

HL IB Psychology

Cognitive Processing in a Technical World

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Sparrow et al. (2011); Rosen et al. (2011)

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The Positive & Negative Influence of Technologies on Cognitive Processes

How do technologies Influence Cognitive Processes?

Note: You have learnt about **cognitive processes** as part of the **Cognitive**

Approach e.g. **memory** and **thinking and decision-making**.

How do technologies influence cognitive processes?

- Cognitive processes include functions such as memory, thinking and decision-making, **attention**, **perception**, **language** and **information-processing**
- Modern technologies include **smartphones**, **the internet**, **computer games** all of which involve the use of cognitive processes, particularly **working memory** and **attention**
- We live in an increasingly complex world due to the fast and technical nature of technology but we are also able to access information in ways which would have been unimaginable even a couple of decades ago
- The concept of **cognitive overload** is one which revolves around the idea that too much exposure to too much technology can overwhelm the individual and result in impaired cognitive and **social** functioning
- People born prior to the internet and prior to the widely-adopted use of **personal computers** are known as '**digital immigrants**' and those born after the establishment of these technologies are known as '**digital natives**'
- There is a school of thought that digital natives cannot function adequately without almost continuous access to their technologies and that this impairs their cognitive processes
- There is another school of thought that modern technologies are beneficial to cognitive processing for both digital natives and digital immigrants alike

Arguments for the Positive Influence of Technologies on Cognitive Processes

- One argument for the positive influence of digital technologies is the idea of '**hyperconnectedness**' which means that an individual can be connected to multiple forms of information and communication e.g. **email, forums, blogs, chat sites, texting, social media, multiple-player computer games** etc. which gives them access to worlds and people that they would otherwise not have had access to
- Using the internet and multiple simultaneous sources of information e.g **scrolling** through social media whilst watching TV results in **multitasking** and moving quickly through personal and work-related tasks which may result in sharper cognitive functions
- Multitasking and changing swiftly between cognitive tasks is linked to **System 1 thinking** which could be highly **adaptive** to 21st century life as these skills appear to be increasingly necessary in a range of situations e.g. having several tabs open on a laptop and switching between each of them to fulfil a specific task
- Switching between tasks can be learned via **metacognition** which is in itself a discipline which may in turn improve and enhance cognitive functioning

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Arguments for the negative influence of technologies on cognitive processes

- One argument for the negative influence of digital technologies is the '**Google effect**': the idea that information is not **retained** if one simply looks it up using a search engine (i.e. the information is there for future reference so there is no point trying to **rehearse** the information to transfer it to **long-term memory**)
- The use of **satellite navigation systems** is also often quoted as evidence that people cannot function without technology, often following incorrect sat-nav instructions against their better judgement
- There is some concern that technology-based laziness may result in less **neuroplasticity** and that, instead, **neural pruning** will occur in the parts of the brain that technology has taken over e.g. the **hippocampus** for both memory and **spatial navigation**
- An over-reliance on technologies may also negatively impact **social interactions** as some research has shown that people who spend more time using a screen lose some ability to recognise faces in real life as screens interfere with the ability to recognise **emotion** in face-to-face encounters

Research which investigates the positive and negative influence of technologies on cognitive processes

- **Blacker et al. (2014):** playing video games may improve visual working memory
- **Morina et al. (2015):** virtual reality therapy may be an effective treatment for phobias
- **Sparrow et al. (2011):** the 'Google effect' may impair retention and recall of information
- **Rosen et al. (2011):** multi-tasking may impair learning



Worked Example

EXTENDED RESPONSE QUESTION (ERQ)

22 MARKS

The question is, 'Discuss the influence of digital technology on one or more cognitive processes'.
[22]

The command term 'Discuss' means that you have to offer a considered and balanced range of arguments, concepts, and explanations to provide a full exploration of the topic. Here is an exemplar paragraph of a 'Discuss' question:

There are arguments both for and against the idea of 'hyperconnectedness': on the plus side it is thought that relying on the internet and multiple simultaneous sources of information results in multitasking and cycling quickly through personal and work-related tasks. This is linked to System 1 intuitive thinking which lends itself to instant decisions and switching rapidly between tasks which can be particularly useful when time is of the essence and quick decisions have to be made. One of the downsides of technology use however, can be seen in schools: mobile phones have presented a challenge when students mis-use them during lesson time. Mobile phones can disrupt the learning process during class time, and interfere with the cognitive processes of memory and attention which are crucial for learning.

