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This is Your Brain on Technology

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Summary: New technologies, in particular gaming, virtual reality, and interactive media, have extraordinary potential to use what we know about learning and cognition to improve brain function.

Discussion

Daphne Bavelier

- In studies of selective attention, researchers found that gamers (particularly action gamers) consistently excel on tests of selective attention vs. their non-gaming peers. This raises the question, are gamers inherently better at paying attention or do games train the brain to better attend to varied stimuli?
- In research conducted looking at gamers, non-gamers, and training individuals with gaming:
    - Students in elementary and middle school who report playing action games show more attention than those that don't play these games.
    - Having adults play action games for 80 hours can actually create changes in visual systems and change what the participants are able to 'see' and attend to.
    - People who play fast-paced games are able to process information at a more rapid rate than peers who do not play these types of video games; despite faster processing speed, accuracy of the players does not suffer – they are just as accurate in processing tasks as non-gamers.
- What in action video games leads to such changes in learning and behavior? Are people who are drawn to video games inherently better at certain tasks? What elements of action video games are capable of improving learning?
- Good video games are designed according to principles of learning:
    - Begin at entry level of player

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  - Engaging activity
  - Difficulty of game increases incrementally, encouraging learning
  - Dynamic environment
  - Motivation/encouragement to keep playing
  - The whole cognitive system is working together in service of motor action.
- Currently, many of these action video games are games that teach about violence and aggression – imagine the benefits if we learn from action gaming and embed the content we want students to learn.

Barry Gordon

- When looking at the technology we have, and our knowledge about improving learning, the question becomes why aren't we doing more? What is stopping us from doing more? It is helpful to examine individuals on a continuum of brain function, including both 'abnormal' and 'normal' brain function. Though an individual with developmental disabilities may have brain abnormalities, they are on the same continuum of learning as someone with more normal brain function.
- For all learners on this continuum, generalization continues to be a problem. Why can't we successfully get generalization for the things we teach? If we have successfully improved visual attention through training, why can't we then improve attention in the auditory domain? Perhaps technology can help learners generalize skills and learning across domains.
- Knowing what we know about cognition, how can we use technology to improve brain function? In many cases, we already know what we can do; the question is deciding which ones will be the most useful in the long run, which ones have the highest payoffs. We currently have a potpourri of methods available to us for improving brain function; the question becomes which ones we want to invest in for the best results and highest payoff for the learner.

David Rose

- Though many criticize teachers as being resistant to change and new research, in reality there is an institutional resistance to change that has little to do with individual teachers.
  - One of the hardest things to change is practice – this can be seen in the medical profession where it is relatively easy to introduce physicians to new research on treatment options and medications, but has been much more difficult to change hand washing behavior.
- Many in the field have looked at what the brain can learn from technology, it can also be

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helpful in this discussion to look at what technology can learn from the brain.

1. Learning is distributed in the brain
2. Learning is distributed in a network
3. Learning is individual
4. Learning is ubiquitous

- New technologies need to be universally designed for individual learning differences. Technologies need to be smart enough to recognize differences in how kids learn and provide options tailored to their needs. As educators we are often too simplistic in how we look at learning and doing, when there are many different ways of learning and approaching a task. Tasks are very rarely only completed by one area; visual processing may involve 30 or more areas of the brain. We must recognize that there are many ways of knowing how to do things. Design technologies according to:
    - Many ways of knowing *how*
    - Many ways of knowing *that*
    - Many ways of knowing *why*

Yong Zhao

- We often look at people with disabilities in terms of deficits and weaknesses, but perhaps in certain contexts these things can be seen as strengths.
    - Focus not just on fixing someone's deficit, but building upon and taking advantage of areas of strength
- Virtual environments may not be physical, but they have become just as real, and may provide an environment for success for different types of learners.
    - Second Life has become a virtual economy
    - There may be people who are better at performing in a virtual world, for example, certain types of people may excel at running virtual stores online
- Technology has great potential, but should not duplicate things or efforts; technology should do things that people cannot do, or are not able to do well. Why have technologies do what human beings can already do?
    - Video games have the potential to improve environment and bring in resources that are lacking (e.g. impoverished areas). Games can become the platform to send resources in.

Discussion and Q & A

Question: Should I limit kids' screen time? Is there a plateau effect seen with gaming?

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- **Daphne Bavelier**: Too much of a good thing can be bad! Kids will become expert gamers but will lose other types of learning. We need to ensure that we tap into executive function and self-control, both of which are good predictors of achievement. Addiction is a big problem in gaming. Making learning and gaming fun is an important element in making sure people want to learn, but we also need to be aware of controlling the other side – getting so engrossed in an activity you don't do other things.

Question: Regarding the possible value of being able to focus better visually, kids in the classroom obviously need to focus on the teacher and the task at hand. Have you looked at whether your ability to modify attention transfers to classroom work?

- **Daphne Bavelier**: Not my work, but others have looked at this issue:
    - Research on training elementary school children to be able to focus on relevant material and suppress irrelevant information.
    - Some research has looked at genetic markers to determine whether certain types of kids are better at these behaviors.
- **David Rose**: The way the nervous system is organized, it is a fabulous context processor, but it is difficult to generalize.
    - Good feature of the nervous system.
    - Must be careful to ensure that kids are not just learning things in one context without generalizing to other contexts.

Question: Is it possible to bypass so-called disability? Is the brain really modular?

- **David Rose**: Typically by looking at the way the nervous system does things, we tend to see things as much more complicated and interesting than we do as educators.
    - Diversity of children as learners – not 'good' or 'bad' at language, there are multiple parts, more ways to do it than we thought. Not a single thing we can call 'language'.
- **Barry Gordon**: Our normal way of looking at things is to break it down, yet we are total organisms. You learn best when you learn things in context, for example new vocabulary in the context of an action video game. Learning is most effective when it engages lots of brain systems.
- **Daphne Bavelier**: Modularity doesn't play well early in infancy… babies' brains are not modular.
    - Challenge of growing up is to develop efficient systems that will take over at the expense of other systems that could have been developed.
    - We talk about 'disabled' children but we need to look at strengths.

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  - Generalization is difficult – Tetris experts become experts at rotating Tetris-like shapes and nothing else. They do not generalize to other types of mental rotation.
  - We need to let the learner discover information vs. feeding learner information.

- **Barry Gordon**: When trying to teach a patient with amnesia how to generalize information, the classic method is to present material over and over. Learning is deeper and more efficient if you present variations of material to the individuals.

Question: Have there been any longitudinal investigations into whether the learning you see with gaming peaks?

- **Daphne Bavelier**: Former gamers still perform better than non-gamers, but not as well as current gamers.

Question: If gaming can enhance attention, does this work for people with ADHD?

- **Daphne Bavelier**: Interesting group because they tend to be very attracted to video games.
  - Do video games cause ADHD or are kids with ADHD more drawn to video games because they are fairly forgiving platforms?
  - People with ADHD do perform more poorly on the tasks of attention in the lab.
- **David Rose**: Studies of dyslexic astrophysicists report on how they do visual searches. Interestingly, dyslexia is overrepresented in astrophysics. Things about the way their visual system works makes them very good at astrophysics, but less good at decoding text.
  - Again look at both strengths and weaknesses.
  - Some people with disabilities may be better at certain activities.

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