

Learning & education processes in learning to drive – Background discussion

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To get a better grasp on what is going on in driver education this annex contains a short elaboration in very basic terms on learning processes, especially of youngsters in traffic.

Summary:

Safe driving can be described as an activity of the body and the brain in a realm where human evolution has not kept pace in every aspect with technological developments. Cars can be seen as extensions of our own bodies in complex and fast changing environments with indirect interaction: our observations and actions are partially intermediated by instruments, steering wheels, brakes, accelerator, etc. Not only traffic but also cars, their way of functioning, the way they are advertised, their position in our culture and their potential have in their own way also an impact on the body and brain, on emotions and motives that ask for attention.

Adaptation to traffic conditions takes place in a scarcely supervised learning process that started long before car driving in other modes of transport, by examples, contact with peers, adults and visual media. This learning process is intensified in explicit training of (young) drivers; necessary because the gap between handling former instruments of mobility and handling the car is too big. Training in driving a car however happens only in a short period before the driving license, while the needed learning process lasts approximately 3 years and/or 50.000 till 80.000 kms experience.

Good driver education intervenes in and supports a more natural learning process, building on basic safety motives and curiosity, provides the necessary feedback and learning environment, and evokes a learning habit for the period after the initial training in which learner drivers have to complete their own education by themselves (influenced by others, only helped by some support of campaigns and enforcement).

Driving instruction and safety campaigns address in particular *conscious cognitive* processes and their translation into handling the car in traffic. However, handling a car in traffic is also about basic physical reactions of the driver – emotions - on internal and external stimuli. These are not always adequately controlled by conscious mental activities. Where cognitive processes are involved these are mostly unconscious – when car and traffic handling skills become automated - and are influenced by these other unconscious or subconscious physical and mental processes.

Very logical reactions from the human organism originate from functioning in slower changing and nearby environments with direct interaction and must be

adapted in car driving. The body and brain have to adapt in an integrated way in which emotions, feelings, immediate intuition and *autonomous* decision making are involved. Therefore it is hard to learn how to drive by just reading texts, listening to and following what someone else is telling (instruction). Examples can also be hard to transfer into ones own functioning system by their mere complexity. Texts, models, telling and instruction must be translated into complex physical and mental actions and integrated into ones own personal behavior. This translation can have many side effects and can – especially for the highest risk group - go against the inner processes of learners, especially those who learn by trial and error. Safe driving needs an optimal level of arousal – arousal is defined as the level of brain activation, a mental state with not too low mental activity (inattention) neither too high (arousal, aggression, risk-seeking). Therefore learning to drive is also about learning to handle one’s own impulses, not only by thoughts but for example also by posture, breathing, relaxation and focusing. These can be initiated by conscious processes. Coaching is a training instrument in which unconscious processes are consciously initiated with more focus on the inner learning and structuring by the learner himself.

Learning process

From birth on the human organism is on constantly reacting to stimuli and impulses from within¹ and from outside². In growing and balancing between, and reacting on those stimuli it develops itself into a more able and mature organism. This is the most basic learning process. The body and brain, in fact every cell in our body that is involved, react on any stimulus first by interpreting: *is this good or bad for me?* The first and most basic *emotions* are danger – reaction: *act or avoid!* - or joy - reaction: *stay or approach!* For survival we are specialized in danger-oriented emotions and reactions. In traffic are not so much well considered fully conscious decisions, these take too much time. Most of our actions are subconscious or nearly conscious, intuitive, split-second decisions. These reactions can be learned and (semi-)automated but that takes time, experience and need some development: maturation of the brain, especially the frontal cortex where executive functions are located that develops till 22 (women) and 24 years old (men). A basic question for all traffic education is how these learning processes take place, and how good interventions can enhance this learning process without dysfunctional side effects as resistance, fear, dependence or miscalibration that leads to risky behaviors.

1 Like hunger, thirst, curiosity, wishes, memories, associations, plans, anticipations, overtly conscious decisions, etc.

2 In the beginning just touches, movements, visual impressions, sounds, smells, vibrations, later in development also words, sentences, feedback on actions from others, etc. Some more complex stimuli from outside can be classified as education, training, instruction, law enforcement, coaching, etc.

