

Can we agree on what measurement is?

Toward a conceptual architecture of measurement

The Society for the Study of Measurement - Second Biennial Conference
25 June 2026, University of Edinburgh

Presidential Address

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Short bio

MS in physics, University of Milano, Italy, 1987; Ph.D. in measurement science, Polytechnic of Torino, Italy, 1994.

Full Professor of measurement science with Department of Philosophy of Università Cattolica, Milano, Italy. Until 2026 Full Professor of measurement science with the School of Industrial Engineering of Università Cattaneo - LIUC, Castellanza, Italy. Teacher in courses on measurement science and statistical data analysis, systems theory, and digital thinking.

He carries out research on Measurement Science and its relations with Information Science and Technology, for which he is the author of various scientific publications, and carries out dissemination activities, in schools, companies and various organizations, on digital culture and in particular artificial intelligence.

Abstract

The history of measurement is also the history of disagreement about what should count as measurement. Competing conceptions have emerged from different philosophical traditions, each relying on its own foundational commitments concerning the nature of properties, the role of empirical operations, the function of mathematical representation, the significance of quantification, and, more generally, the purpose of measurement itself. The contrast between realism and anti-realism is only one dimension of this broader conceptual landscape.

This lecture argues that the question What is measurement? may therefore be less fruitful than it first appears. Unlike empirical questions, it cannot be answered by discovering the uniquely correct concept of measurement. Rather, every conception of measurement is grounded in prior assumptions that determine the criteria according to which something qualifies as measurement, where different assumptions unsurprisingly generate different concepts.

The problem is thus first of all meta-theoretical, and the lecture suggests some hypotheses for a framework for identifying, articulating, and systematically comparing the foundational criteria that underlie the major conceptions advanced in the history and philosophy of measurement. The aim is not to eliminate conceptual diversity, but to make explicit the assumptions from which different positions arise, thereby clarifying where they genuinely disagree, where they simply adopt different starting points, and how apparently conflicting accounts may be understood as coherent consequences of distinct philosophical commitments.

While we may never reach universal agreement on what measurement is, we could nevertheless be able to agree on the assumptions that distinguish alternative concepts of measurement, and this may provide a more productive foundation for future philosophical discussion.

The Society for the Study of Measurement ...
aims to foster research and communication on measurement
from multiple perspectives and across disciplines.

The Society is motivated by the belief that ... disciplinary knowledge
can be enriched by adopting a broader, multidimensional perspective
on the ... contexts that shape measurement practices.

The Society therefore promotes research and scholarly reflection
on the development, foundations, and problems of measurement ...

It additionally promotes the study of measurement
as a cultural, social, and historical phenomenon, of its role in policymaking,
and of its ethical, political, and environmental dimensions.

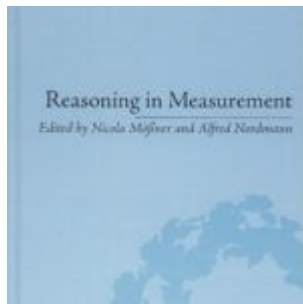
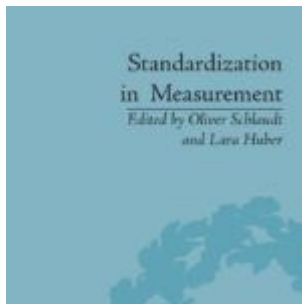
from the [Mission Statement of the SSM](#)

