

A Report of the

BRAIN RESEARCH AND LEARNING SCIENCES

'Emotions & Learning' planning symposium

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Hosted by

Psychiatric Hospital - University of Ulm, Germany

Organisation for Economic Co-operation and Development



Centre for Educational Research and Innovation

The project on "Learning Sciences and Brain Research" was introduced to the OECD's CERI Governing Board on 23 November 1999, outlining proposed work for the future. The purpose of this novel project was to create collaboration between learning sciences and brain research on the one hand, and researchers and policy-makers on the other hand. The CERI Governing Board recognised this as a risk venture, as most innovative programmes are, but with a high potential pay-off. The CERI Secretariat and Governing Board particularly agreed that the project had excellent potential for better understanding learning processes over the lifecycle, but that ethical questions also existed. Together these potentials and concerns highlighted the need for dialogue between the different stakeholders.

The project is now in its second phase (2002-2006), and has channelled its activities on 3 main issues (Literacy, Numeracy and Lifelong Learning) within 3 trans-disciplinary and international networks co-ordinated in collaboration with 3 leading institutions (Sackler Institute-USA, INSERM-France, RIKEN Brain Science Institute-Japan).

The aim of this Planning Symposium on "Emotions and Learning" was to bring together a few researchers and practitioners on the theme of "emotions and learning" in order to establish how this theme might be developed in parallel to the three established project networks within the project's future agenda. The goal of this report is to provide an overview of the content of the symposium.

Introduction

Where were you when the Twin Towers collapsed, or when the Challenger Space craft exploded? Can you remember receiving your high school diploma, your first kiss? Emotions have a profound impact on our memory and learning, and increasing usage of terms like “emotional intelligence” demonstrates a growing awareness of the important role that emotions play in one’s successful negotiation throughout life. However, throughout history, emotions in the classroom have been strict taboo, and yet most teachers today would agree that students participate in class and learn best when they feel good about themselves and their lives. Nearly every aspect of our lives is influenced by the emotional state we experience at that moment - a response based on past experience, yet nobody understands precisely what is involved in the relationship between emotions and learning: We know a lot about the brain structures that underlie learning and memory, and those that regulate our emotions, but how do emotions actually influence learning? Can we enhance learning and memory by activating the brain circuits that stimulate positive emotions? How do we maintain positive emotions and ensure we block out negative ones? What is the best environment to nurture positive emotion? What are the cost benefits for schools? What are the physical influences on emotions, such as sleep, nutrition and exercise? And, whom do we focus on: peers, parents and teachers, or on children themselves?

The goal of this first symposium on the subject of “Emotions and Learning” was to establish how the OECD “Brain and Learning” project will focus its future agenda to accommodate this theme, which runs parallel to its other three topics: Literacy, Numeracy and Lifelong Learning. To this end, several aspects of emotions and learning were covered at this planning symposium: looking at the brain and how it processes emotion (including the involvement of the amygdala, which is closely linked to fear and other emotions, in learning, stress and fear); the history of emotions in education; the role of environmental factors such as sleep and nutrition; and, programmes driven to train the brain to be open and motivated to learning.

The symposium made evident that there certainly are enough data and interventions on this subject currently available that begin to make sense and that have potential to provide preliminary pointers for policy-makers. Our role will be to decide which ones to focus our attention on, in order to draw up a sensible programme which will explore the most effective ways to train up emotional intelligence, and ensure a positive emotional balance to enhance the learning capacity of the brain, by looking at both sociological and physiological factors which influence these.



Manfred Spitzer

Psychiatric Hospital, University of Ulm, Germany

“You cannot train 15-year olds and 50-year olds in the same way, as the younger ones will perform better.”

Goal Setting

Manfred Spitzer is actively involved in the Brain Project as a core member of the Lifelong Learning Network. He heads the Division for Psychiatry III at the University Clinic in Ulm, which since its opening in June 1998, has placed its research emphasis on cognitive neurosciences, i.e. on the study of higher mental performances and their pathology in psychiatric disorders. Experiments on learning processes have been consistently carried out, and considerable expertise has thus been acquired for the planning and execution of basic scientific experimental studies. These studies have been supplemented by basic research orientated experiments in the clinically applied research of learning processes.

