

How people learn – insights from brain research

Humans cannot *not* learn” is one of the first statements made by scientists, especially those who deal with processes in the brain. When it comes to the details, however, learning is a highly complex process which is described differently by different scientists, with different words and concepts. The article summarises the central ideas of 2 books by leading brain researchers (Roth, 2011; Hütther, 2009, see also interview with Hütther in this issue).

Learning: forming connections in the brain

Learning, in simplified terms, involves the connecting and networking of synapses in the brain. At the beginning of their lives, humans initially have a large number of networks and possible connections in the brain. Only those that are used, however, are strengthened and stabilised. The others, the unused ones, die off. At birth, this process is largely complete for those areas that, for example, regulate functions of the body. Other areas remain open to connections, some until puberty.

The first years of life offer the greatest opportunity for connections. It is therefore important to provide the greatest possible variety of sensory impressions to encourage such connections during this period. On the other hand, connections form lifelong. In order to build up the connections between the synapses, substances are necessary which help form the bridges between 2 synapses. The most suitable substance for this is released when a person experiences enthusiasm. Neuropeptides, the foundation

stones of the bridge, so to speak, are then released. Brain research demonstrates convincingly that the brain is not a muscle, growing larger through constant use of the existing pathways. It needs (amongst other things) enthusiasm to allow the formation of new connections. In the presence of fear, on the other hand, the brain mainly “fires” in its old regions, falling back on prototypical or well-learned pathways (cf. Hütther, 2009).

What does this mean for quality in children’s TV?

Television is not a suitable medium for children, especially in the first 2 years of life, as it only offers very limited sensory impressions.

Perception: always selected and pre-interpreted

One thing that the state of research shows is how complex perception in the brain is. Even before we consciously perceive something, an elaborate process of selection and interpretation takes place.

A stimulus is registered (a pattern of excitation is activated) and is first aligned with neural connections formed and stabilised by previous sensory impressions. An inner visual, auditory, and olfactory image arises, which only enters the consciousness if the pattern of excitation is strong enough and our attention focuses on it (Hütther, 2009, p. 23). As a consequence, what reaches the consciousness is only a negligible part of what we perceive. And we only perceive what we are already familiar with, or perceive things against the background of what we are familiar with.

What does this mean for quality in children’s TV?

Without links to things that children are already familiar with, and that stimulate their attention, they can scarcely perceive content, and thus gain nothing from it.

Attention: the limited resource

Attention is a limited resource which we only grant to a fraction of what our brain perceives. Attention can be extrinsic, i.e. directed by outside forces or stimuli, e.g. when we perceive stimuli that the brain interprets as potentially important or dangerous. Attention is attracted relatively automatically, e.g. to the unexpected, to deviations from a pattern (pop-out effect) and the like. Even more often, however, attention is directed intrinsically, i.e. by expectations and interests. We focus on things meaningful to us. Focused attention, moreover, is time-limited. We can only concentrate on complex matters or difficult presentations for a relatively short space of time (Roth mentions 3-5 minutes; Roth, 2011, p. 132).

What does this mean for quality in children’s TV?

Children focus their attention on things which are meaningful for them. In studies, certain elements have been shown to be particularly attractive for children; these include animals, other children, prehistoric topics (dinosaurs, stone age), and magical figures (fairies, trolls).

Programmes can also be designed to strategically encourage attention, e.g. by deliberate and reduced use of

sound design and dramaturgy. Children pay considerably more attention to close ups and extreme close ups than to long shots; simple shots concentrating on the essential are more likely to receive attention than overcrowded images. Talking heads, on the other hand, especially those of adults using specialist terms, often lead children to direct their attention elsewhere.¹ Thus careful editing is required, especially when dealing with topics which are not in themselves highly attractive to children.

**Working memory:
not much space**

Only a small section of what we are experiencing is accessible to our current consciousness. Many things slip into the preconscious or remain unconscious. Consciousness is mainly restricted by the limited capacity of the working memory. It works like a kind of bottleneck for consciousness and attention. It can, on average, only retain 3.5 chunks (units of meaning) in the consciousness at once.

What does this mean for quality in children's TV?

An excess of information and impressions will make children switch off (internally or with the remote control). A small quantity of information, strategically positioned, connected,

and embedded in a context, will have a much greater chance of being perceived and processed.

