

Sensory analysis — Methodology — Magnitude estimation method

ICS 67.240

National foreword

This British Standard is the UK implementation of ISO 11056:1999+A2:2015. It supersedes BS ISO 11056:1999+A1:2013, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AW/12, Sensory analysis.

A list of organizations represented on this committee can be obtained on request to its secretary.

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grandeur*



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Foreword

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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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11056 was prepared by Technical Committee ISO/TC 34, *Agricultural food products*, Subcommittee SC 12, *Sensory analysis*.

Annexes A and B of this International Standard are for information only.

Introduction

Magnitude estimation is a psychophysical scaling technique where assessors assign numerical values to the estimated magnitude of an attribute. The only constraint placed upon the assessor is that the values assigned should conform to a ratio principle; i.e. if the attribute appears to be twice as strong in sample B in comparison with sample A, the value assigned to sample B has to be twice that assigned to sample A. Attributes such as intensity, pleasantness or acceptability may be assessed using magnitude estimation.

Magnitude estimation can offer advantages over other scaling methods, in particular when the number of assessors and the time available for training are limited. Magnitude estimation offers a high degree of flexibility for both the panel leader and the assessor. Once trained in magnitude estimation, assessors are generally able to apply their skills to a wide range of samples and attributes, with minimal additional training.

Magnitude estimation method is also less susceptible to "end-effects" than those methods which employ continuous or discontinuous response scales. These "end-effects" occur when the assessors are unfamiliar with the extent of the sensations being presented. Then assessors might assign one of the initial samples to a category which is too close to one of the ends of the scale. Consequently, they then find themselves short of graduations and are obliged to classify samples perceived as being different into the same category. This should not occur with magnitude estimation since, in theory, there are an infinite number of categories.

Allowing each assessor to start the process at any numerical value, i.e. to use their own scale, gives rise to a particularly important "assessor" effect. However, there are various ways of solving this problem:

- the analysis of variance (ANOVA) allows the "assessor" effect and the interactions to be taken into account;
- the assessors can be forced to a common scale by use of a reference sample to which a value has been assigned;
- the data supplied by each assessor can be reduced to a common scale by applying one of numerous rescaling methods.

It is up to the experimenter to choose the most appropriate approach based on the circumstances.

The magnitude estimation method is not the most efficient technique for determining small differences between stimuli or for conducting assessments in the vicinity of a detection threshold.

Sensory analysis — Methodology — Magnitude estimation method

1 Scope

This International Standard describes a method for applying magnitude estimation to the evaluation of sensory attributes. The methodology specified covers the training of assessors, and obtaining magnitude estimations as well as their statistical interpretation.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3534-1, *Statistics — Vocabulary and symbols — Part 1: Probability and general statistical terms*.

ISO 3534-3, *Statistics — Vocabulary and symbols — Part 3: Design of experiments*.

ISO 4121, *Sensory analysis — Methodology — Evaluation of food products by methods using scales*.

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 8589, *Sensory analysis — General guidance for the design of test rooms*.

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 3534-1, ISO 3534-3, ISO 5492 and the following apply.

3.1

magnitude estimation

process of assigning values to the intensity of an attribute of the products or to their hedonic value in such a way that the ratio between the assigned values and the assessors' perception of the attributes are the same

3.2

external reference

sample which is presented to the assessor to which a numerical value is pre-assigned by the panel leader

NOTE It is the first sample of the series in relation to which all subsequent samples are then assessed.

3.3 modulus

numerical value assigned to the external reference which can be defined by the person conducting the test (fixed modulus) or left to the assessor to choose (non-fixed modulus)

3.4 rescaling

process which consists of multiplying the raw data supplied by each assessor by a factor which reduces the data of all the assessors to a common scale

NOTE Adding the logarithm of this factor to the logarithm of the raw data is an equivalent process.

3.5 internal reference

reference sample introduced into the test series and presented to the assessor as if it were a test sample

NOTE The value assigned to an internal reference may be used for rescaling an assessor's data. If an external reference is used, the internal reference(s) is(are) in principle identical to it.

3.6 Stevens's equation psychophysical power function

relationship expressed as follows:

$$R = KS^n$$

where

R is the assessor's response (perceived intensity);

K is a constant which reconciles the units of measurement used for R and S ;

S is the stimulus (concentration of a chemical substance or physical variable);

n is the exponent of the power function and the slope of the regression curve for R and S when they are expressed in logarithmic units

NOTE In practice, Stevens's equation is generally transformed into decimal or natural logarithms:

$$\ln R = \ln K + n \ln S$$

4 Principle

Samples are presented successively to assessors, who are requested to record the intensity of an attribute of each sample by complying with the ratio principle.

The values are assigned by referring to the value of the first sample (reference) of the series. For this first sample, either each assessor is free to assign a value to it, or the value is fixed by the person conducting the test. The latter case is called "fixed modulus".

5 General test conditions

For the general test conditions, such as those concerning the facilities, preparation, presentation and coding of samples, refer to International Standards on general methodology, in particular ISO 6658 and ISO 8589, or to those describing the methods which use scales and categories, such as ISO 4121.

6 Selection and training of assessors

6.1 General conditions for selection and training

These shall be in accordance with ISO 8586-1 and with ISO 8586-2.

As in all other sensory analysis methods, it is the responsibility of the panel leader to judge the required level of proficiency of the assessors. The objectives of the test, the availability of the assessors, the costs incurred by recruiting additional assessors, as well as their training, are to be taken into account when planning a training programme. Assessors are generally able to use the magnitude estimation methodology after three or four training tests.

6.2 Training specific to the magnitude estimation method

6.2.1 The assessment of surface areas of geometric shapes has been proved to be particularly suited for introducing assessors into the basic concepts of magnitude estimation. The following set of 18 shapes (see Table 1) comprising six circles, six equilateral triangles and six squares ranging in size from approximately 2 cm² to 200 cm² has been used successfully for training assessors.

Table 1 — Dimensions and areas of the training exercise shapes

Circles		Triangles		Squares	
Radius cm	Surface area cm ²	Side cm	Surface area cm ²	Side cm	Surface area cm ²
1,4	6,2	2,2	2,1	3,2	10,2
2,5	19,6	4,1	7,3	4,2	17,6
3,7	43,0	7,6	25,0	8,5	72,3
5,4	91,6	12,2	64,4	11,1 ^a	123,2
6,8	145,3	15,5	104,0	11,1 ^a	123,2
8,3	216,4	19,2	159,6	14,2	201,6
^a Two 11,1 cm squares are introduced into the series in order to be able to evaluate the reproducibility of the assessors.					

6.2.2 Prior to presenting the shapes to the assessors, instruct them in the principles of the method. This instruction shall include, but is not necessarily limited to, the following three points:

- the values shall be assigned on a ratio basis; if the attribute is twice as intense, a value twice as high shall be assigned to it;
- there is no upper limit to the scale;
- the value 0 shall be assigned only in the exceptional case where the attribute is not perceived.

Warn the assessors, at the time of training, that the general tendency is often to use round numbers (such as 5, 10, 20, 25, etc.) but that with this method all numbers are permitted and may be used. As assessors are also influenced by the ratios mentioned during training, always take care to suggest to them the use of different ratios, e.g. 3/1; 1/3; 7/5; 5/6 without limiting oneself to 2/1 or 1/2.

6.2.3 Assign codes to the shapes and present the shapes separately by placing them in the centre of a sheet of white paper of approximately A4 size (21 cm × 29,7 cm).

Instruct each assessor to conduct the magnitude estimation beginning the series with the presentation of the 8,5 cm square (external reference). Record the responses.