The Ministry of Education of the Land Baden-Württemberg has recently accepted to fund the Psychiatric University Clinic in Ulm's current project to expand and develop a Transfer Center for Neuroscience and Learning, whose aim will be to integrate neuroscientific knowledge in the pedagogic and psychological education of future teachers. At the University Clinic they have a research tradition on emotions and learning, the idea being to bring together brain research which focuses on learning and emotions, in order to improve what is going on in schools. Their mission is to use existing brain studies (and design new ones) that may show how this can work in the school environment and to then use this model to improve schools. The model is the same as that which is used in medicine: where you not only have to have a good idea about what might work, but you also have to demonstrate that it does work. There are hardly any randomised placebo controlled studies in the field of education. It is not enough to show the brain lights up here and there when certain things happen, you also need to show that when you apply this knowledge in class you get a certain benefit. Spitzer draws on the example of some rat studies: when one changes the cages of the rats they forget about what they learned in the previous cage because the new cage is so interesting. Translated into the school setting you would get the following scenario: we allow kids to learn fresh vocabulary and then send them to the movies. There are no such informed randomised studies on such effects on kids to date.

Spitzer recently attended a meeting on the retraining of employees where he said he noted that the official dogma of every learning institute for retraining of employees stated emphatically that age does not matter. However, he says you cannot train 15-year olds and 50-year olds in the same way as the younger ones will perform better, and that this causes anxiety in the older subjects. But this is not officially recognised, and so when Spitzer told them about the declining learning rate and what the consequences should be for educational programmes it was evident that they were doing exactly the opposite. He explained his theory of a more cost-benefit effect: if this type of retraining was more focussed on split groups according to age decline, it would ultimately produce a curve effect, and in turn produce a cost benefit effect. He says when you start to think about such issues it becomes evident that there is an endless list of possibilities of things you can do, and this is what he will now be exploring in his new Transfer Center.



Bruno della Chiesa

“Brain and Learning” Project, OECD-CERI

“If you are motivated enough, you will make it.”

“Emotions” within the OECD-CERI “Brain and Learning” Project

Bruno della Chiesa, who has headed the OECD Project on Brain Research and Learning Science since its instigation in the OECD’s Centre for Educational Research and Innovation’s (CERI) programme of work in 1999, outlined how the activity of “emotions and learning” is foreseen to fit into the broader context of the project for the future. It began as an informal activity which was addressed within the three existing networks: Literacy, Numeracy and Lifelong Learning. However, it became evident in the second phase of the project that the networks were not placing much emphasis on the issue, and so rather than create another network which would be too cumbersome to put in place, it was decided to create instead another focus theme to run in parallel with the project’s other network activities. The plan is that post this symposium, which we hope will map the territory, we might be able to settle a formal agenda for this theme to be integrated officially into the project’s programme. The aim is to first decide which areas of emotions and learning, that have come to light during this symposium, will be selected to focus on. He highlighted the following list of possible areas on which to concentrate in the framework of the theme of emotions and learning within the project:

- The neocortex and the limbic system.
- Memory storage related to emotions.
- The “learning environment” (including nutrition, sleep, etc.).
- Social context (including parental/peer relationships).
- Influence and impact of the media on children’s emotions.
- Ethical issues.

Della Chiesa expounded his personal views on the impact of emotions on learning. For him the motivation for learning is related to emotions, his motto being: if you are motivated, you will make it! He stressed the role of pleasure which is positively related to motivation as opposed to the role of fear which is detrimental to motivation and learning.

A series of one or two further symposia per year on focal issues on “emotions and learning” will be integrated into the programme. Dissemination for this theme, as with the other network activities, will be diffused on the “Brain and Learning” project web site <<www.oecd.org/edu/brain>>. A separate channel for “emotions and learning” will be created on this website in early 2004, in order to clearly distinguish this theme from the other networks. The final results of work in this area, as well as the other networks, will be incorporated in a major OECD publication which is aimed for 2006.



Ulrike Rimmele

University of Tübingen, Germany

“Emotional events are remembered especially well, This phenomenon might be due to emotional arousal.”

Emotions, Learning and Brain Research

Ulrike Rimmele is a post-doc student who studied Neurosciences at the University of Tübingen. She worked at the OECD on the Brain Project in the summer of 2003. She has a strong interest in the subject of emotions and learning. The paper she presented in Ulm focussed primarily on the effects of emotional arousal, stress and fear on the brain and learning. She stated that emotional events are remembered especially well, and that this phenomenon might be due to emotional arousal. She began by explaining the role of the amygdala, which is crucial to emotions (particularly fear), and of the hippocampus, which is crucial to learning facts (see diagram 1).

