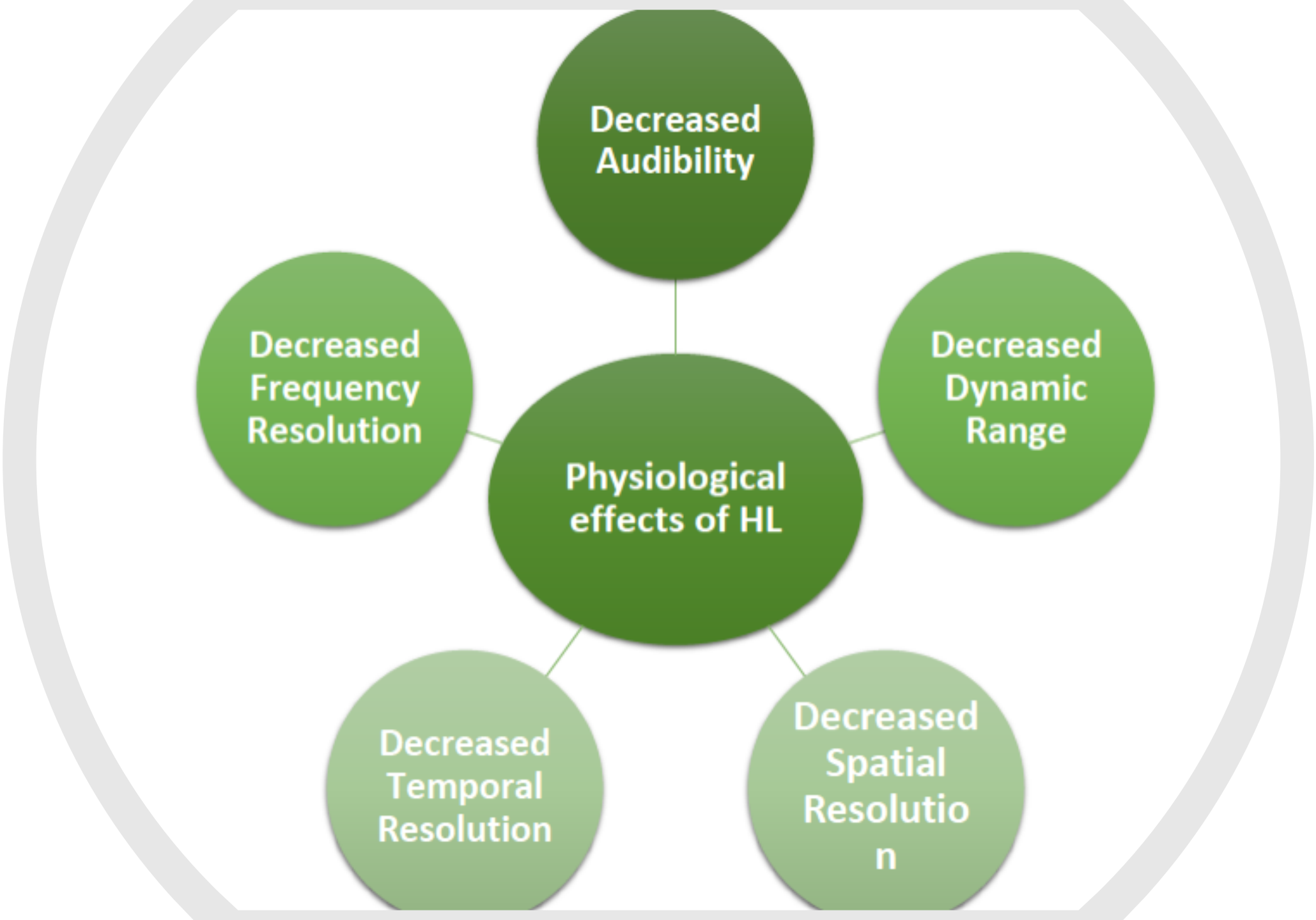
SPAU 332
Hearing Aids I

Dina Budeiri MSc

Physiological & Psychological Aspects of HL


Decreased Audibility
Decreased Frequency Resolution
Physiological effects of HL
Decreased Dynamic Range
Decreased Temporal Resolution
Decreased Spatial Resolutio n

Decreased Audibility

Increased hearing thresholds that causes some sounds to be simply inaudible.