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Two Key Studies of the positive influence of technologies on cognitive processes: Blacker et al. (2014); Morina et al. (2015)

Key Study 1: Blacker et al. (2014)

Aim: To investigate the extent to which **action video games** may improve **visual working memory (VWM)**.

Participants: A **volunteer sample** of 34 male university students (**mean age**=20 years).

Procedure:

- The participants were **randomly allocated** to one of two **conditions** of the **independent variable**
- Condition 1: participants were asked to play active video games e.g. Black Ops games, Call of Duty, Modern Warfare using **single-player mode** i.e. they were not playing with any other players
- Condition 2: participants were asked to play a non-active game (The Sims strategy game); this was the **control condition**
- Participants in each group were asked to **train** (i.e. play the game and practise the skills involved) for over 30 hours across a continuous stretch of 30 days
- Prior to the training period the participants were assessed using a **self-report** (0–9 **rating scale**) which asked them how motivated they were to complete a visual working memory (VWM) task
- After the training period was over the participants were asked to complete another self-report which asked them about how engaged they had been in the VWM task (e.g. their level of enjoyment and absorption in the game)

Results:

- The researchers found no **significant differences** in levels of **self-reported** motivation and engagement between the two groups on either the tasks or the VWM assessments
- The participants who trained using the action game demonstrated significant improvement on one measure of VWM **capacity** (a **change control** task which involves switching **attention** quickly), a small improvement on a colour wheel test and no improvement on a complex **span task** compared with those who trained on the Sims game.

Conclusion: Action video games may directly improve the VWM, or improve it through the enhancement of **selective attention**.

Evaluation of Blacker et al. (2014)

Strengths

- The study has good **application** as it highlights the responsiveness of the VWM to training which could be used in educational settings where improving cognitive skills is a key objective
- The procedure took place over 30 hours which means that the participants were able to immerse themselves in whichever game they were playing across time which makes the findings more **valid** than they would be if a **snapshot** design had been used

Limitations

- There is no way of knowing if the participants stuck strictly to the 30-day practice period: some of them may have practised the game more and some less which would decrease the **reliability** of the findings due to a lack of **consistency** across conditions

The study shows what happened - the improvement in VWM on one measure - but it cannot explain *why* it happened thus it lacks **explanatory power**

Key terms:

Visual working memory

Selective attention

Action video games

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Key Study 2: Morina et al. (2015)

Aim:

- To assess the extent to which **virtual reality exposure therapy (VRE)** can be used to treat a range of **phobias** which may interfere with cognitive processing for the patients who suffer from them (e.g. **perception** of threats in everyday life)
- VRE is a type of **exposure therapy** which involves being gradually exposed to the **phobic stimulus** over time until the patient's distress and fear have decreased significantly
- The patient is taught a range of strategies to help them manage their fear and the **anxiety** surrounding the phobic stimulus

Procedure:

- The researchers conducted a **meta-analysis** which used the findings of 14 **clinical trials** using VRE in the treatment of specific phobias
- 14 studies were used in the study and these covered a range of phobias including fear of spiders, fear of heights, fear of flying, fear of climbing stairs.
- In a VRE **therapy session** the patient wears a special VR viewer (a headpiece rather like oversized lab goggles) into which are projected **interactive 3D** objects and situations associated with their phobia
- The phobic stimuli are **modified** and **manipulated** by the patient's **therapist**
- By experiencing the phobic stimuli safely but at the same time experiencing them at close range, the patient is able to gradually reduce their phobia as they are able to confront phobic stimuli without experiencing a loss of **control**

Results:

- The findings showed that phobic patients responded well to VRE treatment: their **behavioural responses** to the phobic stimuli showed clear improvement following VRE treatment e.g. reduced **anxiety**, increased self-control, increased ability to confront the phobic stimuli
- Some patients were on a waiting-list for VRE treatment and it was found that they did not improve as much as the patients who were already undergoing VRE therapy
- VRE was found to be as effective as other behavioural measures e.g. **cognitive behavioural therapy** in the treatment of phobias
- These findings are supported by previous research into the use of VRE to treat phobias

Conclusion: VRE may be an effective treatment for phobias.

