Now if we go along with its usual analysis as having a 'scope ambiguity', assuming that *not* can take 'scope' over either the predicate or the whole sentence, changing places which the indefinite 'quantifier', we lose track of how in fact we perfectly well understand the forms as they come; when we focus on what actually happens, the parallel with (1) and (2) is clear: the difference comes with the way we make sense of *a sister*, either or not referring to some sister in particular, and is only reinforced by the following negation. The theory should explain how a hearer, given this simple construction, without any problem can arrive at either of these very different understandings, and what is more, does arrive at the one intended by the speaker, without speaker or hearer even being aware of another possibility.

2. The theory should explain the connection between language and reality whenever there is such a connection by predicting what situation all listeners will recognise as fitting a speaker's information when it comes in sight. Take (5) again: obviously its two readings are about different situations. In semantics, often the connection between examples like (5) and the world is described in terms of a difference in truth conditions: in a situation where one of two sisters is interested and

the other visibly bored, the first reading is 'true' and the second is 'false'. This may be so but it does not begin to explain how we actually make the connection, how we actually talk about reality. What matters is that hearers, given (5), understanding it as a statement about some sister, finding themselves in the situation given here, recognise it as fitting the information and recognise this real person as the one talked about, the one not interested. In contrast, should the information be that no sister is interested, hearers would recognise the same situation as not fitting the information.

3. What shows up in the mind completely depends on what simultaneously happens in the brain, so the theory should be consistent with the fast-growing neurological knowledge.

Setting the Stage

The Stage: Brain-Made Awareness

I am not a neuro-scientist, but there is some well-established knowledge about perception and memory ³⁾ that I think should be incorporated in semantic theory, without reducing verbal communication to neural activity. Although nothing comes to mind without its neural correlate, the empirical questions stated above cannot be rephrased in terms of the brain without getting lost; it is brain-made consciousness that sets the stage where verbal communication takes place. It is 'on stage' in the human mind that we find the forms of language recognised as informative in the speaker's sounds, the shape this information takes, that is mental reconstructions of what they are talking about, and the real world when it is within reach of the senses. On the other hand, because everything showing up in the human mind depends on the brain, the more we learn about the brain the better we may come to understand the shape it all takes in awareness. Based on what as far as I know is established knowledge, some basic assumptions about the brain and its mind may help not to confuse what comes to mind with the neural machinery that puts it there.

Reality on Stage

Unless we have a notion of what is there, we cannot use language to stand-in for it. So let's start with the real world; for now, think away language and think away mental images and just focus on reality. When you look at, for instance, a rock (make it a landmark in the landscape), you know it to exist but the rock does not know you to exist. It may seem self-evident that you can see whatever it is you look at but in fact this is an amazing achievement of your brain: it is capable of a special kind of activity during which you are aware of the world around you, an activity that opens a perspective

on things in their own right, separating them from a simultaneously emerging 'self'. The question how a biological machine can achieve this is really tough and I wouldn't know how to begin to answer it, but let's accept this as a fact and go from there. I think it is reasonable to make the following basic assumptions:

- I. It is during and only during this special kind of neural activity in a brain that its 'self' is aware of something,
- II. It is the specific combination of neurons taking part in this activity that determines what shows up in awareness.

It is impossible to find a notation that begins to do justice to the complexity and flexibility of this neural machine, but for easy reference, call this special activity A , represent unspecified complexes of neurons as N and represent the activity A in N as $A(N)$. When relevant, N can be specified; for instance, represent the (complex and perpetually changing) complex of neurons triggered by the light waves reflecting off the rock hitting the eyes as N_{ROCK} . So:

- A the neural activity that equals awareness,
- N an unspecified complex of neurons,
- N_{ROCK} the complex neural network correlated to the rock,
- $A(N)$ A going on in N ,
which equals awareness of whatever thing N is correlated to,
- $A(N_{\text{ROCK}})$ A going on in N_{ROCK} ,
which equals awareness of the rock,
put differently: which puts the rock on stage in the mind.