The greater the degree of HL, the worse speech is perceived.

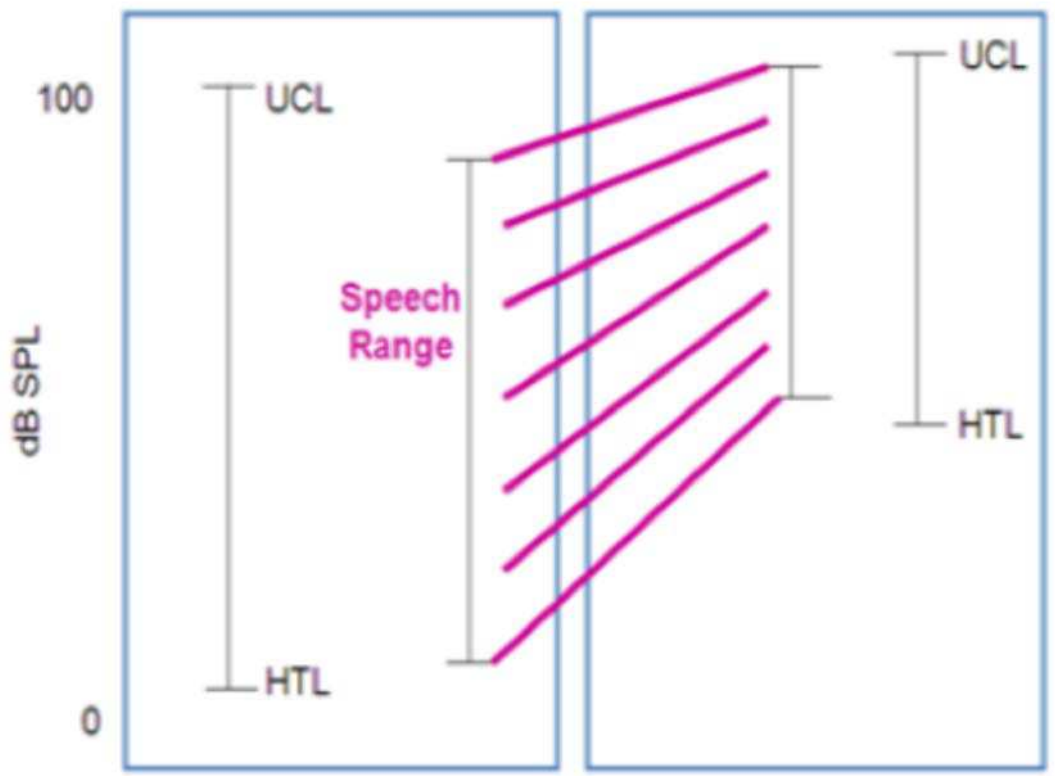
Decreased Audibility

- Other sounds can be detected because part of their spectra is audible but cannot be identified because other parts of their spectra is not audible (typically the high-frequency parts).

Decreased Dynamic Range (DR)

- Dynamic range (**DR**) of an ear is defined as the range of levels b/w the weakest sound the can be heard (**AC** thresholds) and the most intense sound that can be tolerated (usually referred to as **UCL/LDL**).

- A wide **DR** is important to perceive soft sounds soft and intense sounds intense.