**Are there strategic decisions we can make
to support this Mission?**

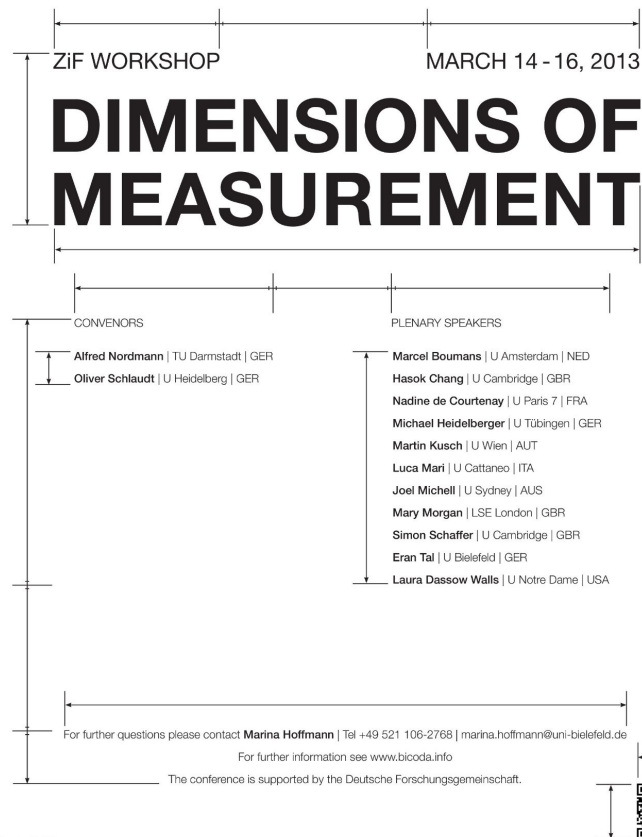
but first of all...

... let's celebrate our Society

Bielefeld 2013



[Standardization in Measurement](#) - Philosophical, Historical and Sociological Issues, Routledge 2015, edited by Oliver Schlaudt and Lara Huber
[Reasoning in Measurement](#), Routledge 2017, edited by Nicola Mößner and Alfred Nordmann



Cambridge 2015

Studies in History
and Philosophy
of Science

EDITED BY DANIEL JON MITCHELL, ERAN TAL, AND HASOK CHANG
Special Issue
Studies in History and Philosophy of Science

[The Making of Measurement](#)

special issue of **Studies in History and Philosophy of Science**, 2017,
edited by Daniel Jon Mitchell, Eran Tal, and Hasok Chang

CRASSH

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Home > What's On

The Making of Measurement

23 Jul 2015 - 24 Jul 2015	All day	CRASSH, Alison Richard Building, 7 West Road, CB3 9DT - SG1&2
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Description

Abstracts

Programme

Keynote speakers:

- Nancy Cartwright, Durham University
- Graeme Gooday, University of Leeds
- Terry Quinn, International Bureau of Weights and Measures

Convenors

[Daniel Jon Mitchell](#) (History and Philosophy of Science)
[Hasok Chang](#) (History and Philosophy of Science)
[Eran Tal](#) (History and Philosophy of Science)



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Related Links

[Recordings of the
Keynotes](#)

Paris 2018



Measurement at the Crossroads

special issue of **Perspectives on Science**, 2021,
edited by Nadine de Courtenay, Fabien Grégis, Jan Lacki, and Christine Proust

The poster features a large, detailed image of a scientific instrument, likely a gravimeter, with a large dome-shaped component and various mechanical parts. The background is dark blue with a pattern of small, light blue figures running.

UNIVERSITÉ PARIS DIDEROT | USPC | UNIVERSITÉ SORBONNE PARIS CDL | SΦHERE | COLLOQUE INTERNATIONAL

MEASUREMENT AT THE CROSSROADS

HISTORY, PHILOSOPHY AND SOCIOLOGY OF MEASUREMENT

27 > 29 JUNE 2018
ENSA Paris-Val de Seine | Amphithéâtre 310
3 quai Panhard et Levassor | Paris 13*

ROUND TABLE
TOWARDS A NEW INTERNATIONAL SYSTEM OF UNITS
27 JUNE | 17h > 18h30

KEYNOTE SPEAKERS
Karine Chemla | CNRS, SΦHERE, France
Wendy Parker | Durham University, United Kingdom
Oliver Schaudt | Heidelberg University, Germany
Eran Tal | McGill University, Canada

ORGANIZERS
Nadine de Courtenay | University Paris Diderot, SΦHERE, France
Fabien Grégis | Tel Aviv University, Israel & SΦHERE, France
Christine Proust | CNRS & University Paris Diderot, SΦHERE, France

website | <https://measurement2018.sciencesconf.org/>
contact | measurement2018@sciencesconf.org