As for this special neural activity A : it is for neuroscience to find out what exactly it is, but anyhow it involves masses of neurons firing in repetitive waves, taking the synaptic thresholds that connect them, the waves coordinated in all the areas involved. The signals fire one way, but feedback connections are essential to achieve the necessary coordination and to keep the action going. Whatever this special activity may in fact consist of, it does not produce awareness but it equals awareness; you are not aware of the rock without $A(N_{\text{ROCK}})$ going on and $A(N_{\text{ROCK}})$ does not go on without you being aware of the rock.

As for the complex of neurons N : perceptual experience results from a complex division of labour; light waves reflecting off the rock hit your eyes, your brain takes the input apart and separately processes it in a number of specialised areas, connected in parallel and hierarchically, separately dealing with shape, colour, texture, etc. Thus, the complex of neurons N_{ROCK} consists of the combination of specific sub-networks of neurons in all those specialised areas. It is not a well-

defined complex; all the time neurons and networks of neurons drop out of action and others join in.

Suppose the rock is square and brown; we can say that N_{ROCK} 's sub-network in the area specialized in shape, say, N_{SQUARE} , correlates to the rock's actual shape, that the network in the area specialized in colour, say, N_{BROWN} , correlates to the rock's actual colour, etc., and that the complex of all these networks together, say, $(N_{\text{SQUARE}} - N_{\text{BROWN}} - N)_{\text{ROCK}}$, correlates to the whole of this specific rock. I think it is reasonable to assume that it is $A(N_{\text{SQUARE}})$ that equals awareness of the rock's shape, $A(N_{\text{BROWN}})$ that equals awareness of the rock's colour, etc., and the coordination of A in all these networks that assembles this shape, colour, etc. into a unified perception. So:

$A(N_{\text{SQUARE}})$	equals awareness of a square shape,
$A(N_{\text{BROWN}})$	equals awareness of the colour brown,
$A(N_{\text{SQUARE}} - N_{\text{BROWN}} - N)_{\text{ROCK}}$	equals awareness of a square brown rock.

Enjoying the Show

As long as $A(N_{\text{ROCK}})$ goes on in your brain the rock is there on stage in your awareness, it exists to you. When $A(N_{\text{ROCK}})$ subsides and the rock slips from your mind, no doubt that does not affect its physical existence but it does cease to exist to you; in general, the familiar sensory world of colour, texture, sound, smell, touch, etc. exists to us only and precisely as long as our brain keeps up the effort. It is only during awareness that our world is there, a world in which we take part as 'ourselves', both as actor and as audience; it is the stage where verbal communication takes place.

Awareness is not an epiphenomenon of a neural machinery doing all the work, it is not just a place where the lights go on to illuminate what goes on in the brain, an extra nicety just to enable us to enjoy the show; without awareness there is no show. To be sure, an enormous amount of vitally important neural activity goes on that does not make anything surface to the conscious mind; undoubtedly a lot, even most, of our actions are automatically being carried out, but our neural machine cannot accommodate the world out there, other people, other things, not someone to make the decisions, there is no language in there. However the brain has evolved into a machinery that can, amazingly enough, create an accommodation for all this, a stage for the show to happen, namely, consciousness, awareness. It is, however, a temporary accommodation: everything going on on stage, including the scenery, is being created on stage: the actors cannot go in the wings waiting for their next cue; when done, they disintegrate along with the coordination of activity A between networks correlated to their parts and just vanish along with A itself, just like we ourselves

lose 'ourselves' during our dreamless sleep, when the brain takes a break from all this neural activity A that keeps our mind so busy during the day.

For each of us, our own reality show starts when our brain makes sense of the signals our senses are able to pick up from around, turning them into awareness of their origin, enabling us to experience small slices of reality at a time, the reality immediately around us. And this is our only way to begin to conceive of the fact that we are part of a world larger than ourselves; in general, whatever knowledge people have of reality, including verbal, including abstract knowledge, it is built upon this basis.

Backstage

Thus the rock ceases to exist to you as soon as it slips from your mind; however, it does not vanish without a trace. Whenever a combination of neurons is co-ordinately firing in this special way A , mechanisms set in to strengthen them together by lowering the thresholds of the connecting synapses and by forming new connections. Thus, of this $A(N_{\text{ROCK}})$ that equals your awareness of the rock, it is N_{ROCK} that gets preserved. As this paves the way for renewed electrical firing, a small input anywhere in the complex easily flashes it into activity A again, unfailingly putting the rock on stage again. This strengthened N is not a representation or a dormant version of the real thing, it is nothing more and nothing less than the combination of neurons originally involved in making you aware of it, preserved for easy reconstruction of the experience; N_{ROCK} records how to be aware of the rock again, like a record of music preserves the music; the only thing necessary to call it into existence again is a trigger to set off activity A in its record. Thus, a glimpse of the rock from afar is enough for the whole landmark to be there in view again, instantly familiar.

