# Back to the big wide world

How to integrate voice biomarkers into clinical practice in psychiatry?

Vincent P. MARTIN

MASTER AI4ONE HEALTH

UGA Université Grenoble Alpes

MIAI Grenoble Alpes

MSCA

LUXEMBOURG INSTITUTE OF HEALTH
RESEARCH DEDICATED TO LIFE

1/8 of the pop.

Mental disorder

-20 year

Life expectancy

1/3 depression

Without structured mental health care

https://www.who.int/news-room/fact-sheets/detail/mental-disorders

# Needs: Follow-up

Accessible

Regular

Ecological

Fatigue

Depression

Sleepiness …

Smartphones

80% of the world pop.

# 4 Needs

REGULAR

ECOLOGICAL

OBJECTIVE

*"Gold-standard diagnostic and assessment tools for depression and suicidality remain rooted, almost exclusively, on the **opinion of individual clinicians** risking a range of **subjective biases**. Currently there is no **objective measure**, with **clinical utility**, for either depression or suicidality"*

Cummins et al. 2015 *Speech Communication*

# Need for objective diagnosis

28 mhealth professionals

87% diagnosis = not reliable

14,9% definitions of the diseases

21,6% patients' characteristics

63,5% clinicians' characteristics

Aboraya 2007 *World Psychiatry*

# Need for objective diagnosis

**Table 6.—Diagnoses Given to Patient F**

| | American Psychiatrists (N = 133) | British Psychiatrists (N = 194) |
|---|---|---|
| **Schizophrenia** | 92 (69%) | 4 (2%) |
| Simple | 0 | 1 |
| Catatonic | 1 | 0 |
| Paranoid | 27 | 1 |
| Latent | 8 | 0 |
| Residual | 3 | 0 |
| Schizo-affective | 33 | 1 |
| Unspecified | 20 | 1 |
| **Personality Disorder** | 10 (8%) | 146 (75%) |
| Paranoid | 1 | 2 |
| Affective (cyclothymic) | 1 | 8 |
| Explosive | 0 | 2 |
| Hysterical | 4 | 105 |
| Asthenic | 0 | 2 |
| Antisocial | 1 | 8 |
| Unspecified | 3 | 19 |
| **Affective Psychosis** | 10 (8%) | 7 (4%) |
| **Neurosis** | 19 (14%) | 37 (19%) |
| **Alcoholism or Drug Dependence** | 2 | 0 |

Kendell 1971, *Arch Gen Psychiatry*

# Clinicians need objective assessements of psychiatric disorders

# State of the art

125 studies

68 depression

23 schizophrenia

21 bipolar disorder

12 PTSD

3 eating disorders

6 anxiety

1 OCD

Low et al. 2020, *LIO*

# Where are they?

# Sociology of traduction

« Big wild world »

« Small world of the laboratory »

1) Problematization

2) « New possible states of the world »