Logos at the bottom: CIT'S, MPO, FIRST TF, LNE, Humanités & Sociétés, UNIVERSITÉ DE GENÈVE, univ-paris-diderot.fr

Milano 2022



[Measurement at the Crossroads: Measuring and Modeling](#)
special issue of **Measurement**, 2024,
edited by Luca Mari, Alessandro Giordani, and Fabien Grégis

DIPARTIMENTO DI FILOSOFIA

MEASUREMENT AT THE CROSSROADS 2020-2022

Measuring and modeling

Invited Speakers:

Anna ALEXandrova, King's College, Cambridge,
Cambridge
Alisa BOKULICH, Boston University, Boston
Denny BORSBOOM, Universiteit van Amsterdam,
Amsterdam

Organizing Committee:

Nadine DE COURTENAY, University Paris Diderot, France
Alessandro GIORDANI, Università Cattolica del Sacro
Cuore, Italy
Luca MARI, Cattaneo University, Italy
Fabien GRÉGIS, Cattaneo University, Italy & Laboratoire
SPHERE, France
Oliver SCHLAUDT, University of Heidelberg, Germany
Eran TAL, McGill University, Canada



Conference

Wednesday, 29th June – Friday 1st July 2022
Microsoft Teams Platform

Sponsor

Informazioni

<https://convegniunicatt.it/mac-home-program>

Per partecipare: CLICCARE QUI



UNIVERSITÀ
CATTOLICA
del Sacro Cuore

Berkeley 2024

The Society for the Study of Measurement 2024 Inaugural Conference



5-7 August, 2024

With pre-conference workshops on August 4th

Invited Speakers



Patient-Centered Measurement

Professor Leah McClimans from the University of South Carolina

Leah will discuss the dual nature of contemporary medicine, contrasting evidence-based medicine with patient-centered care. She will explore how patient-centered measurement, including patient-reported outcome measures (PROMs) and quality of life measures, can integrate patient perspectives into the evaluation of medical treatments and healthcare quality. Leah will address the challenge of how measurement, which relies on standardization, can represent patient perspectives that are often varied and changeable.

Scaling and its Relationship with Measurement: Past, Present and Future.

Professor Derek Briggs from the University of Colorado at Boulder

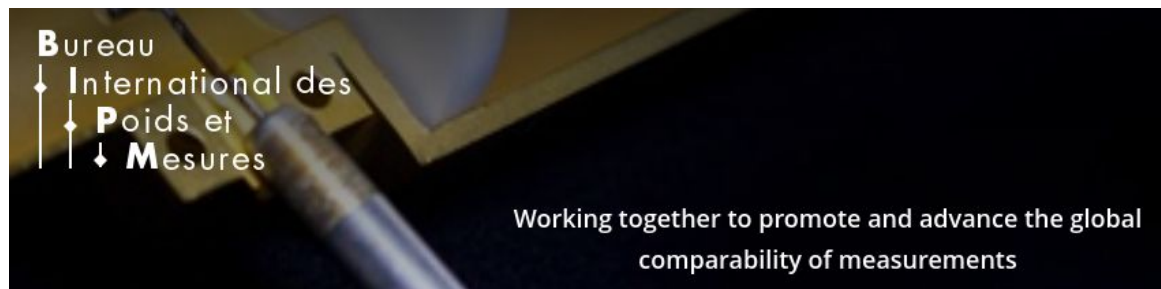
Derek will talk about the history of the psychometric activity of scaling and its relationship to measurement and offer some ideas for how the two can be more tightly coupled in the future.



Workshops (August 4th)

- 9:00-12:00 — Measurement Across the Sciences Workshop [In person] — *Luca Mari & Mark Wilson*
- 9:00-1:00 — Open Strategy Workshop: Developing AI-powered Futures for Learning & Work [In person] — *Luciano Oviedo & Tiburon Batriedo*
- 1:30-4:30 — Learning Machines and Measurement-Related Issues Workshop [In person] — *Alessandro Giordani, Luca Mari & Mark Wilson*
- 2:30-4:30 — ACER ConQuest Software [In person] — *Perman Gochyyev*

A growing interest...