Such strengthened networks are very plastic; millions of neurons are kept together by uncountable connections of unequal strength; out of use the connections may decay and with each new use they become re-strengthened; each new experience involving the same or partly the same networks leaving an adapted, state-of-the-art record.

Reconstructions

Also in the absence of the original thing, its neural record, once strengthened, can flash into activity A , somehow triggered from inside the brain; insofar as this involves the same combination of neurons that was involved in the original experience (it never completely does), it will reproduce the original experience; anyhow, a more or less detailed reconstruction of the original will take

shape, an image that can stand-in for it. The stronger the neural records, the better people's visualisation skills; Temple Grandin is really good at it, her mental pictures always are about as clear as the original. For me, and I think for many people, more often than not mental images are only a shadow of the original, but up to a point I have a choice, I can focus on one or a few aspects by leaving out all irrelevant details, I can take in mind a transparent, colourless shape, or a shapeless colour, but I can also take the time to flesh out my mental image with more and more details.

As these mental images for their occurrence on our mind's stage do not depend on the physical presence of the original thing, they do not depend on their actual existence either: whole scenes may enfold put together from bits and pieces taken from all kinds of previous experiences.

Grasping the World

It is conscious experience of reality that shapes our first notion of what is there around us. Our ability to reproduce bits and pieces of experience when the real thing is out of sight is our first way to conceive of things beyond the range of our senses. Our grasp of reality consists of our brain's ability to call it into existence to ourselves both in its presence and in its absence. Take this rock; your grasp of it is situated in the neural complex N that state-of-the-art records previous experiences of it and comes into effect when triggered into activity A either via your senses or from within, in both cases calling the rock to your awareness, in both cases updating the neural record. Your grasp of this rock will overlap your grasp of other rocks. Take for another example your tortoiseshell cat; your grasp of her is situated in the neural complex that state-of-the-art records your previous experiences with her and fragmentarily comes into effect when parts of it are triggered into activity A , simultaneously updating the record. And your grasp of this cat will overlap your grasp of other cats, to a lesser extent overlap your grasp of other mammals, to a still lesser extent overlap your grasp of other animals, etc. Both your grasp of rocks and your grasp of cats will be part of your grasp of the world, which is situated in an unimaginably complex criss-cross of neural networks in your brain, organised in parallel and hierarchically, overlapping and diverging, in an ongoing state of maintenance and decay, adaptation and reorganisation, small bits of which at a time can come into effect by flashing into this extraordinary activity A , opening the curtains on the surrounding world, re-creating pieces of past experience, or putting fragments of imaginary worlds on stage.

Verbal Communication: an Image under Construction

Synchronising the Image

What we each perceive is entirely of our own brain's making; it turns the signals picked up from around by our senses into awareness of their origin; what shows up shows up exclusively to ourselves. We cannot look through someone else's eyes because that would require their brain at work in our head, but we can come close by taking the same position; shared input at least synchronises our private brain-make worlds.

Also we each are able to take in mind what is not within reach of our senses, taking internal control over our brain's machinery evolved to make the world take shape around us. The resulting mental images, emerging from the same neural processes as the original real things in sight, are not any more subjective than the equally brain-made originals, but they lack the synchronisation of perception; we live in more or less the same real world but in the as-if worlds of our imagination we seem to be on our own.

It is here that language comes in. Now language does not actually convey anything, it does not carry meaning through the air, it does not 'have' meaning. What it does is, it calls up bits and pieces of what is already available, activating fragments of the hearer's earlier experiences as recorded. My basic idea about verbal communication is this: with their sequence of sounds, speakers take remote control over the hearer's brain's machinery evolved to make the world take shape around them; in effect, they synchronise people's mental images.