*High concentration of technique and knowldege*


3) Laboratization

Callon, Lascoumes, Barthes *Agir dans un monde incertain*

Clinicians need objective assessements of ~~psychiatric disorders~~

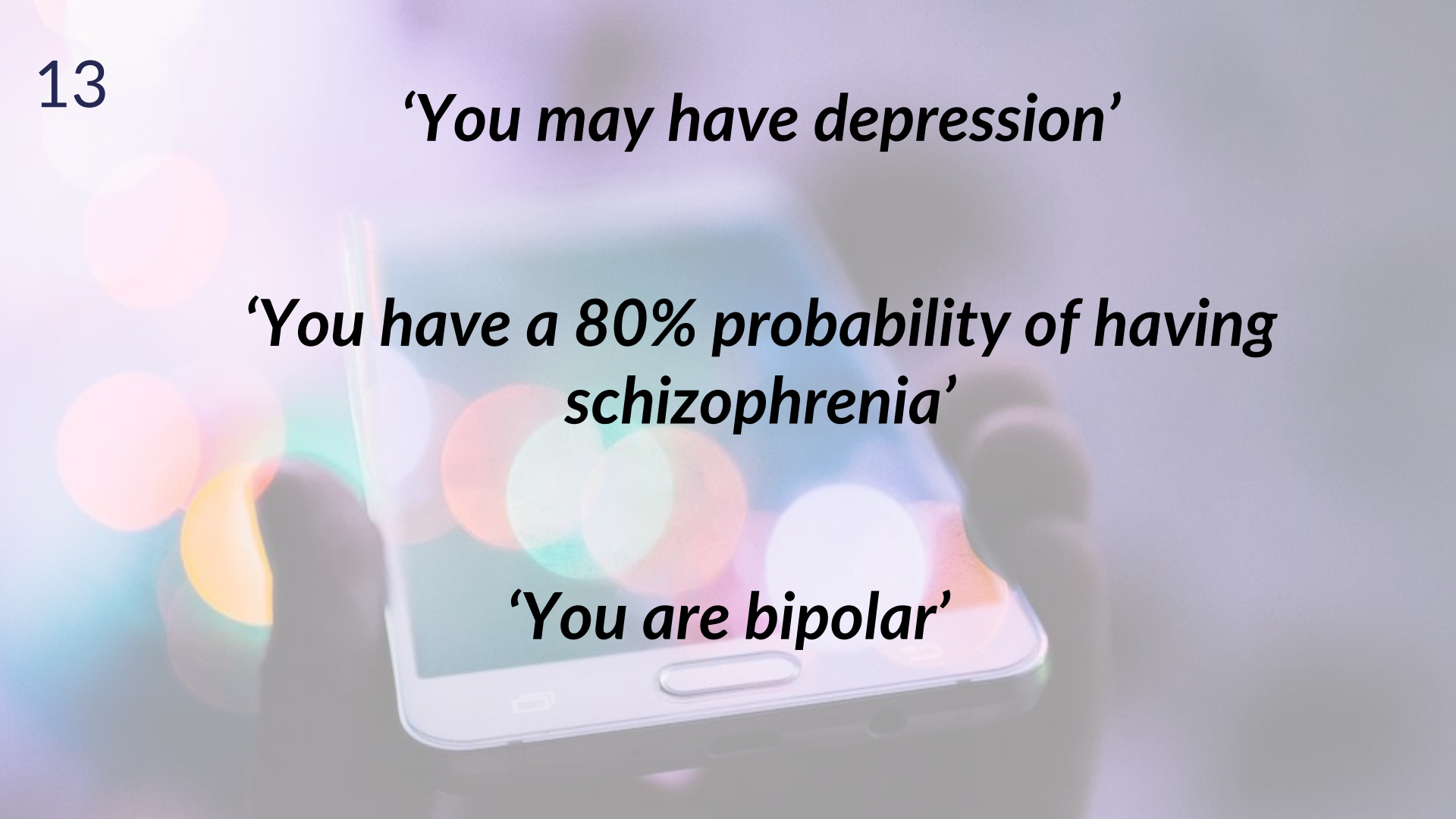
# Why estimating the diagnosis is a bad idea