CCU Task Group on Fundamental Concepts in Metrology (CCU-TG-FCM)

Terms of Reference

- Considering the outcomes of the CCU-WG-CMT, identify the key fundamental concepts in the understanding of metrology.
- Characterize such concepts and their interrelations, in formal (mathematical or logical) terms where possible, also enabling their machine readability and actionability.
- Provide the outcomes of the TG to the JCGM-WG2:VIM and other relevant stakeholders.
- Report progress to the CCU-WG-S and the CCU.

<https://www.bipm.org/en/committees/cc/ccu/wg/ccu-tg-fcm>

A table of contents (sort of)

PURPOSE: Why do we need this concept?



CONSTRAINTS: What must the concept satisfy?



CRITERIA: How shall we characterize it?



DEFINITIONS: How do we formulate it?



CONSEQUENCES: What follows?

A fundamental subject, a persistent disagreement

We have discussed measurement for centuries

Yet we still disagree on **what measurement is**

Euclid (c. 300 BC): determining how many times a unit is contained in a quantity

Helmholtz (1887): determining the ratio of a quantity to another quantity of the same kind chosen as unit

Campbell (1920): assigning numbers to represent properties according to laws

Stevens (1946): assigning numerals to objects or events according to rule

RTMs (~1960): assigning numerals to objects or events so as to represent relations among them

VIM (~2010): experimentally obtaining one or more quantity values that can reasonably be attributed to a quantity

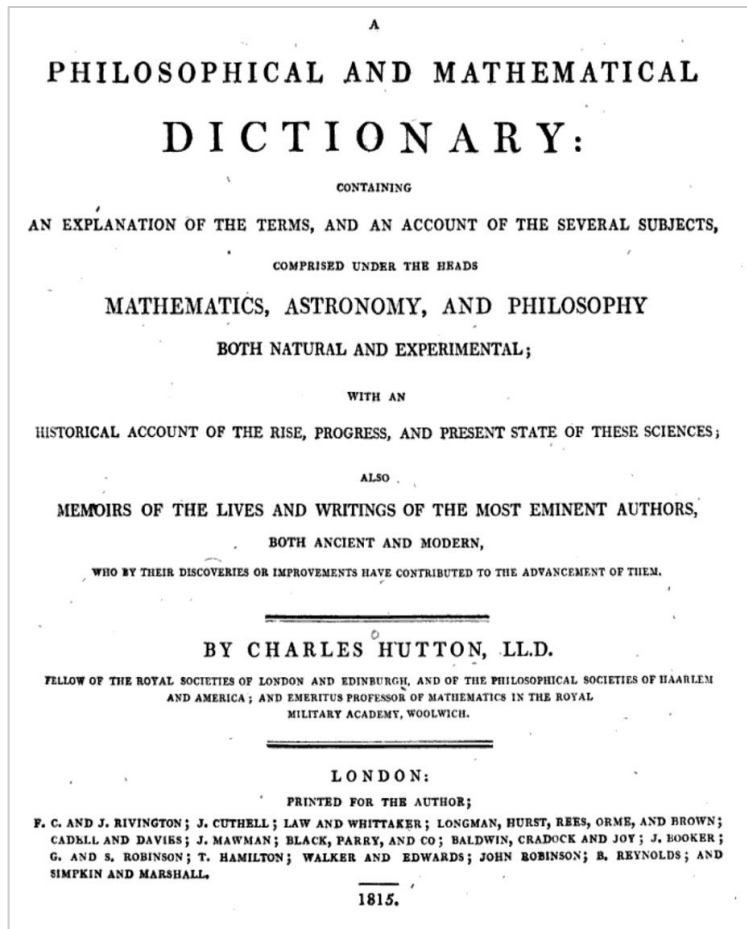
A moving target

(example: what is the source of the expression “weights and measures”?)