Evaluation of Morina et al. (2015)

Strengths

- The findings agree with previous meta-analyses which gives them **concurrent validity**
- Patients may prefer VRE to other traditional forms of phobia therapy such as **systematic desensitisation** as it gives them more control of the process

Limitations

- The number of studies used in the meta-analysis is not large enough to provide **robust quantitative data** from which to draw meaningful conclusions
- VRE is **expensive** and **time-consuming** which means that it is unlikely to be available to most patients

Key terms:

Virtual Reality Exposure Therapy (VRE)

Meta-analysis

Phobic stimulus

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Key Studies Summary Table: The Influence of Technologies on Cognitive Processes

Key Studies Summary: The Influence of Technologies on Cognitive Processes

SUMMARY TABLE: KEY STUDIES OF THE INFLUENCE OF TECHNOLOGIES ON COGNITIVE PROCESSES

<u>Topic</u>	<u>Two Key Studies</u>
<p>The Positive Influence of Technologies on Cognitive Processes</p> <ul style="list-style-type: none"> Use one of these studies to answer a question on the negative influence of technologies too By using one of these studies for a 'negative influence' question you are applying critical thinking i.e. not all technological influence is positive; some research shows that it can also be negative 	<p>Blacker et al. (2014)</p> <p>Morina et al. (2015)</p>
<p>The Negative Influence of Technologies on Cognitive Processes</p> <ul style="list-style-type: none"> Use one of these studies to answer a question on the positive influence of technologies too By using one of these studies for a 'positive influence' question you are applying critical thinking i.e. not all technological influence is negative; some research shows that it can also be positive 	<p>Sparrow et al. (2011)</p> <p>Rosen et al. (2011)</p>

How do I use these studies in an exam question on this topic?

- HL IB students have a lot of content to cover so the purpose of this revision resource is to slim down and streamline the number of studies you need per topic/exam question
- The exam question will ask you to either 'Evaluate' or 'Discuss' either the positive or the negative influence of technologies on cognitive processes
- You may also be asked 'To what extent' technology has a positive or negative effect on cognitive processes
- For any of the above questions (evaluate, discuss, to what extent) you can use all of the studies presented in the summary table here

- If you are asked to (for example) 'Discuss the positive influence of technologies on cognitive processes' you could use BOTH Blacker et al. (2014) and Morina et al. (2015) plus ONE of the negative influence studies (possibly in less depth) as a counter-argument (Sparrow et al. 2011 or Rosen et al. 2011)
- Another solution to the above strategy would be to use either Blacker et al (2014) OR Morina et al. (2015) plus ONE of the negative influence studies in depth for a counter-argument
- Whichever solution or strategy you use in the exam for a question on this topic remember to acknowledge that technologies cannot have a purely positive or negative effect on cognitive processes - always bring in critical thinking and counter-arguments
- Remember that the HL questions will only ever appear on Paper 1 Section B (ERQ = 22 marks), never on Section A

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Two Key Studies of the negative influence of technologies on cognitive processes: Sparrow et al. (2011); Rosen et al. (2011)

Key study 1: Sparrow et al. (2011)

Aim: To investigate the relationship between **memory**, **technology**, and the 'Google effect'.

Participants: The original **journal article** does not give any details of the sample **demographic**.

Procedure: Participants were asked to learn some new items of **trivia** that they had not known before the **experiment** and to enter this information into a computer. The **independent variable** consisted of two **conditions**:

- Condition 1: The participants were told that the information they had entered into the computer would be **saved** and that they would be able to access it at a later date
- Condition 2: The participants were told that the information they had entered into the computer would be **deleted**
- Half of the participants in both condition 1 and condition 2 were told that they would have to remember the information they had learned as they would need it at some point later

Participants then completed a **recognition task** in which they were shown the 30 trivia statements, with half of them altered slightly. Participants were asked to make judgements about each statement: *Is this exactly what you read earlier? Has the statement been saved or deleted? Has the statement been saved to a folder, if so which one?*

Results: In condition 1 participants who were told that they could access the information at a later date did not **recall** it as well as participants who were told that the information would be deleted.

Conclusion: The 'Google effect' i.e. reliance on technology to **retain** information may lead to '**digital amnesia**', the state of being overly dependent on **electronic** sources to **store** and **retrieve** information and this may have a negative impact on memory.