System and Flexibility

When you listen to a language you do not know, the sounds just pass you by; when you listen to your own language, you recognise words put together, you hear intonation, accent, rhythm, emphasis. If I am correct, each of these forms makes its own contribution directly to the image under construction, the show unfolding. The symbolic words conjure up the building stones, the basic images, and the other forms piece them together into larger but still fragmentary mental pictures. The construction is completely systematic, here the speaker is in complete control, but the building stones, the images called up by the basic words, are very flexible; here it is up to the hearer to fill in what gaps the speaker leaves open. Both kinds of contributions are highly efficient in their own way and together they are amazingly effective.

About the system, very briefly: along with syntactic forms there are a number of precisely located prosodic forms for the speaker to choose from, each systematically contributing its own

fragment to the image under construction. They enable the speaker very efficiently to use the same construction to get a multiplication of different messages across to the hearer. Among them two minimal pairs to be combined with (the final syllable of) the noun phrase, a pitch pair that either or not fills up the gaps in the image under construction, thus determining whether or not the noun phrase refers to something, and a rhythmic pair either or not making the image self-replicating ('generic'). Combining to four ways to use the noun phrase, they cover the examples (1) through (5) given above without the need for any 'disambiguation'. And then there are other prosodic forms, each with its own precise contribution. I first published this idea in 1984; recently I proposed a notation designed to represent exactly what takes shape in the hearer's awareness as the other side of what goes on in their brain. For this notation and for further details, see Koene 2007⁴).

Here I want to focus on the basic elements of verbal communication, the words rooted in individual experience.

The Magic of Language

As said above, the actual metamorphosis from words to images escapes our introspection. Now compare: when you hear the unmistakable 'miaow' of your cat in the middle of the night, the sound conjures up the whole cat in your mind. It is your brain that does the trick: it has previously linked the neural networks responsible for you hearing her miaow to the neural networks responsible for the cat's appearance on stage; specifying them respectively as N_{MEW} and N_{CAT} , represent the link as $N_{MEW-CAT}$. Then, when you hear the cat miaow, which equals $A(N_{MEW})$ going on in your brain, the activity A will flash through to $A(N_{MEW-CAT})$ which equals the whole cat showing up to you despite the fact that you do not see her in the dark.

It is not that different when a speaker's *cat* performs its magic. Of course, other than the cat's 'miaow', that will do the trick whether or not you speak English, the combination of sounds *cat* by itself is useless and has nothing to do with the cat; the only thing the cat herself and the word *cat* have in common is that they both can show up in your awareness, both equalling this special activity A going on each in their own correlated networks in their own specialised areas, but this is enough to link them together, provided that it happens simultaneously: whenever different networks are co-ordinately firing in this special way A , routinely and unselectively mechanisms set in to strengthen the networks together. In the case of the cat and her 'miaow', the combination occurs naturally; in the case of language's *cat*, the combination has to be made artificially, in order to prepare your brain for verbal communication.

Thus, when infants experience the cat, $A(N_{CAT})$ going on in their brain, members of their speech community-to-be make them hear the combination of sounds *cat*; consequently, their brain will not only strengthen together the neural networks involved in making them hear *cat* (say, N_{cat}), but also the link to N_{CAT} , leaving the record $N_{cat}-N_{CAT}$. This for the preparation. Now, when they hear *cat*, $A(N_{cat})$ going on in their brain, A will flash through to $A(N_{cat}-N_{CAT})$, which equals the cat showing up to them along with the word regardless of its physical presence or absence.

Generalisation

Of course the facts are not that simple; a word like *cat* can be used to talk about a large and very diverse range of animals (soft toys, teapots, etc.). Above that, mental images are notoriously elusive and idiosyncratic; a word by far does not determine the image it calls up. Listen to *cat*: unless your brain works like Temple Grandin's, the image conjured up will probably not have the specific features of a particular cat; more likely, it will be some vague general cat-shaped outline flexible enough for it to fuse with any real cat (soft toy etc.) that might happen to come in sight. If so, it has taken your brain a lot of preparation to have become as flexible as this.