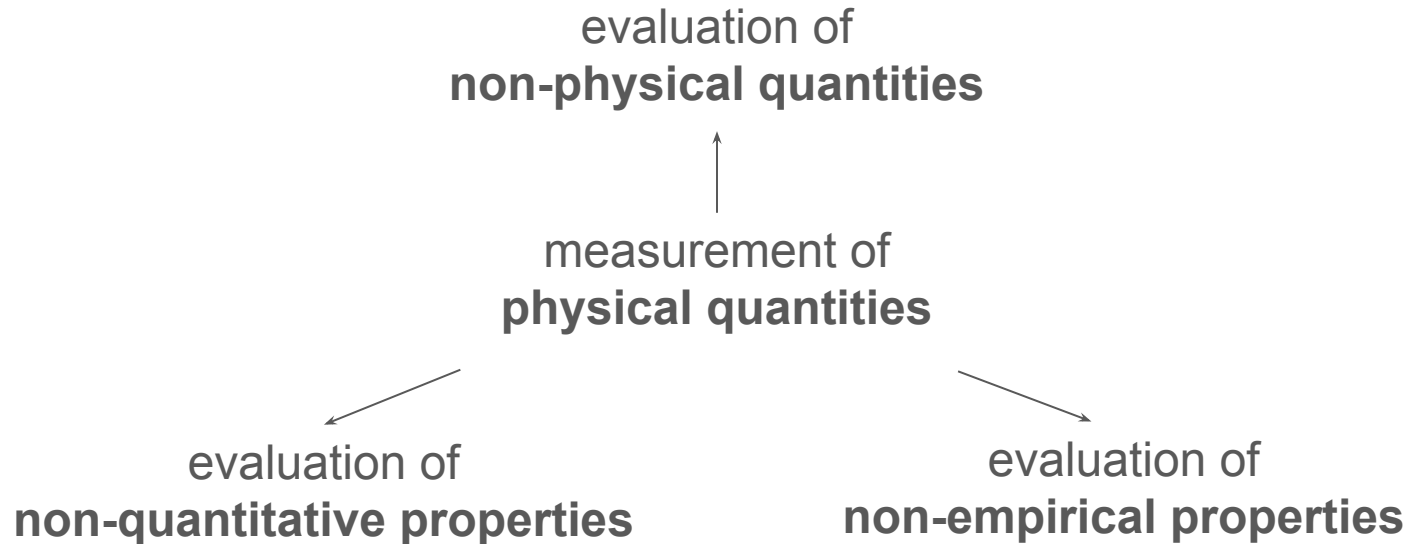
MEASURE, denotes any quantity, assumed as unity, or one, to which the ratio of other homogeneous or like quantities may be expressed.

MENSURATION, the act, or art, of measuring figured extension and bodies; or of finding the dimensions and contents of bodies, both superficial and solid.



Why now?

Due to its acknowledged epistemic authority, 'measurement' is variously stretched:

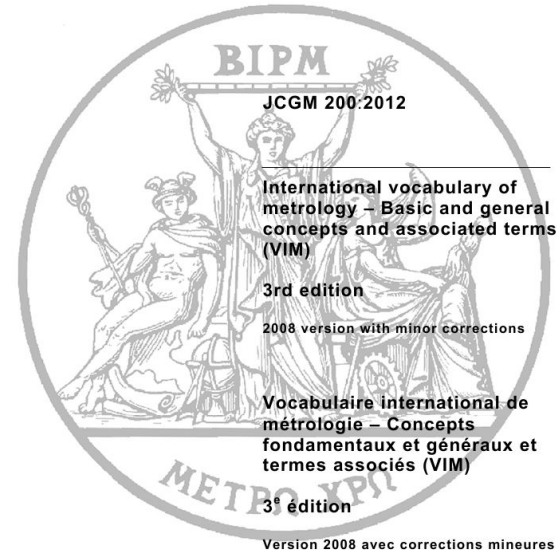


How broad can the scope of measurement be made?

