Selective Attention and Perception

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Before we dive into the effects of selective attention on perception, information integration and our ability to process information precisely, we need to define what we mean by selective attention and why to study attention in the first place.

What is Selective Attention?

We live in a crowded world where noise is inevitable in our daily life, whether we are listening to a lecture, watching a video, or reading an article. This noise or background information is always a challenge to our mind, i.e. we need to identify what is important and what is not to learn anything.

The process of selectively attending to information, says the voice of a lecturer in an audio lecture while ignoring the environment, is called selective attention.

One of the reasons for selective attention is the limited capacity of our brain. It is impossible for the brain to focus on all information available simultaneously. Selective awareness indicates that there are two stimuli present at the same time, we focus on one and attend it whereas completely neglect the other. When we perceive both the

information, our response is made to both of them are not together, but in succession of one after the other.

When we selectively attend to something that involves perception, psychologists believe that our ability to perceive information improves, we are better in integrating this information, and finally, we can understand this new information more precisely.

The subject receives different auditory information from each ear:

- Attended channel
- Unattended channel

Most of the information from the attended stimulus is retained while the other is lost.

When someone attends to a certain task, say selectively attending to hearing that audio from the lecture, he or she is said to decrease the input from other sensory modalities such as vision and touching.

In reality, you do not alter the input at all, but what you do is **modulate how your brain processes the information obtained from the other sensory modalities** when you are trying to focus on a given modality of sensation.

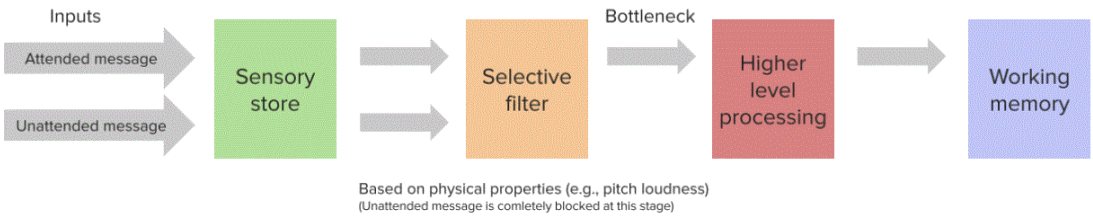
The result is that you can decrease your reaction time, improve your judgment about what you are currently learning, and precisely perceive this new information of interest to you despite having a lot of noise. With noise, we do not mean actual sound noise, but we mean background information that your brain simply perceives as not important.

Of course, one might ask the question of whether we truly do something on the molecular and neurological level when we are selectively attending to something or is it just a perceived feeling that does not have any physiological basis.

Neuroimaging studies of selective attention in visual or auditory tasks showed with clear evidence that when we selectively attend to something, the **sensory cortex** responsible for that modality of perception, say the **occipital cortex in a visual task**, shows increased activity or at least modulated activity compared to when we are not attending. These studies aim to study the effect of attention as a modulator of either **brain activity** in each area or as a modulator of **brain networks**.

Broadbent filter model of selective attention

Inputs from the environment first enter a sensory buffer. One of the inputs is selected and filtered based on sensory modality. The info which remains in buffers quickly decays and is lost. Selected info enters short-term memory storage where semantic tagging occurs.



"Broadbent Filter Model" Image created by Lecturio

Anne Treisman´s attenuation model

The model suggests that the filter is replaced by an attenuator. “Rejects” the unattended sensory input instead of removing it. Explains why we may still sometimes access information thought to be unattended.

“Anne Treisman´s Attenuation Model” Image created by Lecturio

What is Divided Attention?

Another important definition to us has divided attention. Let us say that you are hearing a lecture while browsing the internet and checking your Facebook account. This means that at the same time, you are attending to two different tasks, i.e. **multitasking**, and each task involves a different sensory modality.

Factors associated with performance on multi-tasking include	
Multi-tasking factor	Impact on multi-tasking
Task similarity	If tasks are similar, multi-tasking becomes increasingly difficult
Task difficulty	As for difficulty increases, the ability to multi-task decreases
Task practice	• Practice reduces resources demand • Automatic, “muscle memory”

Interestingly, an average human is usually able to attend to both tasks and still able to process information and reach decisions. This process of attending to two different things is called divided attention. In other words, **we can process and perceive information from two different sensory modalities due to our ability to divide our attention.**

While studying selective attention is easy for the neuroscientist, **divided attention studies usually produce conflicting results**. Depending on the sensory modalities involved, the difficulty of the task at hand, and the similarity between the two tasks, our ability to divide our attention can be different.

Usually, tasks that involve the same sensory modality, say listening to a conversation with a friend while also listening to a lecture on audio, are more difficult to process at the same time.

Divided attention is, therefore, **easier when the sensory modalities involved are different** in the two tasks. Additionally, listening to a conversation and understanding it while also eating a meal involves two different sensory modalities but is usually much easier to process than incorporating two tasks that involve visual and auditory perception. In other words, the performance of the task depends on the number of task-related stimuli. Listening to a conversation while eating has two different tasks not related to each other.

One of the easiest ways to study divided attention by neuroscientists is to study our ability to **integrate information from two different modalities**, say visual and auditory perception tasks. One drawback of these experiments is that they **involve working memory**. Retrieving visual memory is usually faster than verbal memory, hence one can expect that integration of information might usually be in favor of faster and stronger integration of visual information.

Effects of Selective Attention are Different Depending on the Sensory Modality

The final question regarding selective and divided attention was whether selectively attending to something is going to have different effects depending on the sensory modality involved.

Studies investigating selective attention in **bi-sensorial experiments** showed that our brains are more successful in processing visual information rather than auditory. It is important to note that selectively attending to a given modality in bi-sensorial experiments showed that our ability to integrate information afterward from both modalities is not affected. Our performance is more defined and precise in case of processing visual performance by selective attention.

Sensory integration is defined as the ability of our brain to perceive sensory information from different modalities and then translate that into appropriate behavioral responses.

Reaction time during the experiment to give a response can be considered as an appropriate behavioral response, and selective attention studies showed that selective attention does not affect it. This finding means that our brain ability to process information and formulate an appropriate response is not actually influenced by selective attention.

This finding does not mean that our ability to learn and store memories is also not affected by selective attention, quite the opposite, as we have shown that our ability to learn new things is indeed improved by selective attention.

One issue with bi-sensorial experiments is the **complexity of the stimuli** given to the participant. The stimuli are either too simple for visual tasks or too complicated and noisy for auditory tasks. Too complicated and noisy tasks require selective attention to improve our performance.

Conditions Where Selective Attention is Impaired

People with **autism spectrum disorder** are known to have attention abnormalities. Their ability to integrate information from different sensory modalities might be impaired, and selective attention is usually different in these people. For instance, their ability to perceive visual information and process it seems to be higher.

On the other hand, people with autism spectrum disorder are unable to selectively attend to a given task unless the complexity of the task is increased i.e. perceptual load have to increase to high levels to ignore irrelevant distractors compared to normal people who can selectively attend to a given task even if the complexity of the task is low.

Patients with **neurodegenerative diseases** such as **Alzheimer disease** and **Parkinson disease** complain of impaired working memory, executive functioning, and visual selective attention.

The **hippocampus** and **amygdala** in addition to deep brain areas are thought to play an important role in visual selective attention. These areas are usually impaired in patients with dementia due to Alzheimer disease or Parkinson disease. Patients with these conditions might be unable to ignore distractors unless the complexity of the distractors

and the given task are increased, again emphasizing the importance of perceptual load in selective attention.

References

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