1. Clinical practice
2. Heterogeneity
3. Unstability

*‘You may have depression’*

*‘You have a 80% probability of having schizophrenia’*

*‘You are bipolar’*



# Why estimating the diagnosis is a bad idea

Clinical practice

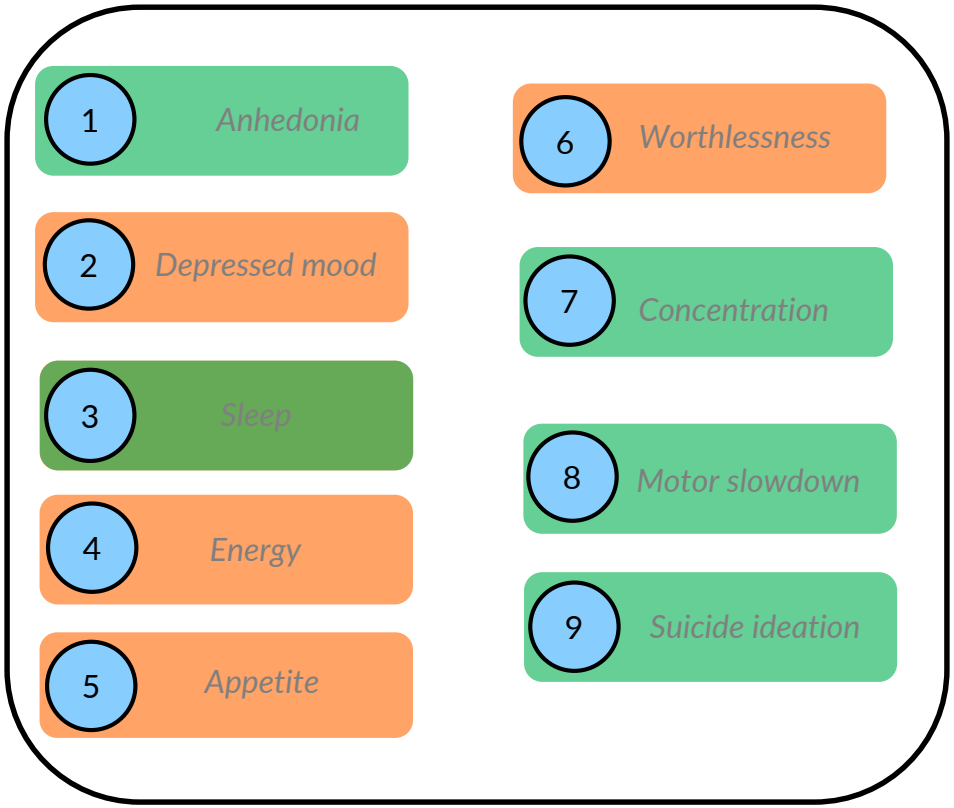
2

Heterogeneity

Symptoms → diag s → treatments

Diagnostic announcement = critical

# Heterogeneity




Depression =

- At least 5
- n°1 or n°2

326 profiles

**Eiko Fried:**

STAR*D (2015) :

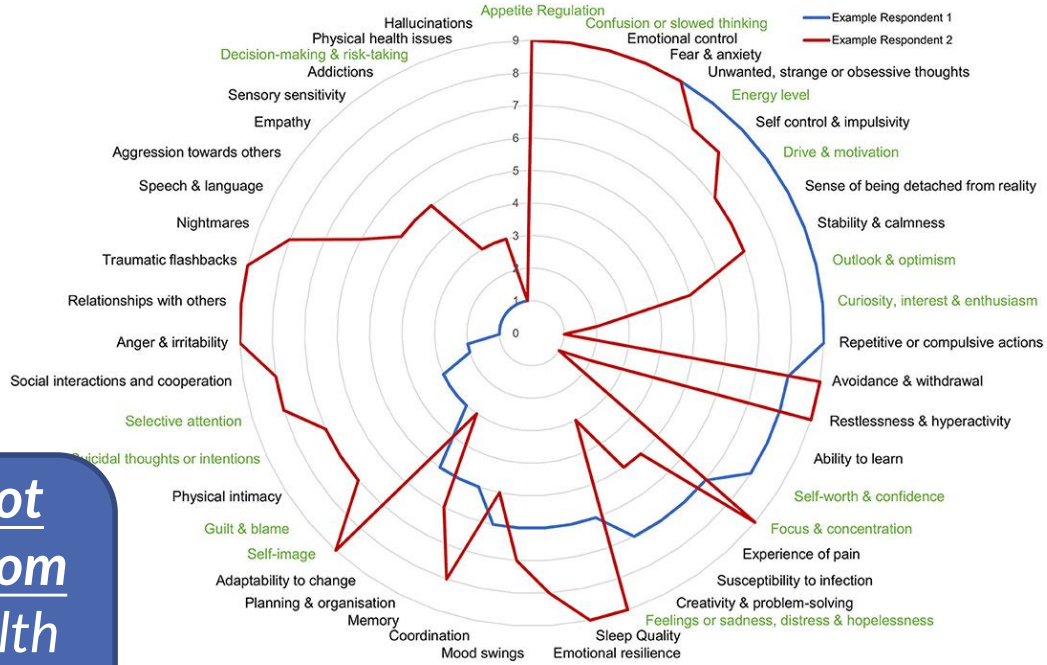
1030 profiles / 3703 “depressive” patients (DSM-5)

# Heterogeneity

107349 patients

10 most prevalent disorders

47 symptoms




*« DSM-5 disorder criteria **do not separate individuals from random** when the complete mental health symptom profile of an individual is considered»*