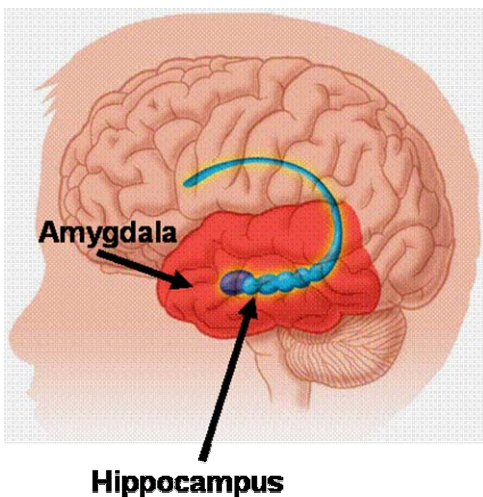


Diagram 1.

She presented research undertaken on patients with selective damage to the amygdala, hippocampus, or both. The results of these tests in which a frightening horn was blasted at the patients in conjunction with colored visuals, showed that: the patients with amygdala damage had no fear reaction, but had knowledge about which colors were followed by the horn; the patients with hippocampus damage showed fear reaction, but had no knowledge which colors were

associated with the horn; and lastly, the patients with both amygdala and hippocampus damage showed neither fear reaction, nor knowledge on which colors were associated with the horn. This shows that in an emotional situation the amygdala system is responsible for unconscious emotional (fear) memory, whereas the hippocampal system is responsible for conscious memory of the emotional situation.

Rimmele then chose to highlight another research study whereby two versions of a story are told, one which has an emotionally arousing bit added to the middle of the story line. In this study patients with damaged amygdalae did not show enhanced memory performance when told the more titillating emotional version. The test was then also performed on subjects who were given an hormonal blocker for the hormone norepinephrine. These subjects also had no enhanced memory when told the more titillating emotional version of the story. This study shows that in fact both the amygdala and hormones play a role in influence memory enhancement for emotionally arousing stimuli.

Rimmele then went on to describe the role of the hormone cortisol, which is released during stress. Cortisol has been found to affect cognition, learning and memory. Memory is impaired when cortisol (or a similar substance) is administered. Animal studies on cortisol secretion under the duration of stress show that it provokes inconsistent results for memory performance.

Rimmele's presentation made the audience aware of: the importance of the tiny insignificant looking amygdala in our brains, which is in fact the key area where fear is monitored; the role of the hippocampus on learning; and, the affects of the release of hormones during stress. This provided a biological background which set the scene for the rest of the meeting.



Jarl Bengtsson

Consultant, OECD-CERI

"We need to strive to work towards a quantum approach to education in the future."

Emotions in an Educational Perspective

Jarl Bengtsson, former Head of CERI (retired in 2002), was the mastermind for instigating the Brain Project within its programme of work in 1999. He is still engaged as a Consultant to the Project. He gave a short history of the role of Education which has reserved no place for emotions. The purpose of teaching has been primordially to transmit values and knowledge in a particular form.

The main influences on education over the centuries have come from the areas of theology and philosophy. There were marked influences: Zen in the Oriental world, who had visions to liberate the individual, while Confucius preached moral and universal morals for all; in the Occidental

world, firstly Socrates with his vision of giving birth to individual thinking and, secondly, was challenged by his pupil Protagoras for whom the purpose of education was to transmit certain values, culture, knowledge in a particular form. Protagoras has retained the most influence in the Western world of education. Plato also came on the scene briefly and attacked the issue of love, but in a very specific abstract way, nothing bordering on emotions. Then the church began to dominate society, and in the Middle Ages philosophy there was strictly no place for any emotions as the church dominated the education system. The discipline of philosophy was itself not liberated from theology before the 18th century.

In the 19th Century the new discipline of psychology in universities brought new thinking to the debate of education, pioneers in this field being Dewey and Maria Montessori. The beginning of the 20th Century saw the birth of natural sciences and in particular agricultural sciences. This prompted the birth of the measurement industry in education (which was derived from agricultural sciences) and which became one of the most prominent forces in education in the last century in the creation of the testing systems in schools. In the testing industry in general, there is little place for emotions.

Today the education system is partially driven, by two main forces, one being the measurement industry, and the other the drive towards social cohesion, an issue which has emerged only in the last five to ten years. The Knowledge Economy is of course still big talk today. There is also an urgent need to develop the Education R&D system to a more science and evidence driven system, in doing so, and with particular reference to brain research, the challenge of bringing in the Quantum theory should not be avoided. There is a need to look to other models such as the medical field where research is evidence and science-based.

There are now some encouraging signs for an open dialogue on emotions and learning that presents before us now a great challenge to explore the influences on education by taking an evidence and science-based approach.



David Servan-Schreiber

University of Pittsburgh, School of Medicine, USA

“I am simply appalled at the gap between what we know and what we fail to do in this field.”

