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Sensory analysis — Guidelines for the use of quantitative response scales

Analyse sensorielle — Lignes directrices pour l'utilisation d'échelles de réponses quantitatives

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4121 was prepared by Technical Committee ISO/TC 34, *Food products*, Subcommittee SC 12, *Sensory analysis*.

This second edition cancels and replaces the first edition (ISO 4121:1987), which has been technically revised.

Sensory analysis — Guidelines for the use of quantitative response scales

1 Scope

This International Standard provides guidelines describing quantitative response scales (where the response obtained indicates the intensity of perception) and their use when assessing samples.

It is applicable to all quantitative assessment, whether global or specific and whether objective or hedonic.

It is intentionally limited to the most commonly used measurement scales for sensory assessment.

It is necessary to distinguish between two common uses of the term “scale”: response scale (see 3.1), and measurement scale (see 3.5).

NOTE Annex A gives examples of an application.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5492, *Sensory analysis — Vocabulary*

ISO 6658, *Sensory analysis — Methodology — General guidance*

ISO 8586-1, *Sensory analysis — General guidance for the selection, training and monitoring of assessors — Part 1: Selected assessors*

ISO 8586-2, *Sensory analysis — General guidance for the selection, training and monitoring of assessors — Part 2: Experts*

ISO 8587, *Sensory analysis — Methodology — Ranking*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5492 and the following apply.

3.1
response scale
means (e.g. numerical, verbal or pictorial) by which an assessor registers a quantitative response

NOTE 1 In sensory analysis, this is a device or tool to capture the reaction of an assessor to some property such that it can be converted into numbers.

NOTE 2 The term “scale” is widely used as being equivalent to the expression “response scale”.

3.2
measure, verb
record the quantity of a property

3.3
measurement
action of measuring

3.4
measurement
number resulting from the action of measuring

3.5
measurement scale
formal relationship (e.g. ordinal, interval or ratio) between a property (e.g. the intensity of a sensory perception) and the numbers used to represent values of the property (e.g. numbers registered by the assessors or derived from the assessors' responses)

NOTE The term “scale” is widely used as being equivalent to the expression “measurement scale”.

3.5.1
ordinal scale
scale in which the order of the values allocated corresponds to the order of the intensities perceived for the property being assessed

NOTE The size of the difference between two values cannot be assumed to reflect the difference between the perceived intensities. Neither can the ratio of two values be assumed to reflect the ratio of the perceived intensities.

EXAMPLES Richter scale of earthquake intensity and Beaufort scale of wind strength.

3.5.2
interval scale
scale which, in addition to possessing the attributes of an ordinal scale, is distinguished by the fact that equal differences between numerical values correspond to equal differences between properties measured (in sensory analysis, perceived intensities)

NOTE Larger values correspond to larger perceived intensities and the size of the difference between two values reflects the size of the difference in perceived intensity of the property being measured. However, a numerical value of zero may not indicate a total absence of the property and the ratio of two values cannot be assumed to reflect the ratio of the perceived intensities.

EXAMPLES Celsius and Fahrenheit temperature scales.

3.5.3
ratio scale
scale which has the properties of an interval scale but for which, in addition, the ratio between the values allocated to two stimuli is equal to the ratio between the perceived intensities of these stimuli

NOTE 1 With this scale, a numerical value of zero designates total absence of the property.

NOTE 2 The ratio scale is the only case for which it is meaningful to say that one result is, for instance, ten times as great as another.

EXAMPLES Kelvin temperature scale, mass and length scales.

3.6
referencing
use of one or more specified standards to designate particular values (numeric or semantic) on the response scale

NOTE 1 A specified concentration of sucrose in water may correspond to a specified numerical value on a scale of sweetness.

NOTE 2 A reference is not always physical (e.g. a hedonic ideal).

3.7
end effect
tendency of assessors to under-use or over-use the extremities of the response scale

NOTE The most usual end effect is for assessors to avoid using the highest and lowest scale values, one reason being to leave responses available for future, extreme samples that do not, in fact, occur.

4 General considerations

All methodologies that use response scales should take the following into account:

— the usual general conditions under which sensory analyses should be carried out; refer in particular to the International Standards concerning general guidance for sensory analysis (ISO 6658), layout of test rooms intended for sensory analysis (ISO 8589), selection and training of assessors and experts (ISO 8586-1 and ISO 8586-2);

— specific standards that use the relevant scale, for example, sensory profiles (ISO 6564, ISO 13299) or classification (ISO 8587).