Newson 2021, *Frontiers in Psychiatry*

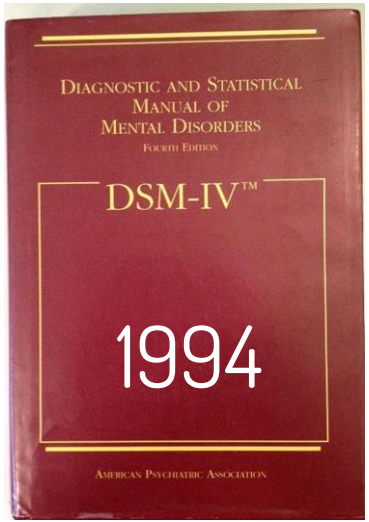
# Why estimating the diagnosis is a bad idea

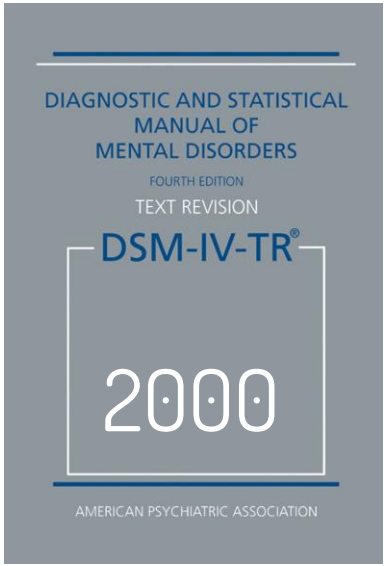
Clinical practice

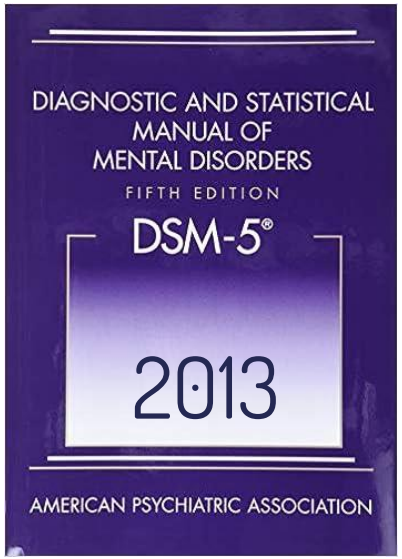
Heterogeneity

3

Unstability




# Why estimating the diagnosis is a bad idea

Clinical practice

Heterogeneity

Unstability

## Glossary of Cultural Concepts of Distress

### Ataque de nervios

*Ataque de nervios* ("attack of nerves") is a syndrome among individuals of Latino descent, characterized by symptoms of intense emotional upset, including acute anxiety, anger, or grief; screaming and shouting uncontrollably; attacks of crying; trembling; heat in the chest rising into the head; and becoming verbally and physically aggressive. Dissociative experiences (e.g., depersonalization, derealization, amnesia), seizure-like or fainting episodes, and suicidal gestures are prominent in some *ataques* but absent in others. A general feature of an *ataque de nervios* is a sense of being out of control. Attacks frequently occur as a direct result of a stressful event relating to the family, such as news of the death of a close relative, conflicts with a spouse or children, or witnessing an accident involving a family member. For a minority of individuals, no particular social event triggers their *ataques;* instead, their vulnerability to losing control comes from the accumulated experience of suffering.

No one-to-one relationship has been found between *ataque* and any specific psychiatric disorder, although several disorders, including panic disorder, other specified or unspecified dissociative disorder, and conversion disorder, have symptomatic overlap with *ataque.*

In community samples, *ataque* is associated with suicidal ideation, disability, and out-

### Taijin kyofusho

*Taijin kyofusho* ("interpersonal fear disorder" in Japanese) is a cultural syndrome characterized by anxiety about and avoidance of interpersonal situations due to the thought, feeling, or conviction that one's appearance and actions in social interactions are inadequate or offensive to others. In the United States, the variant involves having an offensive body odor and is termed *olfactory reference syndrome.* Individuals with *taijin kyofusho* tend to focus on the impact of their symptoms and behaviors on others. Variants include major concerns about facial blushing (erythrophobia), having an offensive body odor (olfactory reference syndrome), inappropriate gaze (too much or too little eye contact), stiff or awkward facial expression or bodily movements (e.g., stiffening, trembling), or body deformity.

*Taijin kyofusho* is a broader construct than social anxiety disorder in DSM-5. In addition to performance anxiety, *taijin kyofusho* includes two culture-related forms: a "sensitive type," with extreme social sensitivity and anxiety about interpersonal interactions, and an "offensive type," in which the major concern is offending others. As a category, *taijin kyofusho* thus includes syndromes with features of body dysmorphic disorder as well as delusional disorder. Concerns may have a delusional quality, responding poorly to simple reassurance or counterexample.