Although undoubtedly the reality of the brain will be immensely more complex, I could imagine the mechanisms of generalisation in principle working as follows: take two different cats, say, a ginger one and a black one. The record of the ginger cat overlaps the record of the black one in the sub-networks correlated to features they have in common like their shape and diverges in the sub-networks correlated to the features in which they differ like their colour. Provisionally, just for the sake of argument, represent the records of the two cats as $(N_{CAT-SHAPE} - N_{GINGER} - N)_{CAT1}$ and $(N_{CAT-SHAPE} - N_{BLACK} - N)_{CAT2}$. Now link the word *cat* first to the ginger cat and next to the black one. If the mechanism works as conjectured above, $A(N_{cat})$ coordinated with $A(N_{CAT-SHAPE} - N_{GINGER} - N)_{CAT1}$ will leave the record

$$N_{cat} - (N_{CAT-SHAPE} - N_{GINGER} - N)_{CAT1}$$

and $A(N_{cat})$ coordinated with $A(N_{CAT-SHAPE} - N_{BLACK} - N)_{CAT2}$ will leave the record

$$N_{cat} - (N_{CAT-SHAPE} - N_{BLACK} - N)_{CAT2}.$$

Now what I assume is that the link $N_{cat} - N_{CAT-SHAPE}$, having been used twice and thus strengthened twice, is left stronger than the links used only once, the links to colour and other complementary features; in the record, the link from N_{cat} to $N_{CAT-SHAPE}$ will be strong, perhaps even as strong as the links holding the sounds *c-a-t* together; and from there the connection will branch into the weaker links to N_{GINGER} and N_{BLACK} . As the record paves the way for occasional renewed firing A , any action started with $A(N_{cat})$ will immediately flash through to $A(N_{cat} - N_{CAT-SHAPE})$, at which point it may either

stop at the thresholds or continue along one of the alternative smaller roads. That is: when you hear *cat*, the shape will automatically be there as well, only optionally colouring either ginger or black.

And so on and so on, when more and more cats with their own peculiarities come along, the link between *cat* and what they have in common will strengthen, and the links to more particular complementary features will branch into alternative and weaker pathways. When in reality some characteristics often, some less often and other rarely occur together, with accumulating experience this gets reflected in the relative strength of the links between the neurons involved in experiencing them. Tagging the world with words builds upon this process of analysing it into what belongs together and what accidentally co-occurs, where words may take the analysis beyond what meets the eye. Eventually, the record of the word *cat* will be heading a criss-cross of networks of neurons of unequal strength, in perpetual state of maintenance, each new experience that involves part of the existing record adapting it, re-strengthening the links re-used. Thus, the word *cat* heads your grasp of cats (and things with some cat-features), your ability to recognise them when in sight and to remember or imagine them when out of sight, dimly or in detail. And *cat* is just one word in your growing vocabulary, each word heading its own state-of-the-art grasp of its own fuzzy-edged piece of your real and imagined worlds, all these complex records overlapping and criss-crossing each other.

Words as Access Points

Words access recorded experience. A word on stage in your mind is literally on the threshold of calling anything previously linked to it, as and insofar as recorded in the criss-cross of neural networks, to your awareness without the need actually to do so, keeping all of this readily available should it become relevant. Thus when you think, words make very economical use of your active mind's limited capacity.

In verbal communication, it is the speaker's words that access your grasp of the world; as conjectured, their syntactic and prosodic forms systematically build up images of what they are talking about from the building stones called up by their basic symbolic words. As for the construction, the speaker is in complete control, but as for these building stones, it is at the access points that the speaker's control comes to an end; they cannot determine what happens from there; from there it is up to the hearer whether or not to detail the image, in what direction to go and what complementary features to add or to erase again.

Now these word-triggered images might be called vague, fleeting, elusive, metamorphic and idiosyncratic; no doubt, within the limits determined by their access points, the words, they are

unpredictable. Still, it is word-triggered images that are the basic elements of verbal communication; it is only by accessing what has been preserved from previous experience and by calling up fragments of it that words can connect to reality, the images fusing with what is within perceptual distance, involving the same networks of neurons; it is only by conjuring up things as-if there on our mental stage that we can build our fictional worlds. And as for their metamorphic character, it is only thanks to the enormous flexibility of the images they call up that words give us a lasting grasp of a kaleidoscopic and perpetually changing reality in the course of our lives. However large our vocabulary may be, it is nothing compared to the complexity of a reality which our brain struggles to make sense of and cope with; our vocabulary did not arise from a detached logical analysis of reality, cutting it up once and for all into neat categories, but as a work in progress, planting these verbal tags wherever they came in handy and re-using them where things seemed similar enough, 'similar enough' far from being well-defined.