5 Response scales

5.1 General

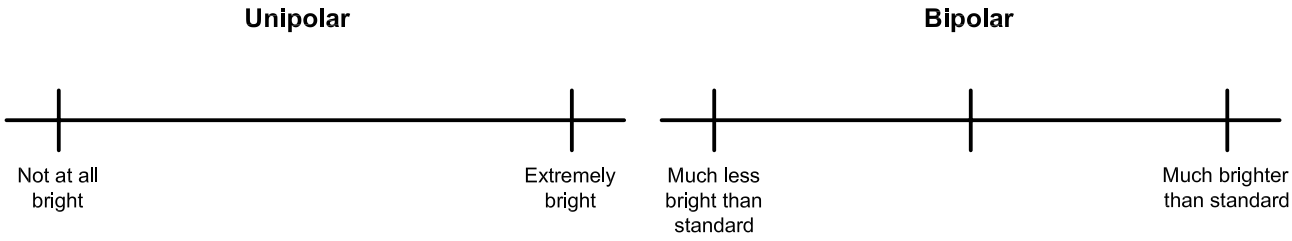
A distinction can be made between numerical, verbal, dynamic and pictorial scales. However, all types of response scale are usually translated into numbers for the purposes of analysis and interpretation (see Figure 1).

5.2 Numerical and verbal response scales

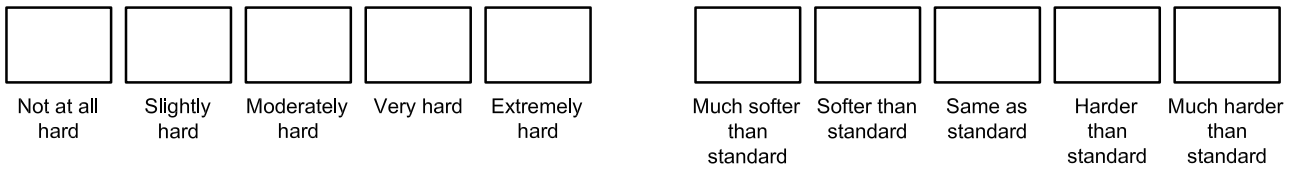
Numerical and verbal response scales are the types most commonly used in sensory analysis. Some examples are shown in Figure 1. For more details, see [4] and [5].

Each assessor gives a response either by selecting it on a questionnaire (e.g. by circling the appropriate response or by marking the appropriate box) or by producing it (e.g. by writing down a number to represent the perceived intensity or by marking a position on a line).

Line scales permit unlimited fineness of differentiation among responses and are examples of *continuous* scales, whereas category scales allow only certain predefined responses and are examples of *discrete* scales (see 6.3).



a) Line scale



b) Verbal category scale

c) Numerical category scale

Figure 1 — Examples of response scales

5.3 Dynamic response scales

Dynamic response scales are continuous scales used, for example, to record the intensity of a perception as it changes over time. The assessor may move a cursor along an intensity scale using a computer mouse or joystick, or may adjust a potentiometer, or the spacing of his or her fingers.

5.4 Pictorial response scales

Pictorial response scales are discrete scales. They are often presented in the form of a series of stylized faces that illustrate different expressions from extreme liking to extreme dislike. They are often used for hedonic tests conducted with children whose reading and/or understanding capacities are limited.

The assessor indicates the face to the person conducting the experiment or selects it himself/herself. The various expressions are then converted into numbers in order to be processed (see [6]).

6 Choice of response scale

6.1 General

The choice of response scale depends on the objectives of the study, the products being studied and the panel.

Whatever response scale is adopted, it is necessary that it be

— easily understood by the assessors,

— easy to use,

— discriminating, and

— unbiased.

6.2 Choice of unipolar or bipolar response scale

The polarity of a scale is defined by the location of the neutral or zero point:

— in a unipolar scale, the neutral or zero point is located at one end of the scale;

— in a bipolar scale, the neutral or zero point is located at the centre of the scale.

A bipolar scale is used when the intensity of a property can differ in either direction from a neutral or ideal value. For example, a bipolar scale may run from "Not sweet enough" to "Too sweet", whereas a unipolar scale may run from "Not at all sweet" to "Extremely sweet".

When constructing bipolar scales, an inappropriate choice of scale anchors can produce a scale that does not form a true continuum and has no logical centre point. Avoid the use of anchors that are not based on a single attribute (e.g. "dark brown" to "bright red") unless they lie on a recognized sequence of stages or grades of the product.

6.3 Choice of continuous or discrete response scale

6.3.1 Continuous scale

Assessors may be asked to make numerical responses on a continuous scale, meaning that numbers with fractional parts can be used. Line scales are typically 15 cm (6 in) long, labelled at each end with the extreme values of the attribute being assessed. The assessor responds by marking the line in the position corresponding to the perceived intensity. The marked position is converted to a number by the analyst.

A continuous scale gives assessors an opportunity to express small differences in judgement. On the other hand, the task may seem more difficult than using a category scale and transcription of the data takes longer unless an automatic data acquisition system is available.

6.3.2 Discrete scale

In the case of discrete scales, it has been observed that:

— the smaller the number of categories, the greater the end effect, which therefore diminishes the discriminatory capacity of the scale (see [7]);

— assessors with little training consider a discrete (9-point) scale easier to use than a continuous (15 cm) scale (see [8]);