The distinctive symptoms of *taijin kyofusho* occur in specific cultural contexts and, to some extent, with more severe social anxiety across cultures. Similar syndromes are found in Korea and other societies that place a strong emphasis on the self-conscious maintenance of appropriate social behavior in hierarchical interpersonal relationships. *Taijin kyofusho*–like symptoms have also been described in other cultural contexts, including the United States, Australia, and New Zealand.

# What is the role of diagnostic ?

- Communication

  ‘one of its most important goal is to **facilitate communication among clinicians, researchers, administrators and patients** […] by establishing a common language.’ Derek Bolton, 2012

- Recognition by society and specialists

# What can we do?

Clinical interwiew = **symptoms & signs**

Treatment = **symptoms & signs**

# Estimation of symptoms

Clinical practice

→Treatment

→ Diagnosis announcement

Heterogeneity

→ Fundamental unit of clinical reasoning

Unstability

→ Stable through time and culture

5

Health

6

New tasks

# Estimation of symptoms

New tasks

Health

## Prognostic

How will the patient evolve in the coming days/weeks/months?

## Differential diagnosis

Distinguishing ressembling but different disorders (e.g. unipolar depression vs. bipolar disorder)

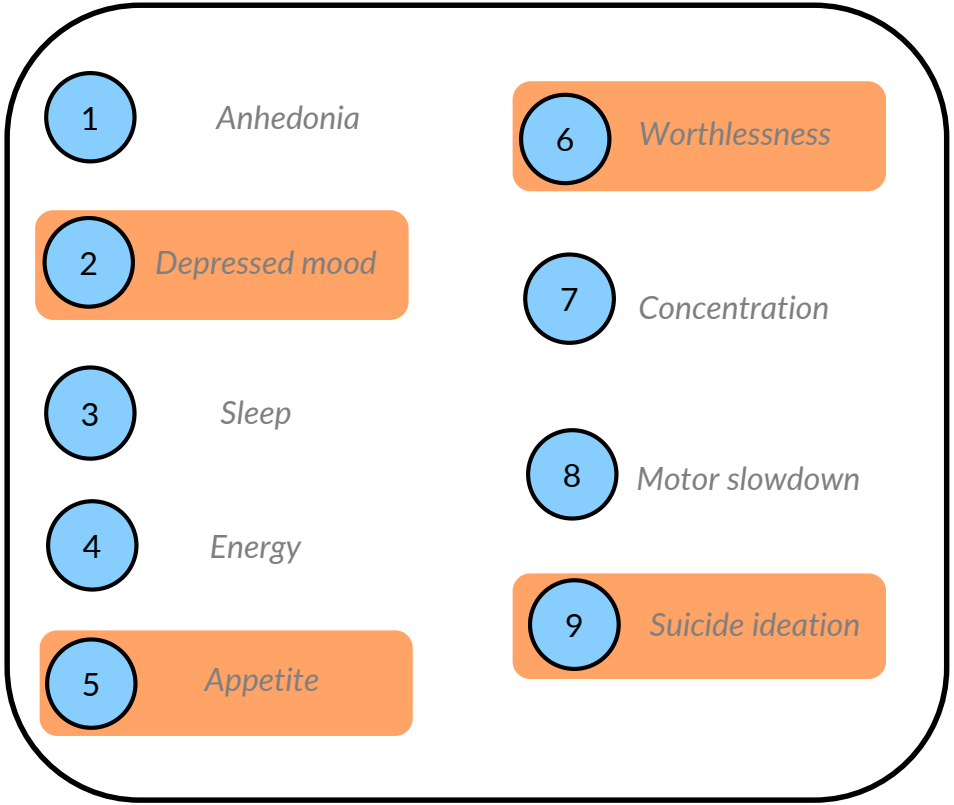
## Therapeutic targeting

Precision therapeutic based on symptoms

# Estimation of symptoms

New tasks

Health ≠ Pathology



# Estimation of symptoms

## Clinical practice

→Treatment

→ Diagnosis announcement

## Heterogeneity

→ Fundamental unit of clinical reasoning

## Unstability

→ Stable through time and culture

## Health

## New tasks

Clinicians need objective assessements of

~~**psychiatric disorders**~~

Clinicians need objective assessements of

**symptoms**

# Is estimating symptoms instead of diagnosis enough?

# Psychiatrists point of view

515 psychiatrists

Data privacy and security

1/3 situation

- Smartphone EMA
- Connected wristband
- MRI Machine learning

Therapeutic alliance

Bourla et al. 2018, JMIR

# Psychiatrists point of view

**Acceptability**

| | | | |