Back to the basics³: our first and *emotional* reaction is: *do* something: fight, flight, freeze (or: react, get away or keep silent and don't move). These basic reactions are particularly physical in the way that they are not very conscious cognitive, they have been preceded by some cognitive processed alarming observations but they are in it self almost thoughtless. The 'bodybrain' acts very swift with physical action, hardly conscious. See for instance a jerk at the wheel. A bit later we identify what's going on in our organism: we *feel*. We begin to notice what is going on in our body-brain system often after we had already reacted. Note well: especially in fast developing situations *feeling* comes after *emotion*. We may have acted before we did realize that action was necessary, and *feel* the fear, anxiety or anger afterwards and learn more conscious from there.

One step further: we *reflect* on what was going on (often triggered by emotions and feelings). This opens the possibility of feedback loops on a more conscious cognitive level. Further in our development we can actively steer our reactions on quick developing situations like in traffic: a mix of acquired automated and to the car adapted reactions and thoughtful (more reflected) actions.

When we have automated and internalized some basic activities and reactions in traffic we slam on the brakes and declutch simultaneously for example before we consciously realized that we had to. Memory and associative dynamics give also stimuli on which we react. Of course we can train and memorize actions, but it is clear that in this process emotions and feelings play an important role. In stress however the basic fight-flight-freeze-reactions (emotions) tend to overrule reflected thinking and acting. This is the case especially with young immature drivers. They have to learn how to handle their energy and emotions and give balanced reactions on all kind of stimuli, not only the rules for safe traffic. Their motives and emotions correlate also with identity building and peer group pressure and can originate also from stress in the interaction with the driving instructor and the examiner at the final test. This stress may be followed by basic stress reduction mechanisms like for example obedience. Obeying is more of a stress reduction mechanism then leading to real in the self rooted learning. Some youngsters may obey during basic driving lessons until the exam ("*Very expensive, so I do not discuss*") and go their own way after. They keep on learning, but what do they learn? From who? Under which influences?

Brain development

We saw that learning in traffic asks for some maturation of the brain. The brain – or better: the 'bodybrain' - brain and body are strongly interwoven – does develop very strongly in the first 10-12 years: the brain develops from deep inside to the

³ Fundamentally described in Antonio Damasio *Looking for Spinoza. Joy, Sorrow and the Feeling Brain.*(2003)
See also: Immordino-Yang, Mary Helen and Damasio, Antonio, *We Feel, Therefore We Learn: The Relevance of Affective and Social Neuroscience to Education*(2007)

cortex and from the back to the front, stimulated by stimuli from outside and inner stimuli, that change over the years. Children learn to move, interpret, listen, speak, obey rules and internalize values and rules. This is a dynamic and not always very coherent process. After that period those neural connections that are not used will fade away (called 'Neural Darwinism'), and the others will strengthen, get faster and much more efficient, need less space also giving way to other new developments.

This whole process we can summarize as 'learning and developing in constant interaction with the environment'. You cannot 'not learn'. Every processed stimulus (inner or external) leads to learning, new connections in the bodybrain, storage of new experiences as we processed them. The question is "*What do we learn?*". Basically: young people in development do *not only* have the task to learn how to handle their own energy, reactions on the environment, emotions and goals, in traffic combined with the possibilities and the extra energy of the vehicle (moped, bike, car). They are *also* confronted with other participants. So traffic asks for specific social interactions as well, governed by traffic rules, laws and personal estimations. These developmental tasks again need some brain maturation, efficiency and processed experiences as well. Even how flexible the human brain is, they cannot be realized at any age.