An authoritative reference: the International Vocabulary of Metrology (VIM)



BIPM, IEC, ISO, OIML, 1st ed, 1984



Joint Committee for Guides in Metrology:
BIPM, IEC, IFCC, ILAC, ISO, IUPAC, IUPAP, OIML, 3rd ed, 2008

What is measurement?

set of operations having the object of determining the value of a quantity

(VIM1, 1984)

process of experimentally obtaining one or more quantity values
that can reasonably be attributed to a quantity

(VIM3, 2008)

Another example: what is a value of a quantity?

expression of a quantity

in terms of a number and an appropriate unit of measurement
(VIM1, 1984)

magnitude of a particular quantity

generally expressed as a unit of measurement multiplied by a number
(VIM2, 1993)

number and reference

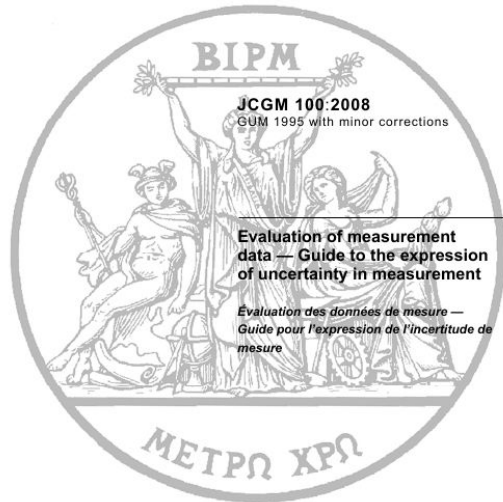
together expressing magnitude of a quantity
(VIM3, 2008)

individual quantity

identified either as the product of a number and a measurement unit or on an ordinal scale
(VIM4, 2026 ???)

An authoritative reference: the Guide to the Expression of Uncertainty in Measurement (GUM)

“In 1977, recognizing the lack of international consensus on the expression of uncertainty in measurement, the world’s highest authority in metrology, the Comité International des Poids et Mesures (CIPM), requested the Bureau International des Poids et Mesures (BIPM) to address the problem in conjunction with the national standards laboratories and to make a recommendation.”



Joint Committee for Guides in Metrology:
BIPM, IEC, IFCC, ILAC, ISO, IUPAC, IUPAP, OIML, 1993

Another example: what is measurement uncertainty?

parameter, associated with the result of a measurement,
that characterizes the dispersion of the values
that could reasonably be attributed to the measurand

(GUM, 1993, and then VIM2, 1993, and VIM3, 2008)

doubt about the true value of the measurand
that remains after making a measurement

(GUM-1, 2023)

SHORT COMMUNICATION • OPEN ACCESS

What is measurement uncertainty? A discussion^{*}

Luca Mari^{*,**}, Richard J C Brown, Claudio Narduzzi, Gunnar Nordin, Stefanie Trapmann and Daniel Varela Magalhães

Published 5 December 2025 • © 2025 The Author(s). Published on behalf of BIPM by IOP Publishing Ltd

[Metrologia](#), Volume 62, Number 6

Citation Luca Mari *et al* 2025 *Metrologia* **62** 062101

DOI 10.1088/1681-7575/ae1f1e

A different question

Is this disagreement because some theories / positions are wrong?

Or are they answering different questions?

Perhaps the issue is not about the answers, but about the questions

Too rarely we compare the questions they answer

A preliminary acknowledgment

Measurement is not a “natural” entity:
it is something we do, not something we find

We cannot design experiments to answer the question

A map of the questions

What is measurement?



How has measurement been conceived?



How should we compare those conceptions?



Why do we measure?

A better map of the questions

What is measurement?



How has measurement been conceived?