Making the Brain Ready for Learning

David Servan-Schreiber already addressed the topic of emotions already at an early stage in the history of the Brain Project, firstly at the First High Level Forum of the Brain Project in 2000, and at the Launching Meeting of Phase II of the Brain Project in London in 2002.

He began by stating that he is simply appalled at the gap between what we know and what we fail to do in this field. We have enough data today in respect of training emotional intelligence and enough interventions that make sense. His main message which he hopes will be given heed, is that physical influences directly affect the ability to pay attention and learn. There is solid data available on nutrition, sleep and exercise and he stresses that this should not be ignored.

He began by showing slides from Yale studies of the activation effects of cortisol/stress on memory in the brain. It is obvious that we cannot process information as required in schools if we don't have a handle on the interaction between emotional arousal and brain function; there are interventions that have proved to work. He stressed that there are three groups of influences that we know directly affect the brain's ability to perform, learn and pay attention. The first of which are the physical influences on the brain, the fact that the brain is part of the body, and that what we do to our bodies, directly affects its ability to pay attention and learn. We know that 20% of the brain is made up of essential fatty acids which the body is incapable of manufacturing (hence, these have to come from what we eat). In our school systems, we control to some extent what our kids eat, so we should provide them with elements that make up the brain, otherwise there is no chance that their brains will be able to do their jobs properly. Alexandra Richardson expounds further on this later in this report. Servan-Schreiber cited a very interesting study done in prisons where a 35 per cent reduction of violent acts resulted when prisoners were simply given a nutritional supplement to compensate for what is lacking in institutional kitchens.

Servan-Schreiber stated firstly that you can teach kids direct control over their physiology which in turn directly controls their emotions and provides them with a vastly improved emotional context for the brain to enhance their learning capacities. Secondly, he referred to the important social influences on the brain, social interaction etc. which has a direct impact on the ability to work. He showed a picture of a monkey that has lost its mother, which speaks louder than words (see diagram 2). This picture spells out the necessity and importance of social influences on physiology and behaviour.

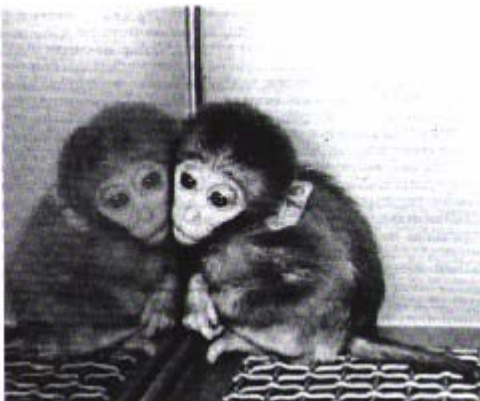


Diagram 2.

Thirdly, there are the emotional influences for which the school is not necessarily directly responsible. However, we all have to learn how to manage conflict. Parents, teachers and peers need to be trained to be aware of emotional problems facing children today and how to get a grip on them so that it is not being reflected by resulting poor results. In the school context, a simple training in conflict management (non-violent conflict resolution) would considerably improve social cohesiveness and would have a profound impact on learning.

To conclude Servan-Schreiber says there is no excuse that the educational system cannot take these physical and social factors that determine the emotional context of learning into consideration and do something about them. If the purpose of the school is to enhance the ability of the brain to learn and to enhance knowledge we need to include nutrition, emotional management and conflict resolution in the curriculum, be it simply in order to permit sound learning to take place. Training can show a distinct improvement on school performance and the

results are measurable. It is also interesting to note that children appear to perform better at school after a divorce, as they are better able to control their emotions after this experience.

To sum up: the three way integral message of Servan-Schreiber in schools, is to address the physical (nutrition and exercise); emotional (learning how to control our emotional state to be as optimal as possible), and social (learning how to control this in a social context). He is adamant that it is totally unacceptable that we continue to ignore the studies and methods available to achieve this.



Alexandra Richardson

University Laboratory of Physiology, Oxford, UK

“School children are overfed and undernourished and typically given sugary snacks to ignite their brains.”

Brain Development, Nutrition and Cognitive Performance

Alex Richardson has undertaken leading studies in the UK on the effects of nutrition on behaviour, and is recognised for her work in the field of dyslexia (reading problems), dyspraxia (motor coordination, difficulties in carrying out any complex sequence), and ADHD (attention deficit hyperactivity disorder). She began her talk by stating the alarming fact that as many as a quarter of the school population are affected by one or more of the following conditions: ADHD, dyslexia, dyspraxia and autism. She said the predisposition for these mental disorders is evidently there before we are born, some of them being genetic factors. She also stated that there is an excess of males who are affected, with a commonality to persons with a family history of these problems. Then there are a whole host of psycho-somatic related problems such as: delays in motor and language development (being slow to reach the usual milestones); sleep problems; food disorders; behaviour problems; and perceptual and cognitive anomalies. There is an enormous amount of literature on each of these conditions which show more commonalities than they do differences.