Different modes of transport; adaptation

The tricycle, bicycle, moped, bike or car are extensions of our body and brain. They enable us to move faster and longer with less efforts and more payload. We use dashboard instruments as extensions of our receptors: eyes, organ of balance, skin or ears. Human organism and its feedback systems in physical actions are originally geared to the immediate surrounding environment and need for traffic some adjustment or adaptation. For example nearby orientation is altered into wider and longer distance orientation with shorter reaction times. Eye movements in order to see patterns in fast changing fuzzy environments have to adapt for hazard perception. We also need fine tuning on new instruments that intermediate between environment and our own observation organs, and give us feedback in this new and rather fast movements, for example the speedometer. Tiny movements with arms or feet have big effects. Our feet operate no longer directly but are mediated by accelerator, gears, motor and brakes. Direction is intermitted by steering wheel, etc. Not only our survival emotions for safe traffic but also other emotions (irritation, anger, fear, self expression, too high self confidence) can be expressed more fierce in a car and can be stimulated by the effects of traffic or the car in itself as well (sounds, arousal by quick effects, fast escalation, etc.) or can be deafened by constant noise, fatigue, inattention caused by underestimation of hazards, automated reflexes and more.

During our maturation we develop attitudes: complex unities of propensities how to react on stimuli from within and from outside. We develop the ability to act in

complex situations; this asks for an adequate developmental phase of the brain and its connections with all other bodily functions.

Higher order skills and maturation

The maturation of the human brain develops from deep in the brain (where basic functions and emotions are processed) towards the neocortex that covers the deep brain, and the neocortex roughly develops from behind to the front. First are those brain parts (neocortex) that coordinate the spatial and visual information and spatial-physical responses, soon also the sound (language) processing parts. Later follow the frontal lobes that are specialized in so called higher mental or executive functions as anticipation, self reflection, inhibition. The fine development of some skills (*including reflection, anticipation, inhibition, paying attention, empathy, perspective taking and accurate corresponding decision making*) asks for experience and is preceded by skills for immediate movements and actions. These skills – especially balanced decision making - require more experience and corresponding maturation of the slower developing prefrontal cortex. More over: the rewarding of novelty behavior (our natural inquisitiveness but also risky behavior) by dopamine in the prefrontal cortex may overrule the inhibition. Especially in boys the GO-system is stronger than the STOP-system⁴. Traffic education is about these processes: it intervenes in and intensifies maturation.

This maturation and the basic integration of different mental functions in our acting lasts generally spoken until 22-24 years⁵ although some further progress will be made later. Girls mature on average a bit faster than boys while in boys the development of swift and immediate reactions is mostly sooner than their reflection and anticipation skills. It is believed that this contributes to the higher accident rate in young male drivers (strengthened by imagery of masculinity and examples of adult male role models). They are in a developmental phase in which they define themselves by comparison with adult people and mutual contest. Whether we like it or not: notably boys learn more by trial and error. They develop their self image and their image in the eyes of others particularly through development and exhibition of those skills that they can show: for example fast special acting where they are specially good at, while they are behind in dual or multi task processing that characterize traffic. They overestimate their skills and underestimate the risks involved⁶. This makes them good learners from their own

⁴ Romer, Daniel & Michael Hennessy, *A Biosocial-Affect Model of Adolescent Sensation Seeking: The Role of Affect Evaluation and Peer-Group Influence in Adolescent Drug Use* (2007); Romer, Daniel & Angela Duckworth *Adolescent Risk Taking: Implications for Public Policy* (2007)

⁵ Gied, J.N. *Structural magnetic resonance imaging of the adolescent brain* (2004); Dahl, Ronald E. *Adolescent Brain Development. A Period of Vulnerabilities and Opportunities* (2004)

⁶ Fuller, Ray, *Driver training and assessment: implications of the task-difficulty homeostasis model* (Dublin 2007)

experience but also more risk prone than girls. Their quest for self esteem leads to less imitation of instructors and more reach for autonomy. They may obey the instructors just for the purpose of getting their (expensive) license as soon as possible, but once they have their license they go their own way and much more risky learning processes can take over.

Developmental phases in traffic

When young people learn to drive in cars, this learning process is for most of them preceded by many former experiences of moving in public space (walking, scooter, tricycle, bicycle, moped). They have learned in situations in which the speed, complexity, the risks and the required span of control are increasing. Others have less previous experience and have less developed the capacity to handle themselves including their own energy and emotions in traffic, notably in combination with the extra energy of engines. The access to new means of transport is limited by age (and corresponding potential skills). Most of these experiences are not guided or only very basic and at the beginning.

