Attention

William James, in 1890, wrote "Everyone knows what attention is. Attention is the taking possession of the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalisations, concentration of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others". Attention is a very common process that everyone engages in. In layman terms, it means focusing on some particular object.

We are constantly confronted with more information than we can pay attention to, and there are limitations on how much we can attend to at one time. At any given moment, a person is faced with a number of cues that surround him, and it is not possible to attend to all these external stimuli simultaneously. And here the attentional processes play a helpful role. Attention is the cognitive process by which the mind chooses from among the various stimuli that strike the senses at any given moment. For example, while reading a particularly important text or a book, we 'tune out' the various other sensations that we may experience such as the pressure of our feet on the floor or the light falling on our faces and the like. However, when required to attend to two stimuli at the same time, it becomes difficult to attend simultaneously to more than one cue of the same modality, such as two auditory cues or two visual cues.

Moreover, some tasks can be performed with very little attention. With practice, some tasks become less demanding of our attentional processes. For example, driving a car, or riding a bicycle may be a highly practiced habit and would require very little attention.

Since the time of William James, a number of experiments and researches on related topics have been done which has provided a better perspective on the issue, and has helped in the better understanding of the process of attention.

Orienting Attention

We don’t passively see or hear, we actively look and listen. The orienting of attention can be defined as "the aligning of attention with a source of sensory input or an internal semantic structure stored in memory". Two ways have been suggested that are employed by a person to orient to a stimulus, Overt orienting, and Covert orienting.

- Overt Orienting – As the name suggests, this process involves ‘overtly’ orienting our attention to a particular stimuli. It is the process in which the person selectively attends to a particular stimulus over others by moving his/her eyes to point in the direction of the stimulus.
- Covert Orienting – In this process, the changes in attention are not attributable to the overt eye movements. Covert orienting is the process which involves the shifting of one’s attention mentally, without moving one’s eyes.
- Attentional Gaze - Attentional gaze is another important concept which suggests that attention can be drawn to a particular location independent of where our eyes are looking or our ears are oriented.

Cueing Attention

Attention can also be oriented through the help of presentation of some cues. In a typical cueing task, the subjects are given a cue as to where the target will appear in the visual field. Two types of cues are used in order to analyze attention, based on the type of visual input. They are exogenous and the endogenous cues. The endogenous cue is invariably an arrow which was presented in the centre of the screen, whereas the exogenous cue is generally a highlighting or a flashing light in the peripheral visual field.

These cues are then manipulated with the help of three different types of trials; Valid, Invalid, and Neutral trials.

- Valid Trials – In valid trials, the subsequent target is presented in the same area as indicated by the cue.
- Invalid trials – In invalid trials, the target is presented in the area opposite to that indicated by
the cue.
- Neutral trials – In neutral trials, cues are not presented prior to the presentation of the target stimulus.

Thus, such a cueing task through the comparison of the performances on all the three trials can help in finding out whether the cues direct attention to a particular area, and whether such cues benefit or hinder attentional performance.

**Selective Attention**

Selective attention, as the name suggests, is the process of selectively attending to one stimulus from among various other stimuli which occur simultaneously. In a typical selective attention experiment by Cherry (1953), Known as the ‘Dichotic Listening Task’, the participants were presented with two different auditory stimuli directed to different ears simultaneously over headphones. They participants had to repeat out loud, the contents of the message they heard in one ear (a process known as ‘Shadowing’), while ignoring the message being presented in the other ear.

Results obtained on this task showed that the people did not recall the shadowed message well, suggesting that most of the processing necessary to shadow the attended message occurred in working memory and not in the long term memory. The performance on the unattended message was worse, and the participants were not able to report anything about its content. The participants could not detect the semantic features such as, the shift from one language to another or the repetition of items, of this unattended channel. However, it was observed that the physical attributes of the unattended message were detected by the participants, such as a switch from male to female voice, or a switch from human voice to the sound of a musical instrument.

**Theories of Attention**
The filter theory of attention was proposed by Broadbent (1958), which states that a person can attend to only a limited amount of information at any given time. Thus at any time if the amount of information exceeds capacity, then a person uses some attentional filters in order to let through some of the information and block the rest. This attentional filter is based on some physical aspect of the attended message, and only the message that gets past the filter can be analyzed later for meaning. For instance, two sources of information gain access in parallel into sensory buffer. Then one input is allowed through a filter based on its basic characteristics, while the other remains on the buffer for later processing. Beyond the filter, a mechanism processes the information thoroughly (meaning etc.).
before its meaning is identified.

However, the theory has faced a few contradictions, the most prominent being the ‘Cocktail party effect’ given by Moray (1959). According to this effect, the shadowing performance is disturbed when one’s own name is embedded in either the attended or the unattended message. Thus, if a message content is perceived to be ‘important’, it can penetrate through the attentional filters set up to block unattended messages, as opposed to what has been proposed by the filter theory.

**Attenuation Theory**

Annie Triesman, in 1960, proposed a modified filter theory, known as the ‘Attenuation theory’. According to this theory, the unattended messages are not completely blocked before they can be processed for meaning, but are just turned down in their volume. The messages coming in are subjected to three types of analysis.

- In the first analysis, the physical properties of the message are analyzed.
- The second analysis is on the linguistic level, where the message is broken down into words and syllables.
- The third kind of analysis is the semantic analysis, where the meaning of the message is processed.

In a typical experiment, a story was presented to the ear to be attended in a dichotic listening task. After some time, the story was switched from attended ear to unattended ear. It was seen that the participants mistakenly shadowed from attended ear to unattended ear after this phenomenon of ‘switched ears’.