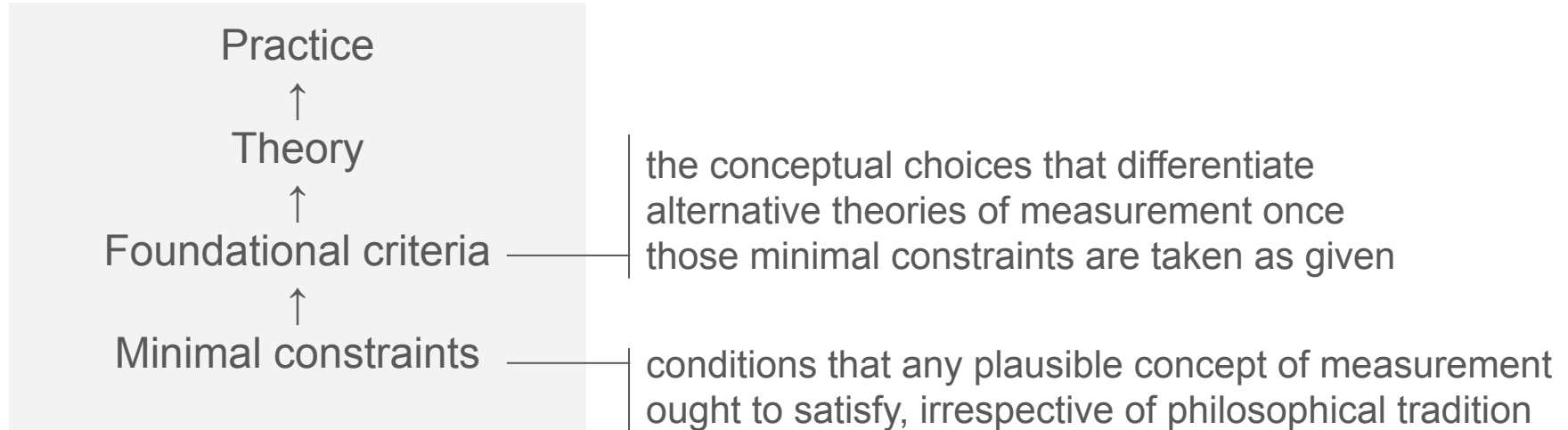


How should we compare the conceptions underlying the answers?



Why do we measure?

A meta-theoretical standpoint



Definitions are consequences, not starting points

Minimal (?) constraints

(While “measurement” is not a trademarked term, we might preliminarily agree that...)

Measurement:

- is a process (*‘measurement’ and ‘measure’ are different concepts*)
- produces information (*measurement is not transduction*)
- is about the state of an entity (*measurement is not naming / identification*)

More minimal (?) constraints

Measurement is a form of property evaluation...

... but not any property evaluation is measurement

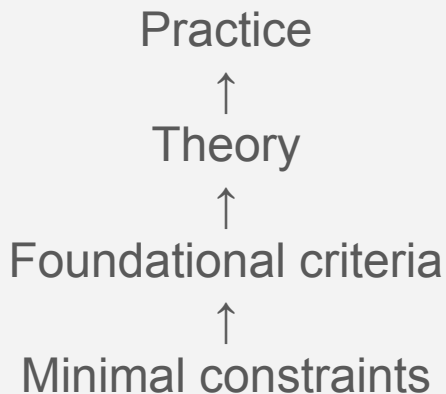
(property evaluation through opinion, guess, random choice, ...
is not measurement)

The specification is not about quality:
there can be good opinions, and bad measurements

A key consequence

A theory of measurement should provide **epistemic criteria about a process**, not (only) constraints about the inputs or the outputs of the process

Some candidate foundational criteria



Nature of properties
Role of empirical operations
Mathematical representation
Quantification
Comparison
Uncertainty
Traceability
Purpose
...