|---|---|---|---|
| **Sex** | Female | | Male |
| **Theoretical approach** | Psychoanalytic | CBT<br>Integrative/systemic | Neurobiological |
| **Role** | Resident | Hosp. practitionner<br>Assistant practitionner<br>Private practitionner | Professor<br>Assistant Prof. |
| **Practice** | Child psy.<br>Forensic psy. | | Adult psy.<br>Addiction<br>Geriatric psy. |
| **Graduation** | 2016-2020 | 2010-2015 | 1990-2009 |

Clinicians ~~need~~ objective assessements of psychiatric disorders

**Some** clinicians may **use complementary** objective assessements of symptoms

# Lessons from self-tracking data

1

23 Danish
General practitioners

Haase et al. 2023,
*Social Studies of Science*

2

20 French
Sleep specialists

Calvignac 2023,
*Médecine du Sommeil*

3

12 Belgian
GP and cardiologists

Gabriels et al. 2018,
*JMIR*

# General practitioners

Reli[illegible]ty/a[illegible]acy
transparency

*Interestingly, they did not seem to ever explore whether the wearables actually were 'validated'.*

*[…] data as relational objects that only make sense when the wider clinical context is known*

Recontextualisation
→ actionability

Haase et al. 2023, *SSS*

# General practitioners

Recontextualisation
→ actionability

Self-reported questionnaires

- Who initiated the test
- Why the patient had conducted the test



Cardiac data

*I use them as a springboard for a discussion about 'but why did you take it?'*

Sleep data

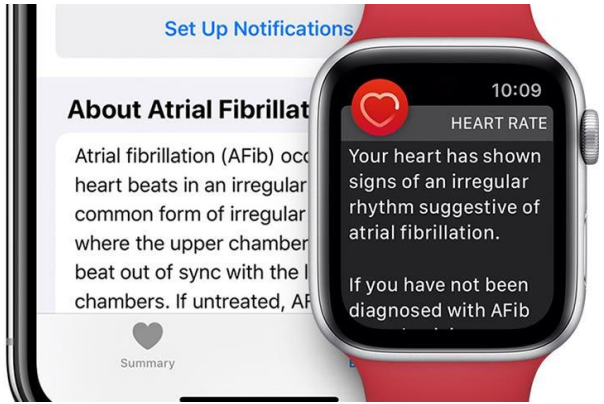
Haase et al. 2023, *SSS*

# General practitioners

Recontextualisation → actionability

Self-reported questionnaires

Cardiac data




Sleep data

*These patients are here because of an incredibly high measurement, but it is unsure whether there is a real problem or just an error.*
[10, cardiologist]

Gabriels et al. 2018, *JMIR*

Haase et al. 2023, *SSS*

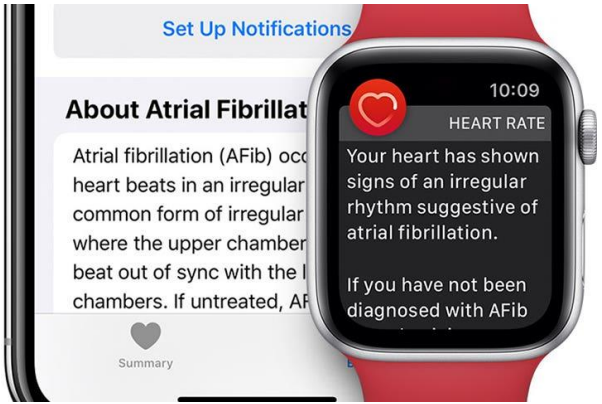
# General practitioners

Recontextualisation → actionability

Self-reported questionnaires

Cardiac data

Sleep data




Complementary exams

*Data were seen as sufficient to initiate clinical action or, if the data indicated something harmless, the GPs would immediately dismiss any further investigations.*