Statistics show peaks in accidents at the start of using every new mode. The step from bicycle (and / or moped) to driving cars however is a big step. In most countries there is some kind of professional instruction or guided learning process to reduce this peak. But:

1. Regardless the modes of instruction used until now, there still is a peak in accidents with young drivers (and then again approximately double or even triple as high in young men than in young women).
2. It takes roughly as much as 3 years and/or 50-80.000 kilometers practice to automatize the basic skills. This automation is necessary while it results in fast reaction-time in complex situations and makes more space in the brain free for anticipation, self-reflection, memory and fast decision making in abnormal situations, like near accidents, surprising road conditions, a sudden bend, blinding by the sun, snow, night driving, etc. In more and more countries it is practice to reduce the mental load of youngsters by restrictions, until they have matured in traffic (read: automated their reactions and act more thoughtful with more insight in themselves and others).
3. So the learning (adaptation of the body-brain, mind & attitudes to the demands of traffic with cars) takes about 50.000 kms or 3 years, *while most guided learning in traffic encompasses only a very short period at the beginning* until the 'driving license'. Further learning (adaptation to traffic) happens unguided with only self assessment, parents and peergroup and finally police surveillance as safeguards.

The role of guided learning

The basic question to guided learning in driver education is whether it supports or reinforces this maturation and reflection on *'the self in complex situations'* or it initiates other, sometimes counterproductive processes like mere copying and dependence, or temporary obedience and/or reactance. Acquiring the basic pure technical skills is for many youngsters easy. Tactical, strategic and the 'higher order skills' like anticipation, self assessment, traffic assessment, inhibition, planning and more are harder to meet in guided learning. One can question if this need can be addressed via texts, warnings or instruction with all the 'noise and rumble' in the communication, translation problems and transfer to own integrated, responsible and autonomous decision making.

Self structuring of knowledge is in fact much more effective than structuring from the outside, it reflects the functioning of the brain. How learners get as far as that may vary in many people.

Some may learn better by imitation first and later self adjustment (and this is supported by instruction and modeling),. Others favor trial and error and are dependent of feedback on their actions, basically direct feedback in action, but also feedback from relevant others, instruments and even law enforcers (although law enforcement has some other counterproductive aspects as well, like evading that kind of feedback more than doing what the enforcers want you to do). Some go from concrete action and experience into more abstract knowledge, others want to have the full picture before they go into detail, although it is questionable if this works as well in concrete swift action as needed in traffic . It may work for those who are fearful and so it gives them some insight and corresponding relaxation. But again: all have to integrate all learning from sources outside their own system and self processed experiences into their own complex autonomous behavior.

Not organic but artificial developed feedback systems can intensify learning, but should keep pace with the natural more organic development of the bodybrain and also pay attention to the learning styles, the socialization, imagery in the media, adult examples and personality building of youngsters, especially their initially somewhat vague and weak feeling of self, self acceptance, self esteem (real, not acted as if) and self-confidence. Artificial control systems (like in enforcement) are necessary to set the limits and give feedback, but may also lead to reactance, evasion or externally controlled behavior instead of the wished for autonomous safe driving.

Autonomous handling of the car and the *'self in the car and in traffic'* cannot be reached just by listening to cognitive knowledge as written in books, showed on video, spoken by or showed by an instructor – *"Do this, don't do that, take these*

steps in order to..." and translating this into ones own complex and swift responses to traffic situations. It is a very complex process: in the integration of new responses is the personality of the learner involved. Rational safe behavior is easily overruled or crossed by emotions, especially stress. *"They should know that..."* is the projection of adult people on less developed and balanced youngsters, and as such a rather weak answer to trespassing behavior in situations where the cognitive rules are overwhelmed by strong emotions. The good question is: *"Do they know that....? And can they operate on that knowledge?"*

Stress in the relation teacher-pupil or in the relation examination-learning process can be counterproductive for continued learning to drive safe after the test. It can be questioned if it stimulates autonomous learning, while autonomous continuation of the learning process in the next 3 years and 50.000 kms is nuclear in reaching safer traffic. The big challenge for everybody concerned with safer driving of especially young people is to develop and organize a learning process in which youngsters learn to develop safe driving also in the long period after passing the driver test.