No doubt word-triggered images differ from person to person. This is how it works. For each of us, it is our own history of learning to cope with reality that gives us our grasp of what is in fact there. It is putting verbal tags on whatever it is we ourselves experience that determines what will re-surface when other people use these words. It is because we make an effort to synchronise our word-world connections, making sure we, each in our own way, recognise the same things as fitting the same words, that we make ourselves a basis for verbal communication.

The Stuff Meaning is Made of

The Meaning We Attribute to Words

By themselves, words are just arbitrary combinations of sounds but we make them work, which takes some preparation. Infants learn their first words 'in function', but before that, they have to explore the world, their brain constantly busy making sense of all their sensory input, shaping their world around them. Words then build upon this first knowledge, each word added as an invisible but audible extra feature of whatever it is they experience, the feature 'this combination of sounds applies', the word *cat* just as firmly connected to the cat as her natural features and her mewing, the word *dog* just as firmly connected to the dog as his barking. Unsurprisingly, (at least in Dutch), in baby talk a dog often is called a *woof woof* [*woefwoef*], but such onomatopoeic words are exceptional simply because things usually do not make sounds we can imitate. Unsurprisingly, we tend to use words that hopefully reflect something of whatever it is tagged on, 'smooth' sounding

words for smooth things, etc., but also in this respect the possibilities are limited and in the end, it is us (or rather our ancestors) that connected arbitrary sounds to what matters.

Anyhow, after the link has been established, word and thing seem inextricably to belong to each other, recorded in one complex neural network that when part of it is triggered easily flashes into action as a whole, the cat in sight calling up the word *cat* and the word *cat* calling up the cat. Because of the way our brain works, it is hardly possible to have the word in mind without being aware of what it can be tagged onto. And thus, even when we realise that this is an illusion, words make the strong impression of just 'having' meaning; the word *cat* itself impresses us as naturally cat-shaped, self-evidently giving away its meaning. And thus, starting as empty features, artificially added to what we experience, words soon become what seems to be containers of meaning, containers of what matters.

And then, as the same empty word-feature gets added to more and more diverse concrete things, as the brain comes to record the word heading their records not neatly next to each other but amalgamated together, largely lost to separate recollection, as the word then accesses this neural criss-cross and the image called up can still go in all directions, the impression gets stronger that this 'meaning' the word has must be something more abstract, something removed from those concrete experiences, a 'concept', independent of people who make use of it.

Also in another way the connection between words and experience becomes less obvious. An infant's first words, first vocabulary, will only get 'meaning' when added to what they consciously see, feel, smell, taste, touch, but with their growing vocabulary they can learn new words by adding them to the simulated experience called up by the words they already know. A process that continues all through our lives.

As said, it is an illusion to think that words 'have' meaning. The beauty of language is that it works as if they do. In fact, what we (or rather our distant ancestors) have achieved by adding those empty artificial word-features to what we experience is this: as we can use, think up, speak, hear, the words as we choose, we have made ourselves tools to bring our grasp of the world under our conscious control, both for our own use and for the sake of communication.

Temple Grandin: A Struggle for Meaning

Let's return to Temple Grandin; by looking at our differences we can see more clearly what we must have in common. One of the things I especially like about her book is how clearly her examples illustrate where meaning comes from, the fact that meaning has to be rooted in concrete experience.

Try to imagine her almost tangible mental pictures. There is nothing elusive about them, when she takes a dog in mind it must be a particular one, some specific Great Dane she knows or another specific Great Dane she knows or another specific dog. She can change details in her images (she gives the example of changing the colour of the paint of this specific church she has in mind, p.22) but the resulting picture remains the non-original one; she cannot strip away what is irrelevant, picturing for instance a colourless church, or a 'generalised' dog. I suppose what happens is that her intense sensory experiences in one go leave all the connections between the neurons involved at equal and maximum strength, which do not selectively get stronger with new similar experiences or weaken over time; apparently, new experiences leave completely new and equally strong records next to the earlier ones and do not get amalgamated with the earlier ones; apparently, each of these records only as a whole can flash into action again as (I suppose) there are no thresholds left high enough to stop the action once started and so, memories reconstructing the experiences stay apart and do not get confused.