Haase et al. 2023, *SSS*

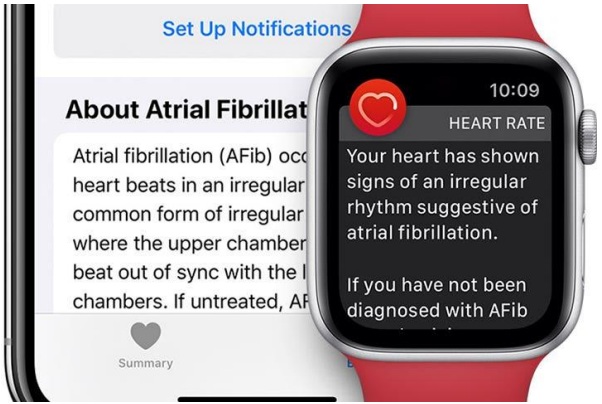
# General practitioners

Recontextualisation → actionability

Self-reported questionnaires

Cardiac data

Sleep data




Complementary exams

Nothing

*If the clinical information did not indicate a heart disease, Johnny suggests he would consider the data from the wearable insignificant or unrelated to this claim for this specific patient*

Haase et al. 2023, *SSS*

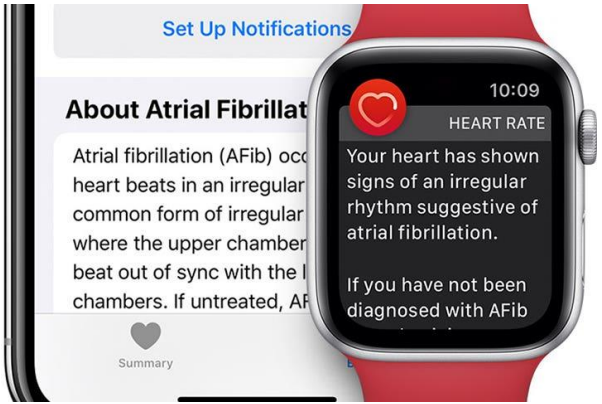
# General practitioners

Recontextualisation → actionability

Self-reported questionnaires

Cardiac data

Sleep data




Complementary exams

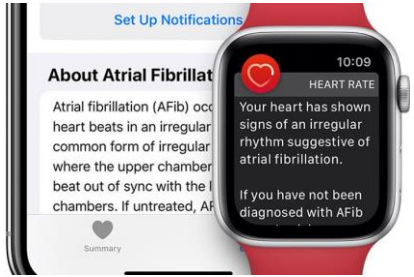
Nothing

*"The GPs found it challenging to convince patients that it could be 'normal' (non-pathological) to receive 'abnormal' (beyond certain thresholds) test results."*

Haase et al. 2023, *SSS*

# General practitioners

Recontextualisation → actionability




Self-reported questionnaires

Cardiac data

Sleep data

*"At one point, a Saturday evening at 11 pm, I received an e-mail that contained a deviated heart rate measurement. I think 'hmm, this is strange.' So I send him [the acquaintance] an e-mail and he lets me know that he was at a reception, where he met someone who said that he suffered from a heart rhythm disorder and he [the acquaintance] subsequently gave him his smartphone to try the technology."*
[12,cardiologist]

Haase et al. 2023, *SSS*

Some clinicians may use complementary objective assessements of symptoms

Some clinicians may use complementary **and contextualized** objective assessements of symptoms

# General practitioners

Self-reported questionnaires

Cardiac data

Sleep data


**Expertise**

**Time (52 patients interaction/day)**

Sleep clinic

*'my phone states that I am not sleeping well enough'*

*"Then I refer some of them [the patients] to a sleep monitoring clinic but they get rejected"*

Haase et al. 2023, *SSS*

# Lessons from self-tracking data

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Gabriels et al. 2018,
*JMIR*

# Sleep specialists

Ferrario and Loi 2022, SSRN

Reliability/accuracy
transparency

**How Explainability Contributes to Trust in AI**

Andrea Ferrario*
aferrario@ethz.ch
ETH Zurich
Switzerland

Michele Loi
michele.loi@polimi.it
Politecnico di Milano
Italy

**Notions of explainability and evaluation approaches for explainable artificial intelligence**

Giulia Vilone *, Luca Longo
*School of Computer Science, College of Science and Health, Technological University Dublin, Dublin, Republic of Ireland*

**Integrating Artificial Intelligence into Medical Education: Lessons Learned From a Belgian Initiative**

Ilaria Pizzolla, Rania Aro, Pierre Duez, Bruno De Lièvre, Giovanni Briganti, University of Mons, Belgium

Journal of Interactive Learning Research Volume 34, Number 2, 2023 ISSN 1093-023X Publisher: Association for the Ad of Computing in Education (AACE), Waynesville, NC

Journal Info | Table of Contents | New issue alerts

Transparency? Actionability? Faithfulness? Interpretability?
Informativeness? Explicability? Explicitness?