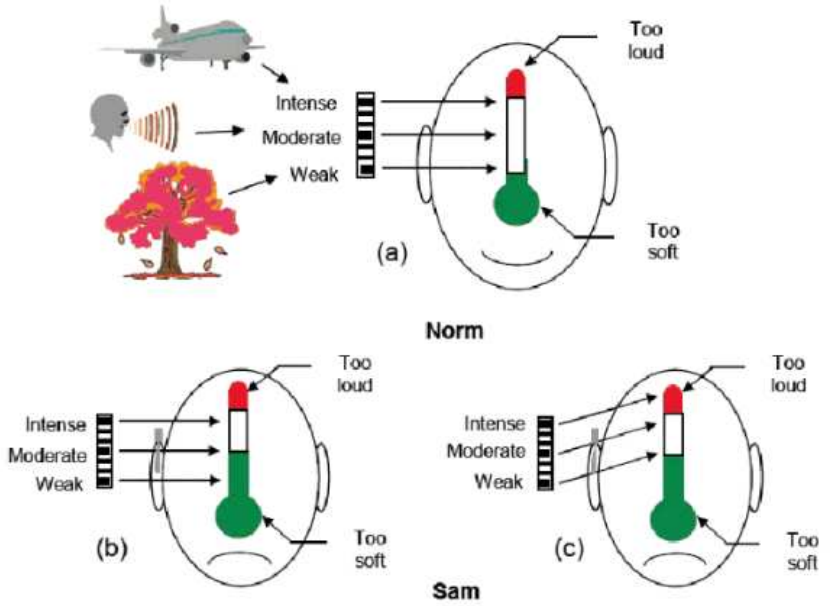


Figure 1.2 The relationship between the dynamic range of sounds in the environment and the dynamic range of hearing for: (a) normal hearing, (b) sensorineural hearing

Decreased Dynamic Range (DR)

Decreased Dynamic Range (DR) Cont.

SNHL increases the HTLs much more than it increases the UCLs

People with reduced DR hear sounds louder than normal hearing people because of **recruitment** .

Recruitment is defined as an abnormal loudness perception which means that each increase of sound level produces a bigger loudness increase when compared to normal-hearing people.

Decreased Frequency Resolution/Selectivity

Defined as the reduced ability to detect and analyse energy at one frequency in the presence of energy at other frequencies.

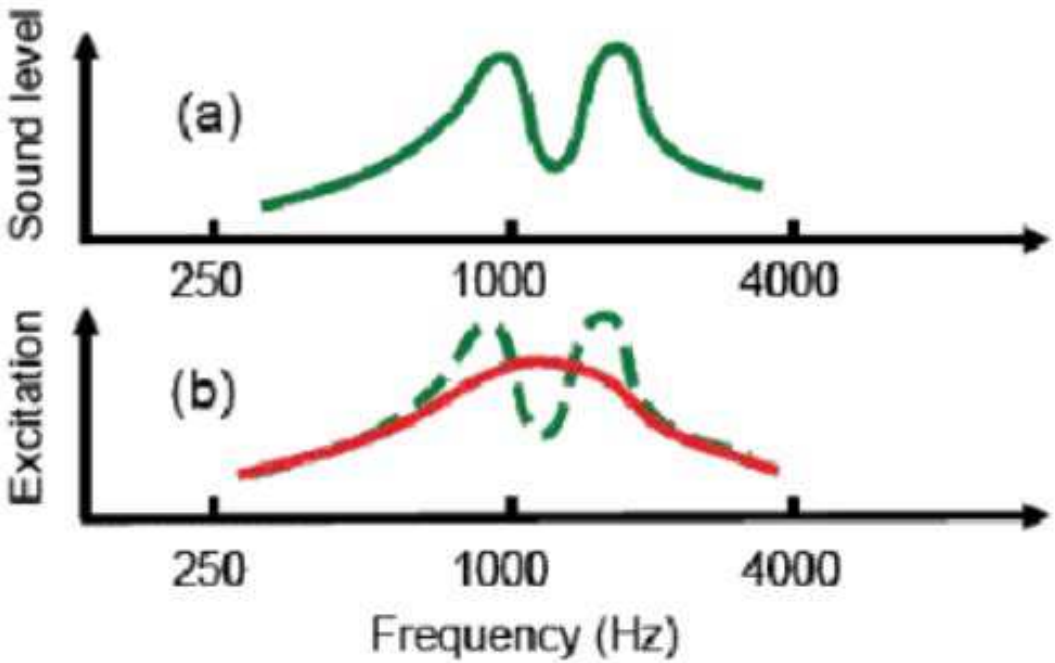
This results in difficulty separating sounds of different frequencies which affects speech understanding.