Memory: explicit, implicit, and emotional

According to the present state of research, memory can be subdivided into 3 different forms (see ill. 1).

The **declarative** or **explicit memory** comprises the conscious and reportable contents.

The **procedural, non-declarative** or **implicit memory** comprises all cognitive and motor skills and habits available to us. The areas of what is known as priming are included here, i.e. the reproduction of knowledge on the basis of cues.

Emotional memory is seen as the third kind of memory. It retains whether an event was associated with pleasure, displeasure, joy etc. When the person who carried out the action responds to the event again, the first thing to be retrieved is this feeling. Thus the remembered emotion and not the content itself becomes the motivation for repetition or avoidance. This is how we make many of the intuitive decisions in our lives (Roth, 2011, pp. 103ff).

What does this mean for quality in children's TV?

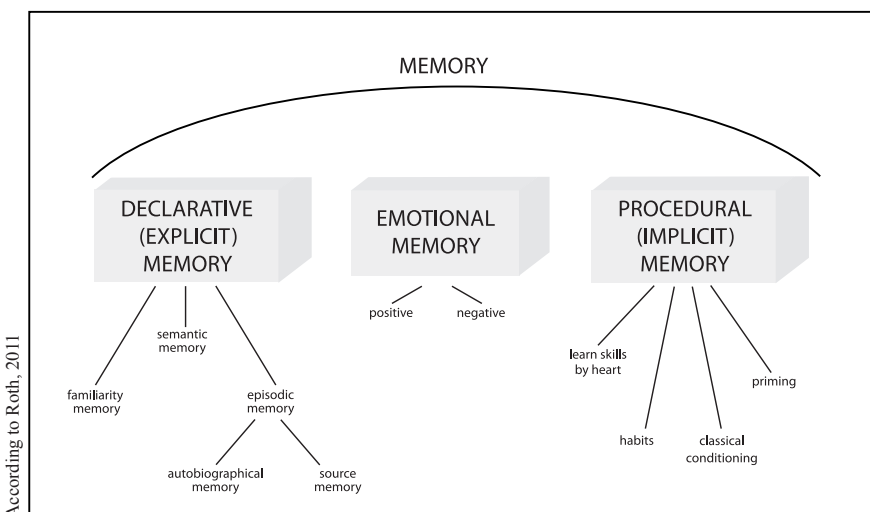
Learning cannot take place without emotions. Not only is it easier to retain

information if it has been learnt with emotional involvement. Whether a programme will be switched on again is connected to a considerable extent with whether it was a pleasant experience for the child. Without being conscious of it, the child will not think back to the remembered contents (e.g. "I learnt a lot"), but to the feeling retained. If this was unpleasant, the child will probably avoid the programme. Thus, a positive memory of the (learning) experience of the last episode of a show is extremely important.

**Remembering/forgetting:
the more connected,
the more accessible**

Forgetting is an important process in which we give priority to things that are important and meaningful for us, while the others fade, are no longer constantly present, or are simply no longer retained.²

According to the current state of research, forgetting – apart from pathological events – is connected with problems storing and retrieving information in the declarative memory. Gerhard Roth uses the image of "knowledge tokens" which can cling on to the nets of the memory with their arms and legs. The longer their arms and legs, the more likely it is that the items of information to be learnt will remain attached in the upper networks (ill. 2). The others fall down to a deeper level, or through the network, making it correspondingly more difficult, or impossible, to "pull them up" again when remembering. There is solid scientific evidence of what determines the "arms and legs" – i.e. the memorability – of the knowledge tokens: they need to have a distinct shape, the contents must be clearly recognisable and differentiable, the individual must be able to see the point of learning them, they must be able to be connected as much and in as many ways as possible with things already learnt, and they must have an emotional colouring and context (Roth, 2011, ill. 3).