![Example of Attenuation Theory](image)

These results supported the assumption that the unattended messages are not completely blocked but weakened, and that significant stimuli can still be recovered from such unattended messages.

**Early selection models of attention:** Both the Filter theory as well as the Attenuation theory are early selection models of attention, as the information to be attended is selected ‘early’ in the processing. However a number of limitations of these models have been demonstrated. Some of them can be listed as follows –

- Memory for unattended channel may depend on familiarity or importance, for example, Cocktail party effect.
- Effects of practice may also lead to early selection
- There is implicit memory for the unattended channel, even when there isn’t explicit memory.
- People can shadow meaningful message that switch from ear to ear, as shown in the experiment of switched ears conducted by Triesman.
- Memory for unattended channel affected by similarity to attended channel.

Moreover, context also plays an important role in how the information is processed and understood. In an experiment, the participants were presented with the following sentence in their Attended ear: “They were standing near the bank”. While one of the following was presented to the unattended ear; “river” or “money”. It was seen that the participants interpreted “bank” as a riverbank if they heard “river” in the unattended ear, and a financial bank if they heard “money”. These results supported the role of contextual effects in the attentional processes.
Late Selection Theory

The ‘late selection theory’ was proposed by Deutsch and Deutsch in 1963, and was later elaborated and extended by Norman in 1968. As the name suggests, this theory holds that all the incoming messages are routinely processed for at least some aspect of meaning and that the selection of which of these messages to respond to, occurs ‘late’ in the processing.

Like the filter theory, the late selection theory also suggests a filter, but place it later in the processing, after certain aspects of the meaning of the message have been extracted. All the material is processed up to a point and the information that is judged to be ‘important’ is then further processed and elaborated more fully, and this information is likely to be retained. The importance level of the message depends on a number of factors such as the context, and the personal significance of its content, and even the observer’s level of alertness.

Despite getting decent supporting results, this late selection model also has demonstrated some limitations, which can be listed as follows –

1. Even if pertinence is controlled for, people are more likely to notice effects in the attended channel (87%), and are less likely to notice effects in the unattended channel (8%)
2. If selection is late then why do people feel like they are consciously selecting early?
3. Neurological evidence have also shown that there is enhanced neural processing at early stages.

These theories are also collectively known as ‘Bottleneck theories. According to these theories, all the information gets into the sensory register but somewhere along the way, the information is filtered or selected for attention. In the early selection models, this happens at the perceptual level. While in the late selection models, this happens at response level. Only selected information makes it into awareness and long-term memory.
Capacity theory

Tasks take mental effort. People have limited mental effort to allocate to all demands on our attention. The capacity theories believe that attention can be directed at more than one task at a time, depending on the capacity demands of each task. The more complex the stimulus, the harder is the processing, and thus more resources are engaged.

Daniel Kahneman, in 1973, proposed a model of attention known as the 'Resource Allocation model' of attention.
This theory suggests that people have a conscious control over where they direct their mental resources, and they can choose the stimuli they want to focus on. Some tasks require more attention than the others, and thus may require or demand more capacity. A number of factors influence this allocation of capacity. These factors may include –

- Level of arousal, or the state of alertness
- Available capacity
- Enduring dispositions
- Momentary intentions

The availability of resources for a particular task may be affected by the overall level of arousal of the individual, which in turn is dependent on the difficulty of the given task. Some tasks are easier to perform than others and don’t seem to affect attention, especially tasks that are well practiced, whereas, other tasks are tedious and require our conscious attention. Furthermore, the allocation policy of the resources is also dependent on the individual’s enduring dispositions, momentary intentions, and evaluation of the demands on one’s capacity.

**Divided Attention**

Divided attention occurs when a person learns to perform and pay attention to two tasks simultaneously. This can be seen in the various dual task experiments, in which the participants were asked to perform multiple tasks at the same time, and the effect on their performance was seen. Through the various experiments and their results, the following conclusions were observed.

- Divided attention is difficult when-
- Tasks are similar
- Tasks are difficult
When both tasks require conscious attention
- Divided attention is easier when-
  - Tasks are dissimilar
  - Tasks are simple
  - When at least one of the tasks does not require conscious attention
  - Tasks are practiced

**Automatic Vs Controlled Processing**

Automatic processing is that processing which occurs without intention, without conscious awareness, and does not interfere with other mental activity.

Controlled processing, also known as Attentional processing, is the processing that requires attention, is capacity limited, and is under conscious control.

The major differences between these two kinds of processings can be enumerated as –

<table>
<thead>
<tr>
<th>Automatic Processing</th>
<th>Controlled Processes</th>
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<tbody>
<tr>
<td>I. Fast and efficient</td>
<td>I. Slow and less efficient</td>
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<tr>
<td>II. Unavailable to consciousness</td>
<td>II. Available to consciousness</td>
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<tr>
<td>III. Unavoidable</td>
<td>III. Controllable</td>
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<tr>
<td>IV. Unintentional</td>
<td>IV. Intentional</td>
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**Neurological Basis of attention**

A number of neurological studies have tried to examine and find which areas of the brain are active when a person is attending to a stimulus or event. Of all the regions, the parietal lobe has been seen to play an important role in attention.

- **Visual Neglect**

  Patients, who had suffered parietal lobe damage, have been seen to display the phenomenon of sensory neglect. These patients ignore or neglect the sensory information that is located in the visual field opposite to the damaged hemisphere.
**Balint’s Syndrome**

Balint’s syndrome also results from lesions to posterior parietal lobe, or at the parieto-occipital junction. The symptoms include:

- fixed gaze
- gross mis-reaching for objects
- simultagnosia (only perceiving one item)

Apart from the parietal lobe, other areas of the brain such as the areas of the frontal lobe also are associated with attention.