Then she has to say this about language: 'Words are like a second language to me. I translate both spoken and written words into full-color movies' (p.3). I think she hears words for what they are, like we hear words of a foreign language: just empty verbal tags that do not self-evidently stand-in for the real thing. The remarkable thing is that she does not translate this second language into a first language, as she does not have a 'first' language, but directly into what matters, a picture resembling the real thing, and she has to make each entry in her 'dictionary' herself. It is clear that this meaning does not always come naturally to her; it may take her rather an effort to find a picture she can use. Concept formation, flexible thinking, it all is hard earned, which is why she can tell us about those processes that for most of us our brain performs automatically.

Take her example of dogs. As she says, her concept of dogs is 'inextricably linked to every dog I've ever known. It's as if I have a card catalogue of dogs I have seen, complete with pictures, which continually grows as I add more examples to my video library.' (p.15) That is, where for 'neurotypical' people new experiences update the records by changing the strength of re-used connections and adding new branches somewhere within the whole criss-cross already there, Temple Grandin's brain adds a completely new record (or at least that is how I imagine the difference).

The difference is reflected in what the word calls up. To me, the word *dog* usually calls up a vague colourless flexible shape that may or may not get colour and further details, equally easily to be erased again, which I suppose is more or less typical. Temple Grandin, given *dog*, going through her card catalogue, has to pick one, run the video and if necessary, run another one and then

another one until she has one she can use. As she separately can remember each dog she encountered, the ongoing history of her concept formation is preserved in her memory and she can tell us about it. To me, new dogs do update and expand my record, but most of them get lost to separate recollection and will get (con)fused in my mental reconstruction of dogs.

The 'concept' of dogs is still rather down-to-earth. Temple Grandin's examples where visualisation is not that easy are equally interesting: 'spatial' words like *under*, adverbs like *quickly*, non-visual information, 'abstract' words like *honesty*. To Temple Grandin they remain meaningless until she has found a concrete picture to go with them. For *under* she found the image of herself under the cafeteria tables at school during an air-raid drill, *quickly* had to be paired with the verb *to run*, together to be translated into the picture of the fast running character from a reading book at school. For *honesty* she found meaning by thinking of a news report describing a person returning a wallet with all the money in it (p.14).

Each of these examples strikes me as a reminder of how I myself, in my own way, with my own succession of experiences, could have mastered those words and concepts. This is especially relevant in the case of 'abstract' words: however far removed an abstract word may seem from daily life, for each of us it needs to be rooted in our own experience in order to have any meaning at all, and there is no better way of explaining to someone else what we mean by it than to give a series of concrete examples like the pictures Temple Grandin has found for herself.

Words and Reality: Meeting Point

Although for 'neurotypical' people this is easier than it is for Temple Grandin, we each make our own inventory of words and what they mean to us. Our own history of placing these verbal tags on what we ourselves experience, taking care to place them on the same things as other people do, prepares our brain for verbal communication: it forms the bridges on which the words we recognise in a speaker's sounds can meet the real thing talked about when it happens to be within perceptual distance.

When I try to picture this neural bridge from a word to reality I see a road paved by the waves of firing neurons that made the previous connections, from the records, the correlated neural networks, of the word to the records of all the experiences earlier brought under its heading, as and insofar as preserved. When I try to picture the difference between Temple Grandin's records and my own, in my case I see the first part of the road as a speedway, after which it branches into smaller and alternative pathways. In her case, I picture a hurdle between the record of the word and the records of the experiences, after which the road immediately splits into all these alternative

and equally fast lanes. Maybe this is something like what it looks like in our brains, although undoubtedly the neural reality will in fact be immensely more complex .

It is not the neural pathways themselves that connect word and reality, as they both only come into existence to us while they are 'on stage' in our awareness, but as the pathways pave the way for the kind of electrical firing that equals awareness, the neural pathways linked together make it possible for word and real thing to be on stage as part of each other.

Information and Meaning

The only thing a speaker can actually convey to the hearer is sound; information is not contained in it and meaning does not travel through the air; the sounds are just sounds until a hearer turns them into 'the speaker's words' and, almost immediately, into a mental reconstruction of what they are talking about, which briefly takes shape in their brain-made awareness. That is all there is.