According to Roth, 2011

Ill. 1: Subdivisions of the human memory

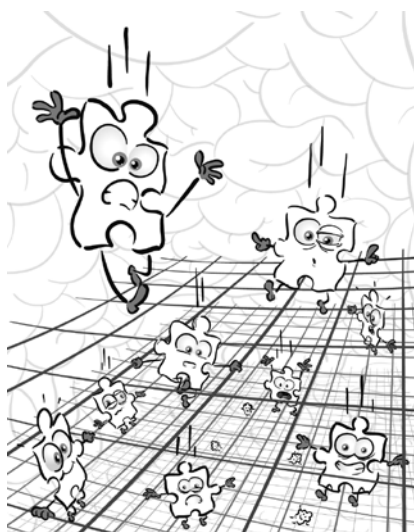
The most effective way to counter forgetting is repetition (Roth, 2011, p. 126). Here the “knowledge tokens” are hooked up out of the depths, so to speak, and given longer arms and legs so that they remain attached on a higher level and are more easily retrievable.

What does this mean for quality in children’s TV?

One important insight is that things experienced emotionally and episodically become fixed in the memory more quickly and more lastingly than pure facts (Roth, 2011, p. 105). It is therefore advisable, for example, to “pack” knowledge in episodes which are as rich in detail as possible, and which remain attached in the brain by as many links as possible. Bare facts, on the other hand, have difficulty finding an “anchorage”. Repetitions (as long as they do not feel like repetitions) are particularly helpful in “re-anchoring” what has been learnt on a higher level.

Mental images

From the perceptions the individual has paid attention to, and which have been stored as “knowledge tokens”, he or she constructs his or her “mental image” of him-/herself, the world, its meaning, and appropriate courses of action. In doing so, the individual looks for recurring elements (constants) which he or she can link with already familiar patterns. These mental images become the lens through which perception is shaped and becomes the basis for actions. If the individual encounters a new challenge, he or she searches through his or her mental images in order to contextualise the situation, and to plan and carry out an appropriate course of action. If this action is successful, the connection in the brain is reinforced, the neural pathway is consolidated, and the likelihood that this image will be evoked again next time is increased accordingly (cf. Hüther, 2009).



Ill. 2: “Knowledge tokens” cling on to the nets of the memory. The more connected they are, the more likely it is that the information remains attached in the upper networks



Ill. 3: What makes an item noticeable? Distinct shape, meaningfulness, connectability to information previously learnt, emotional colouring, and context

What does this mean for quality in children’s TV?

Television is one of the sources of children’s patterns of action and interpretation. It is therefore important to reflect on the images television conveys about human beings, enemies, and the world, and on what values are emphasised, what ideas are repeatedly retold, or not retold.

It is particularly important to support openness and curiosity as a fundamental attitude towards the world, and to encourage children to perceive learning, research, and active doing as things which will enrich their lives.

Perceiving, remembering: a question of attitude

Perception, consciousness, remembering, and mental images form the subjective perspective and are dependent on it. The brain (and the rest of the human being) can deliberately keep itself open to experiences, and expansions, and use these for individual growth. It can also close itself to all these things, however, due to a fear of failing, or of being hurt or humiliated, or a negative attitude towards the teacher (i.e., facilitator of learning) or the teaching material. All these shape the fundamental attitude of the brain in relation to what it perceives, interprets, and retains. The most suitable basis for building up knowledge in the long term, according to Gerhard Hüther, is an attitude of curiosity, openness, and learning with enthusiasm (see Hüther in this issue).

What does this mean for quality in children’s TV?

Children’s programmes which see things from a child’s point-of-view, and which know children’s ways of appropriating the world and take them seriously, can facilitate important positive experiences of learning – and can supplement or provide a counterweight to learning at school. ■

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NOTES

¹ Here it usually makes no difference whether these adults are wearing funny hats, are disguised as trolls, or behave like children – young viewers usually turn away in boredom. Exceptions: 1. adults who convincingly embody “quasi children”, i.e. convincingly approach things as a child would, or 2. adults who succeed in giving children something to connect with, through what is seen as genuine curiosity or special descriptive skill.

² Here, forgetting resembles a negative exponential curve. Just 20 minutes after learning, only 60 % of information is retrievable, after 1 hour only 45 %, after 1 day just 45 %. Only 34 % of information is stored long term (Roth, 2011, pp. 123 f.).

REFERENCES

- Roth, Gerhard (2011). *Bildung braucht Persönlichkeit. Wie Lernen gelingt*. Stuttgart: Klett-Cotta.
Hüther, Gerald (2009). *Die Macht der inneren Bilder*. Göttingen: Vandenhoeck & Ruprecht.