Richardson firmly states that nutrition is fundamental for building the brain in the first place. She said there are 39 vital elements that can only be ingested as they are not fabricated in the body and which must come from our diet. She also stated that there are individual differences of needs for vital elements which have not been taken into account and that should be documented. When she began her studies in schools she discovered that almost a third of the kids were turning up at school with no breakfast at all in their stomachs. She has found school children to be overfed and undernourished and typically given sugary snacks to ignite their brains. Richardson has a convictional belief on the importance of specific fatty acids in brain development and function, the evidence of which is strongly grounded in her research findings. These fatty acids are often under consumed or under produced in children with behavioural and learning challenges. Richardson emphasized her point by showing the audience a picture of a rhinoceros brain, which is about the size of an average orange, stuck inside its gigantic head. The reason for the rhinoceros atrophied brain is that it feeds entirely on grass.

Her theory that certain key fatty acids found in fish oil and evening primrose are crucial in shaping brain development and function, but they have been disappearing from many modern diets due to the fact that fats in general have been demonised. She kills the myth of margarine and hydrogenated fats which are notoriously abundant in biscuits and snacks. She warns that we should beware of the media advertising which is indoctrinating our children towards sugary foods and foods full of junk fats. Instead she stressed that it is rather the essential fatty acids (omega-3) which matter to everyone, but appear to be particularly crucial for individuals predisposed to learning difficulties. She warned vegetarians that these fatty acids can only be obtained from animal fats and that they should therefore look into taking supplements. Her study undertaken in school in Northern Ireland using a new nutritional supplement with a different fatty acid balance, based on very recent studies which show that of the omega-3 fatty acids found in fish oil, it is EPA (as opposed to DHA as previously thought) that appears to be most effective in these conditions. After three months, the first results indicate that something as safe and simple as supporting the diet with fatty acids in fish oil and evening primrose oil could help many children with dyslexia and ADHD. She highlighted examples from studies on depression which all show EPA has significant reductions in depression and aggression. Across countries depressed individuals have a characteristic profile, they do not have enough EPA.

She also mentioned tests on the benefits of breastfeeding introducing bottle feeds with and without the fatty acids, and these have shown not only improvement for visual development and early life, but better visual and cognitive functions later on. She stresses however, that there is now an urgent need for large-scale studies to confirm and extend those findings.

Richardson has also developed breath tests for children with dyspraxia. These tests are still in the early stages, but it may be possible to develop this for routine testing in schools for the future. She also mentioned several other simple bodily check markers which can be tell-tale indicators of deficiencies for parents to look out for such as: dry flakey skin; lack luster hair; little goose bump type pimples on the upper arms and thighs; and white spots on the nails.

She concluded by saying we need to find out how to incorporate the results of her studies into the education domain. Her pilot studies on dyslexic children with ADHD features show improvements from the EPA supplements. Other studies also show promising results for improving reading progress and spelling in a recent study in the UK, and she added that they also had spontaneous reports in the improvement of sleep from the moment they began the trials. What we need to do is to find out how best to identify the individual children who can be helped by this kind of nutritional approach. She stated that due to the fact that nutritional substances cannot be patented, pharmaceutical companies cannot sell nutrients, and there is therefore a problem for their wide distribution. The most important message to retain from Richardson's talk is that what children are fed really does affect their brainpower, and that the world, including the educational community, should sit up and take note of the results of the power of EPA supplements.



Nikolaj Ilsted Bech

Learning Lab Denmark

“Emotions contribute to and qualify decision making, problem solving, reasoning and intelligence.”

The Learning Lab Denmark initiative on “Emotions and Learning”

The Learning Lab Denmark was established by the Danish Government in 2001, and is a practice-orientated research organisation working in close collaboration with the private and the public sectors. It focuses on learning, competence development and knowledge creation for individuals, organisations and society in general. Nikolaj Bech presented the work of the Learning Lab and explained that its main goal was to investigate how neuroscientific knowledge about learning can be used in an educational context.