A possible foundational criterion (the position I have been developing)

Measurement produces information
whose trustworthiness is publicly assessable
in terms of the object-relatedness (“objectivity”)
and subject-independence (“intersubjectivity”)

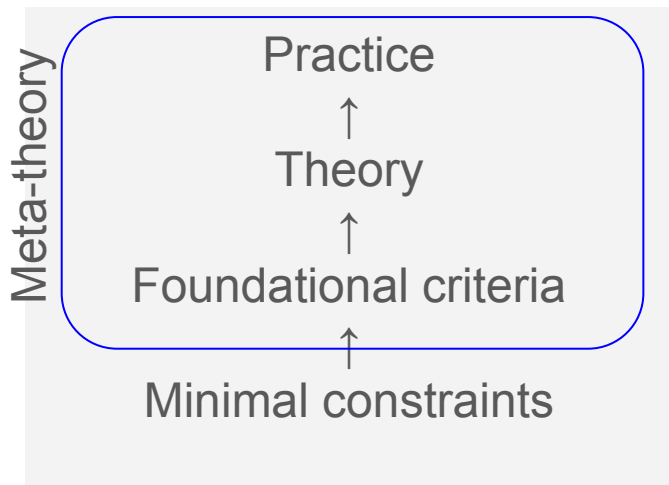
(a definition I recently proposed)

*Working with several colleagues,
we have argued that this position
enables us to explain the social role
of measurement*

Measurement is a designed evaluation process

- whose input is an empirical property of an object and
- whose output is information in the form of values of that property,
- where this information is causally grounded in the property intended to be measured and
- is accompanied by meta-information that publicly and explicitly justifies the trustworthiness of those values

From measurement theories to a meta-theory?



Foundational criteria distinguish theories

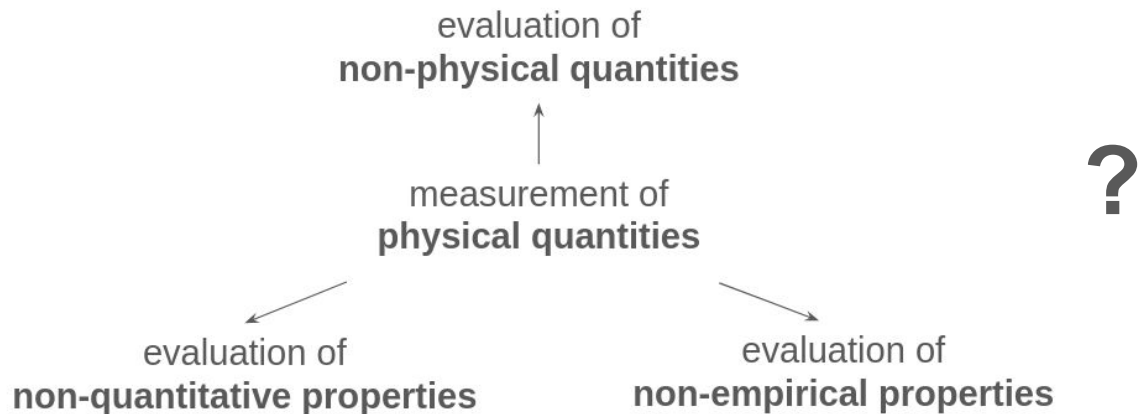
Different criteria generate different concepts

Definitions embody criteria

Different criteria generate different boundaries

Why now?

If we aim at agreeing on the scope of measurement...



... perhaps we need less new theories of measurement,
and more **a philosophy of the theories of measurement**

A strategic perspective

We do not necessarily need

- one definition
- one methodology
- one ontology

We probably do need

- explicit assumptions
- comparable standpoints
- common vocabulary
- bridges between traditions

Our Society – and perhaps our society... – needs less one more definition,
and more **a shared map for conceptual interoperability**

The Society for the Study of Measurement could strive to become...

- a home for mapping different traditions
- a place where assumptions are made explicit
- a laboratory for conceptual clarification
- a bridge between philosophy and practice
- a community that studies not only measurement, but also how measurement itself is conceptualised

Some possible guidelines

1. Make epistemic purposes explicit
2. State minimal constraints
3. State foundational criteria
4. Distinguish criteria from consequences
5. Compare assumptions before definitions
6. Bridge philosophy and practice

Closing

Agreement on one definition / position may remain elusive

Agreement on assumptions may be achievable

Different concepts



Shared framework



Better dialogue

Not reducing diversity, but understanding it

**Thank you for what you have done and will do
to support our Society
and to develop high quality Study of Measurement**

Luca Mari

<https://lmari.github.io>

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