Happens due to loss of OHCs function: increasing the sensitivity of the cochlea for frequencies to which the corresponding part of the cochlea is tuned.

Frequency resolution helps the brain to separate speech sounds from background noise containing energy at similar frequencies.

Decreased Frequency Resolution/Selectivity Cont.

- The figure shows how two bundles of energy can be heard easily by a normal cochlea and how the two bundles are heard as one in case of reduced frequency resolution



Decreased Frequency Resolution/Selectivity Cont.

Even without the presence of background noise, decreased frequency resolution can adversely affect speech understanding.

Upward spread of masking: when intense low-frequency parts of speech (e.g. first formants of some speech sounds) mask the weaker higher frequency components (e.g. the second and higher formants).

The degree of reduced frequency selectivity, and its impact on speech understanding, increases with the degree of HL.

Decreased Temporal Resolution

- Defined as the decreased ability to hear a signal that rapidly follows, or is rapidly followed by, a different signal.
- A decreased temporal resolution is related to the inability of the cochlea to increase its sensitivity when the masking sounds stops as in normal hearing people. This is related to the reduced precision in **timing of neural firing**.
- Hearing-impaired individuals suffer from increased ***temporal masking*****.** It happens when intense sounds mask weaker sounds that immediately precede them or follow them, thus affecting speech perception.

Decreased Temporal Resolution Cont.

Noise energy fluctuates and normal hearing people tend to make use of the very short noise reduction period to understand what is being said, known as ***listening in the gaps.***

HI people cannot make use of that because of decreased temporal resolution especially where **SNR** is low.

Reduced Spatial Resolution

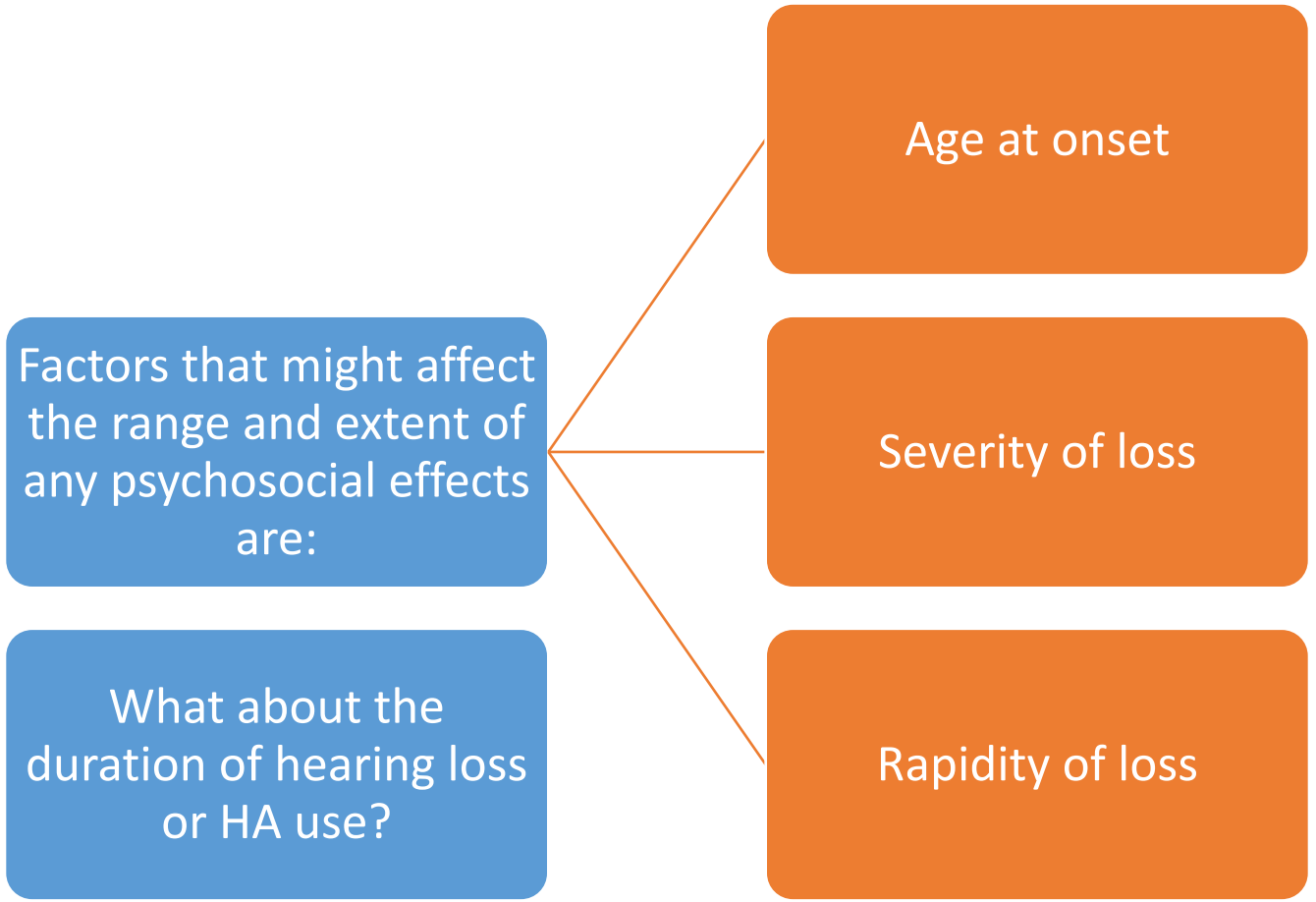
- Refers to the reduced ability to separate sounds on the basis of the direction from which they arrive