He highlighted the topics within the area of emotions that are of particular relevance to learning and education, notably: Emotional Intelligence (EQ) - emotions as an object to intelligence; emotional regulation of declarative learning - emotional value promotes learning; positive theory of emotions in cognition - emotions are part of intelligence. Studies reveal that the degree of emotional response to information or an experience predicts whether declarative memory about the event is stored. Emotions contribute to and qualify decision making, problem solving, reasoning and intelligence. This has been proven in: lesion studies; gambling tasks; philosophical arguments; and, in practitioners' reports. Emotional learning can be understood as the mediator between the organism's primary reinforcers, such as food and sex, and reinforcers of *higher order*, i.e. everything that is beneficial to the organism.

Bech then went on to describe what Learning Lab Denmark is currently doing. He explained that they have a number of applications out for areas such as: “The Emotional Resource Lab”. Their ambitions are to conduct further basic research, to reinterpret neuroscientific evidence in an educational context, and undertake research on the hypotheses that: emotions are an object to intelligence; higher emotional value promotes learning; and that emotions are part of intelligence.



Søren Kjær Jensen

Learning Lab Denmark

“Are you too smart for your body?”

Søren Jensen is the Head of the Learning Lab Denmark’s Play and Learning Consortium, which explores the relationship between body, mind, cognition and learning. He began his animated talk by stripping off his jacket to reveal a t-shirt with the words “Are you too smart for your body?” imprinted on it. He then asked everyone to stand up and take a good long stretch. He wasn’t showing off, he was making a point that an energetic approach to teaching is beneficial to grabbing the attention of students. It certainly had the desired effect on the audience, with the lunch hour approaching, everyone felt motivated to hang in and listen to what he had to say. The project that he is working on is called “Body and Knowledge” and is exploring ways to help teachers get the attention of their classes. In Denmark he says they are addressing what they believe to be societal changes on applying research in education. He explained that they were using a transdisciplinary approach to keep theories alive and to ensure that they work with each other. For a study within an educational setting it is important to make all the elements work together, so it is vitally necessary: to work with child educators to find out their knowledge; to borrow the best tools from everyday life; and to instill confidence in the teaching force in order to adapt these methods at the end of the day. You cannot simply impose of tools at people, they need to be adapted and built around experiences. This approach has enabled them to secure funding to do R&D research. So far they have had two symposiums on the role of the “body in learning”, and they are exploring this in several practice orientated workshops with the help of practitioners. With the “Body and Knowledge” project, the aim is to try to get all the different players in the role of education to be aware of the body. They are researching new methods for innovative kinds of physical learning and to increase physical intelligence. Children at school only move around during recess periods, the body should not only be used as a vehicle of transportation or something that is mechanically maintained to be fit, it should be recognised as an entity with which you learn things. The knowledge of the body should not be restricted to merely cognitive, academic, or abstract representations. His team is therefore working systematically across the disciplines of humanities, science, technology and social sciences and applying theory and practice research. Physical activities have bearings on issues of personality and identity and they are focusing on body and movement (working with tangible object); psycho-motor skills and intelligence and aspects of the body and emotions is important, as you cannot rely on educators to put knowledge into peoples heads. Jensen said they hoped to get further funding to do lab setting work and field work on the role of emotions in learning.

To sum up: the Play and Learning Consortium is looking into the introduction of physical activities in other classes, which may help to increase participation and facilitate new methods of learning. A number of schools and day-care centres in Denmark have already demonstrated an interest in collaborating on such innovative physical learning projects for children. The most important point is that this issue needs to be addressed as a societal challenge for the future.



Manfred Spitzer

Psychiatric Hospital, University of Ulm, Germany

“It is most interesting to note the discrepancy between what people tell you and what their bodies experience.”

What can we do in terms of emotions and schools?