Evaluation of Sparrow et al. (2011)

Strengths

- These findings could be used to inform **intervention strategies** to improve recall in educational settings i.e. to encourage children not to rely on electronic forms of memory but instead to work on their own memory ability
- The findings may reflect the idea that individual memory is changing to that of a '**shared memory**' with the internet being the receptacle for information that is accessible to many rather than just to the individual which in turn increases the **validity** of the findings

Limitations

- In real life people may work harder to remember key information, particularly if it is of personal significance to them which means that this study lacks **ecological validity**
- It is almost impossible to **generalise** the results as nothing is known of the sample demographic i.e. were they similar in age? Were they all familiar with technology? Were they from a range of **cultures** or was the sample **ethnocentric**?

Key terms:

Google effect

Digital amnesia

Recognition task

Key study 2: Rosen et al. (2011)

Aim: To examine the extent to which **texting** during a lecture may impact recall of the lesson.

Participants: 185 college students (80% female; 20% male; age range 18–66 years; **mean** age=25 years). 83% of the sample was born between 1980 and 1989, and so belong to what is called the '**Net Generation**', also known as '**digital natives**'.

Procedure:

- Participants were told that they were going to view a 30-minute videotaped lecture relevant to their course, and that during the session some of them would receive texts from the researchers, to which they should respond as promptly as possible
- Participants were informed that they would be tested on the material after the lecture
- There were three **conditions** of the **independent variable**
- Condition 1: The 4-text condition (4 texts were sent to participants in this condition)
- Condition 2: The 8-text condition (8 texts were sent to participants in this condition)
- Condition 3: The no-text condition (no texts were sent to participants in this condition)
- After the lecture participants were asked to list information about the text messages, including time received, whether a response was sent and the number of words in the response
- The participants also noted any personal text messages they received during the lecture
- Participants were also asked questions about their typical texting behaviours in the classroom, and their attitudes about whether it was acceptable to text during class and whether texting during lectures was harmful to their ability to learn the material

Results:

- 75% of participants agreed that receiving and sending texts negatively impacts the ability to learn from a lecture, but 40% agreed it was acceptable to text during a lecture
- 18% stated they never responded to a text in class, and 67% stated that they would respond to a friend's text, and 75% would respond to a text from a family member
- The no/low texting group (conditions 1 and 3) performed 10.6% (**memory score**) better than the high texting group
- The test score was **significantly negatively correlated** with the total number of words sent and received i.e. the more texts sent/received the lower the score on the memory test
- Those participants who chose to wait more than 4–5 minutes to respond to a text message did substantially better in the test than those who responded more rapidly

Conclusion: Students should be taught **metacognitive** strategies that focus on when it is appropriate to take a break and when it is important to focus without distractions in order to maximise their learning.

Evaluation of Rosen et al. (2011)

Strengths

- 83% of the sample was born between 1980 and 1989 which makes them ideal for this procedure as participants had to be familiar with and adept at texting
- The participants were in a familiar situation, doing what they would normally be doing so some ecological validity can be claimed

Limitations

- Although, as stated above, there is some ecological validity to this study the students watched a recorded lecture and were allocated to a condition by researchers (some of whom were texted by the researchers) which means that there are still **artificial** elements to the procedure
- This is a **snapshot** design so the results cannot point to the **long-term** effects of **multitasking** during a lecture i.e. texting whilst also trying to follow the lecture

Key terms:

Net Generation

Digital natives

Metacognition



Worked Example

EXTENDED RESPONSE QUESTION (ERQ)

22 MARKS

The question is, 'Discuss the positive and/or negative influences of modern technologies on cognitive processes'. [22]

This command term requires you to offer a balanced range of arguments on the topic. Have a look at these exemplar paragraphs for guidance:

The findings of Rosen et al. (2011) suggest that it is not technology itself which has a negative influence on memory but how it is used and responded to that is the crux of the problem. The study found that delaying replying to a text message mediates any negative effect on memory and allows for better multitasking. These results suggest that when interruptions can be deferred users have a strong tendency to focus on the main task until mental workload has been minimised. This contradicts the idea that multitasking produces only undesirable effects and impacts learning negatively.

There is a school of thought which argues that digital technology actively and directly enhances memory via data input/output tools and electronic storage. Data-gathering and analysis is enhanced by computers, online databases, virtual simulations and online collaboration tools, all of which supplement and support our limited human long-term memory. In this way it could be argued that a shared, digital consciousness actually serves to benefit human memory.