Whatever a hearer makes of what a speaker says is the private product of their individual brain, still it is fruitful to distinguish between what in effect comes across and what the hearer fills in, 'information' and 'meaning'. Information results from the systematic part of verbal communication; it is what takes shape in the hearer's mind following general rules of construction apparently mastered by all member of a speech community. As for this systematic information, my aim is to design a theory that traces what happens in the head of 'the' hearer, each element in the theory a hypothetical representation of what actually shows up in this generalised head, mirroring as closely as I can the mental content.

Then, what we are used to call 'meaning' goes beyond the speaker's information: it is what we for ourselves turn this information into, filling in what a speaker cannot possibly squeeze into sounds, drawing from our personal grasp of whatever we have agreed the basic words can be tagged onto. 'Meaning' basically is what language calls up to ourselves; it cannot be abstracted away from people, it does not come across with the words; 'meaning' cannot be but what already is available in our heads. But there is no room for meaning in the circuitry and activity of our brain; what is in the brain is this amazing and almost unimaginably complex equipment to make meaning emerge in our minds: meaning has no existence beyond the fragments of reconstruction and recollection scattered over our private minds, disappearing when fading from awareness. If this is counterintuitive, it is because our introspection is limited to what our brain makes us aware of: meaning is there the moment we need it as if it never had been away and we are incapable of noticing its non-existence while we are not aware of it.

Inescapably private as this meaning may be, all through our lives we try to escape its subjectivity by making our words cover the same reality, the same experience, the same actions, the same emotions. But inevitably we have to build our own neural bridges between words and reality, and for the same word no two persons' bridges will be exactly the same, if only because of the haphazard way and accidental order in which we build up our personal dictionary; how completely different the bridge's architecture can be, still making eventually the same connections, is beautifully illustrated by the examples Temple Grandin's gives.

Then, in communication, a speaker systematically constructs an image of what they are talking about out of these basic building stones, and every single word in this building accesses a wealth of possibilities, everything previously brought and preserved under its heading. Now, activating the whole lot all at once would far exceed our brain's capacity, but we could take the word out of context, take our time, and successively take in mind all these options, shifting from one possibility and association to another, drifting away in memories and coming back to the starting point again, start anew, etc., and then, having assembled the full meaning the word has to us, deliberately weighing our options, make our choice. It would make verbal communication a rather time-consuming process; for Temple Grandin, translating other people's words into something that matters to her must be a bit like this.

This is not what we usually do when we make sense of a speaker's words, but we turn the information into meaning by letting come to mind something out of this whole wealth of options that fits in with what is already there on stage in our mind (possibly the real thing itself), postponing details or tentatively filling in the gaps left open in the information, if necessary erasing them again if they turn out not to fit in with the information that follows. And then we hope to have reconstructed more or less what the speaker meant to tell us. Usually we are close enough.

Notes

¹⁾ Grandin, T. (2006): *Thinking in Pictures And Other Reports from My Life with Autism*. London: Bloomsbury. First published (1995): Doubleday.

²⁾ See for instance Grandin, T. & Barron, S. (2005): *Unwritten Rules of Social Relationships Arlington: Decoding Social Mysteries Through the Unique Perspectives of Autism*. Arlington: Future Horizons.

³⁾ My ideas on brain and mind were largely shaped by reading the following literature: *Scientific American's* 1992 special issue on the brain (*Scientific American* 267, no3); in this issue, especially:

Crick, F. & Koch, C.: *The Problem of Consciousness*, pp. 111-117.

Damasio, A.R. & Damasio, H.: *Brain and Language*, pp. 63-71.

Kandel, E.R. & Hawkins, R.D.: *The Biological Basis of Learning and Individuality*, pp. 53-60.

Zeki, S.: *The Visual Image in Mind and Brain*, pp. 43-50.

Also:

Crick, F. (1994). *The Astonishing Hypothesis: The Scientific Search for the Soul*. London: Simon & Schuster Ltd.

And especially:

Fuster, J.M. (1995). *Memory in the Cerebral Cortex: An Empirical Approach to Neural Networks in the Human and Nonhuman Primate*. Cambridge, Mass: MIT Press.

⁴⁾ Koene, N. (2007). *The Shape of Information: How Language gets Hold of the World*.

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