Manfred Spitzer took the floor for a second time during the symposium to brainstorm his ideas on what could be done in terms of emotions and schools. Rather than waiting until we have the final theory of emotions, he feels we should try to explore the existing interesting data and see how far we get with that. He drew on studies undertaken by a psycho-physiologist on the physiology of children, who devised his own developmental method. In this study, he hooked kids up with an ECG (Electrocardiogram monitor) and with two movement sensors, from which it is possible to derive three variants: firstly, if the motion sensor goes up, the pulse rate goes up; secondly, if the heart rate goes up, then it appears that the subjects are cognitively challenged; and thirdly, if the heart rate alone goes up, then it is evident that something emotional is going on, in particular when the heart rate goes up and movement sensor remains stable. His method has since been adapted for all kinds of further studies, one example being performed on train drivers in Germany, as subjects. If you ask train drivers when they feel stress, they state it is when they drive through the Black Forrest because it is steep and curvy. However, when you look at their ECG, nothing happens. However, when these train drivers approach a train station with all the people lined up on the quay sides close the tracks, although they do not mention this situation as something stressful, their hearts definitely register stress. So, it is most interesting to note the discrepancy between what people tell you and what their bodies experience. He also undertook a larger scale study, in which school children of the ages of 11 and 15 (100 schoolboys in each group) using the ECG's, the sensors and small hand-held computer. In two-thirds of the occasions the hand-held computers would respond whenever there was a major change in the physiology of the kids. One-third would light up randomly on an average of every fifteen minutes. In the hand-held computer there was a small questionnaire, on what the kids were actually busy doing, their whereabouts, how they were feeling etc. The kids were hooked up first during several stages of the day beginning early in the morning. The most striking thing that was made apparent from this study, is that when you ask the kids when they feel stressed, they all say it is in the morning during in school. However, when you look at the data from their heart rate and movement sensors it is apparent that they are almost inactive in the morning, and that their emotional responses all occur in the afternoon (when they are out of school). It is exactly the opposite of what you get when you ask the children. Although this study is not internationally recognised, it is the only existing study on child life that monitors the body and psychology closely. As this study is now ten years old, it would be interesting to see the results if replicated today, and modified to include the children's access of PCs and Internet. Spitzer has ordered the equipment to do the study, with the inclusion of girls in his study (the incidental reason why only boys were used in the original study, was that girls could not be administered the ECG monitors

to their chests by men). Spitzer hopes to shed light from his study on the emotions and stresses in the lives of young children, and draw conclusions about the effectiveness of the school system. He indicated that the German schooling system is currently undergoing major changes; Spitzer believes that when envisaging change, it is more a question for the society than the schools. He hopes his new data will give a clear argument for introducing effective changes that make sense.

The other thing he hopes to explore is how emotions modulate memory. He cites studies performed in 1988 where subjects were placed into scanners and shown very dull images. Subjects were then shown a stack of pictures of which some they had previously seen. The aim of the study was to see where in the brain there more activity when things “get stuck in the brain”. The results reveal that the hippocampus area shows a difference in brain activity when you remember something, or if you have forgotten it. Spitzer has performed a similar study by adding an “emotional twist”, whereby he showed boring pictures interspersed with emotional images (such as a big close-up of a hungry shark or a cute smiling baby images), which supposedly modifies your emotional state. Then he also introduced strings of flash cards with words, intermittently introducing some ugly or bad words amongst them. The subjects then wrote down the words they remembered after they emerged from the scanner. What Spitzer found was that subjects memorised most of the words in a positive context. From the data they explored the areas in the brain where words get stuck in either a positive or negative emotional context.

Spitzer addressed the subject of diffusion of memory in the brain which transfers from one area of the brain to another. He spoke about the benefits of sleep whereby “transfer” occurs only during deep sleep. He compared sleep as similar to doing heavy duty off-line processing. Spitzer warns that when you learn something in the negative context it ends up in the amygdala (see diagram 1). He gives the example of when you come across a snake in your path, your body is immediately aroused to respond by running away. This kind of response, he explains, is responsible for changing your cognitive style: you become more focussed, you know what you have learned, however, you are no longer able to think laterally to solve problems. This is exactly what occurs when you learn things in a negative context. So, he asks, what is the upshot for schools? As we cannot know what the world will look like in thirty years, it is believed that we should not teach facts because they will become outdated. Instead we teach meta-cognitive basic competencies. If you ask people what that is, they refer to reading, but cannot elaborate further. Spitzer states that the role of the cortex is to extract rules from events, so, what we need is a bunch of events that can be used to extract rules. What we do not need are problem-solving skills per se, i.e. when you teach someone to do this or that. Because in that situation, the brain extracts that there is someone there in front of you dictating that “You” should do something. It is not so much the competency aspect that we need to focus on in schools, but rather we should give proper examples or important rules. Spitzer says it is nonsense to teach good manners to children in the classroom setting. He says if the teacher him/herself behaves and portrays good manners, then these will rub off on the children without having to “teach” them.

Spitzer has one firm conclusion to convey: whatever we teach kids in our schools, we should do this in a positive context, because whenever we use a negative context it produces a chain of negative effects on learning and causes our brains to switch off into a non problem-solving mode.



