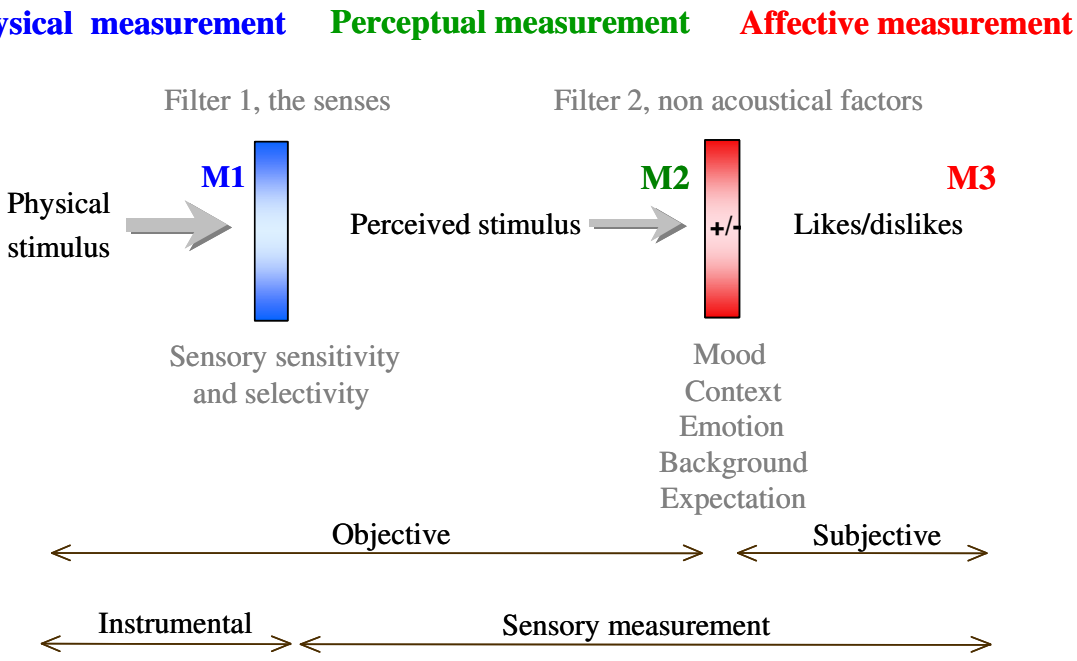
The Filter Model

Can subjective measurements be objective?

Confusing terminology
Listening tests are sometimes called subjective tests because persons, subjects, generate the results in contrast to results obtained with measuring instruments. Tests where persons use their senses to give assessments are more correctly called sensory evaluations. There are two types of sensory tests, the objective and the subjective.

The filter model
The filter model below illustrates the relations between physical (instrumental) measurements and the sensory (objective and subjective) measurements.



The physical stimulus, the sound, is perceived by hearing, but the hearing sense acts like a filter (filter 1) e.g. by colourising the sound by not perceiving physically equally intense sounds with the same loudness. After the first filter we have the perceived sound. The only way to measure the characteristics of this is to ask listeners

about their perception. The perceived sound passes through a second non-acoustical filter. This filter represents individual factors such as mood, context, the personal background and expectations. After this filter, we can ask about individual opinions; how preferable or suitable a sound is, if the quality is satisfactory or how annoying a sound is.

Measuring points M1-M3 are shown in the model. Measurements at each of these points may be made independently.

M1 represents the physical/instrumental measurements, i.e. sound pressure levels, spectra, psycho-acoustic metrics, speech intelligibility metrics etc. Some of these metrics are intended for prediction of the sensory evaluations

M2 represents the perceptual measurements, which are *objective* quantifications of sensory attributes of the perceived stimulus. It may also be threshold determinations. The main purpose is to give information about the character of the sound as perceived by the hearing sense. The characteristics of the perceived stimulus are rated in objective terms without asking the assessors for preferences or annoyance. The tests are usually made with a panel of trained persons who understand the attributes and how to rate them. From these measurements the perceived characteristics are found and a perceptual sound profile can be made. These tests are reproducible and usually with small confidence intervals.

M3 the affective measurements are *subjective* measurements of preference, annoyance or of connotative attributes. They are normally performed with a group of naive (untrained and without experience in listening tests) test persons who are representative of the relevant target group (consumers, users, average citizens etc.). The main purpose is to give information about reactions to the sound in a given context. The context will usually have a major influence on the final result together with cultural and individual factors. The test results depend on who is asked and subgroups or clusters with different preferences may appear.

To interpret the results of the physical measurements in M1, the perceptive measurements in M2 are often a valuable tool. It may also be easier to make predictions of the reactions in M3 from the perceptive measurements (M2) than from the physical measurements (M1).

Relations between physical and perceptual measurements are called *perceptual models* and relations between perceptual and affective measurements are called *preference mapping*.

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