"Blindness separates people from things; deafness separates people from people."

— **Helen Keller**

Psychological effects of acquired HL

Factors affecting the severity of the psychological effects of HL



Age at onset

- In addition to HL, aging is associated with other multi-factorial problems; the overall effect of more than one problem that are related to ageing.
- These problems may include: motor problems, visual problems and cognitive decline, etc.
- Having more than one health issue may mean that a HL has a greater psychological effect.

Severity of HL

- Intuitively might expect a strong relationship but,
- There is no linear relationship between degree of loss and psychiatric disturbance.
- However, in patients with severe loss + poor speech discrimination, the increase in psychiatric disturbance usually is dramatic (e.g. anxiety and depression).

Rapidity of loss

- Sudden onset loss may result in very different psychosocial effects to a gradual onset loss.
- Usually, sudden onset HL is associated with serious psychological effects compared to gradual HL.

Psychological effects Cont.

01

Psychiatric disturbance was not found to be related to duration of deafness or HA usage (Thomas and Gilhome Herbst, 1980).

02

The effects of a congenital HL are likely to be very different than of an acquired HL.

03

The psychosocial effects of a unilateral loss are far less than a bilateral loss (Mahapatra, 1974).

Ramsdell's 3 levels of hearing

- The psychology of the hard-of-hearing and the deafened adult, D. A. Ramsdell, 1946.

- Ramsdell's model classifies the consequences of HL into three levels:
  - Symbolic or Speech level
  - Loss of signals/warnings
  - Loss of auditory background

Symbolic or Speech level

- This level is related to the consequences arising from the reduced ability to understand speech as a result of HL.

- It may involve:
  - Fatigue, due to increased listening effort and lip-reading
  - Embarrassment, due to inappropriate responses
  - Depression and anxiety
  - Reduced quality of life

Reduced awareness to signals or warnings

- Refers to the effects related to reduced awareness to one’s surroundings.
- It may involve:
  - Loss of security
  - Stress and anxiety
  - Detachment from the real world

Loss of auditory background

- This level refers to the loss of everyday general auditory background input (sounds you aren’t aware of but make you feel connected to the world), such as a clock ticking, wind sound etc.

- It may involve:
  - Detachment from the real world
  - Feeling of loss