Alan Watkins

Imperial College, Department of Cognitive Neuroscience and Behaviour, UK

“Understanding that physiology, emotions, feeling and thinking are different phenomena is critical to creating an effective emotionally literate learning experience”

Program for Emotional Management Training in the UK School System

Alan Watkins has been working closely with Southampton Education Authority in the UK, who are leading the British Government's drive to raise emotional literacy standards in schools. The British Government recently identified twenty-five education authorities who will test and implement pilot emotional literacy programmes. Southampton Educational Authority has taken a stand in placing as much importance on emotional literacy as numeracy, literacy and digital literacy, and the 16-piece ExPRESS Project, developed by Watkins, is at the heart of their campaign to raise emotional literacy standards, enhance performance and reduce emotional stress in schools. He began by reminding the audience not forget to include the insights of children themselves when making decisions about educational issues and children's future. He said that we do not have all the answers and, that we should learn from each other, and from the children as well.

Watkins described how the ExPRESS Project works. He said that if the goal is to improve performance in schools it is simply insufficient to focus just on behaviour. Behaviour is often difficult to change. He says that in order to achieve a measurable, sustainable change in behaviour and performance it is necessary to go beyond ideas of behavioural change and even beyond interventions that target cognition and feelings. It is necessary to work directly with emotions and their underlying constituents – an individual's physiology. The ExPRESS Project does this by first teaching adults and children how to create a stable coherent internal physiological state through rhythmic breathing. However, generating a coherent physiological state is not enough it is necessary to teach individuals how to change their emotional state. If an individual can manage their emotional state this then has a spiral effect working upwards on their feelings, thinking, behaviour and finally their performance.

He then demonstrated how easy it was to push an individual's physiology into a chaotic state and also how easy it was to generate cardiac coherence, which is a first step in controlling the physiology. This was demonstrated with a volunteer. Even at the mere suggestion of undertaking a stressful challenge such as some simple mathematics, the subject's heart rate rhythm became very chaotic. Watkins explained that most people have no control over their physiology and when their heart rate rhythm becomes chaotic, their brain (prefrontal cortex) is significantly inhibited – it “switches off”. He then showed the audience, using some customised biofeedback equipment, how this can be prevented through rhythmic breathing exercises. This is a simple, yet effective method, which can help individuals stay focused and alert and in an effective learning state even under stressful circumstances. The rhythmic breathing method is only a very small piece of the entire ExPRESS Programme. However, it provides a stable platform on which to enhance emotional literacy. Adults and children are taught the antidote to their own negative

responses and learn to become aware of their emotional states, how to manage them, and, how to control their own performance, thereby enhancing their learning.

So to sum up, Watkins' approach is to work with the physiology first, then with emotions to create a State of Optimum Unconditional Learning in which other cognitive and behavioural strategies can be more effective. Emotional Intelligence is achieved by enabling individuals to control their own brain function to become aware and actually experience, manage and direct their own emotional energy.



Anthony E. Kelly

George Mason University, USA

“The role of emotions on learning has left no doubt that it is of extreme relevance to the OECD Brain project.”

Conclusions

The role of emotions on learning has left no doubt that it is of extreme relevance to the OECD Brain project. A clear agenda for the incorporation of this theme in the project will be established in early 2004. Even though the areas of focus within this theme are yet to be established, this symposium already made evident some preliminary potential pointers for policy makers.

Preliminary potential policy pointers:

- There is a clear connection between cognitive skills and physical activities, so we should apply a more physical approach to learning. An introduction of physical activities in a number of other classes besides PT classes might facilitate and open up new methods of learning and participation and also help towards alleviating problems such as obesity and related problems in later life.
- Today's children are not only sedentary, but are the victims of fast food chains and an impoverished Western diet. Diet has a direct influence on the brain, which is made up of essential fatty acids which can only be ingested. If we do not pay attention to the diets of our children, we may be faced with a future of brain degenerating problems which are strongly linked to learning problems.
- Today's world has many environmental factors (high divorce rates, terrorism, violence in schools, media influences, etc.) which can cause havoc to the emotional stability of our children. In order to understand student emotionally related learning problems, parental and teacher training on emotional management, conflict etc. is recommended.
- Whatever we teach kids in our schools, we should do this in a positive context, because whenever a negative context develops, it has a negative effect on learning. A closer look at teaching methods needs to be undertaken to focus on event-related teaching methods which can be used to extract rules and focus more on enhancing problem-solving.

- There is not enough data currently available on the neuroimaging of the emotional stresses facing children today. More research studies on the emotional lives of children and the effects in their brains need to be undertaken in order to draw conclusions on whether it is a societal or school problem we are dealing with and for implementing any changes that make sense in schools.
- There are already various learning therapy interventions to cope with stress and enhance emotional intelligence and stability such as the one presented by Alan Watkins in the UK, the work of the Learning Lab Denmark and in the German schools. More pilot studies for such interventions should be conducted on a wider scale in OECD countries.