Vilone and Longo 2021, Information fusion

# Sleep specialists

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michele.loi@polimi.it
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Italy

On the Relation of Trust and Explainability:
Why to Engineer for Trustworthiness

Lena Kästner*, Markus Langer †, Veronika Lazar†, Astrid Schomäcker*, Timo Speith*‡, Sarah Sterz*‡
*Saarland University, Institute of Philosophy, Saarbrücken, Germany
†Saarland University, Department of Psychology, Saarbrücken, Germany
‡Saarland University, Department of Computer Science, Saarbrücken, Germany
Email: {lena.kaestner, astrid.schomaecker, firstname.lastname}@uni-saarland.de, sterz@depend.uni-saarland.de

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Journal Info Table of Contents New issue alerts

Explainability **contributes** to trust
Explainability is **not necessary** for trust


Kästner et al. 2021, IEEE REW

# Sleep specialists

## 1 Variety of offers on the market

Reliability/accuracy
transparency

Most of them provide inaccurate data compared to what can be recorded, and often worry patients who come in saying, 'I don't have deep sleep' or 'I only have sleep like this or like that,' when a watch absolutely cannot, at least currently, detect sleep stages and thus gives a very biased view to patients."

*Interview 5, neurologist, public sector, 14 years of experience, Auvergne-Rhône-Alpes.*

'Datadvertasing' approaches
= insincere advertising because too flattering.

Patients behavior

Calvignac 2023, *Médecine du Sommeil*

# Datadvertasing

179 applications

2 publications

Leong et al. 2022 *JMIR*

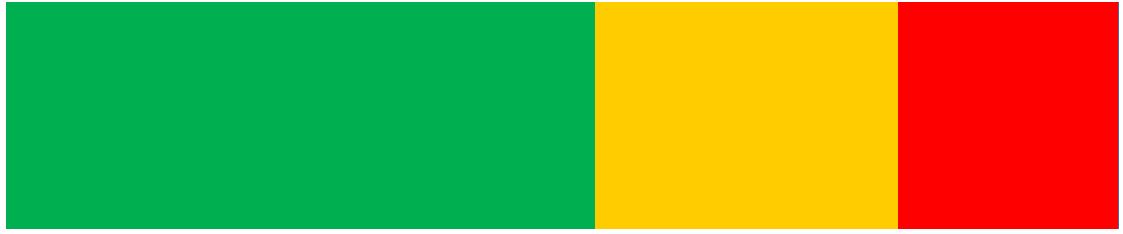
# Datadvertasing

53% proofs

27% not clear

20% no proof

73 applications → 49 claims



Larsen et al. 2019 *Nature Digital Medicine*

# Sleep specialists

1. Variety of offers on the market
2. Validation pop.

Reliability/accuracy
transparency

Patients behavior

Calvignac 2023, *Médecine du Sommeil*

# Sleep specialists

1. Variety of offers on the market
2. Validation pop.
3. Score transparency and stability over time

Reliability/accuracy transparency


'You have a sleep score of 80%.' What does this sleep score of 80% mean? 80% of what?"
(Interview 6, neurologist, public sector, 30 years of experience, Provence-Alpes-Côte d'Azur)

Calvignac 2023, *Médecine du Sommeil*

# Sleep specialists

Reliability/accuracy transparency

*"All the professionals interviewed, without exception, initially asserted that, most of the time, **these self-measurements revealed less about sleep itself than about the sleeper**. In other words, it's not so much the data themselves as the act of self-collection that carries meaning."*

Patients behavior

## Adherence

*"The patient who comes in with an app they've been using for three months, where they've noted many things, **it's an important aspect of the patient's personality**, and it becomes a lever for follow-up."*
*(Interview 8, pulmonologist, private sector, 30 years of experience, Île-de-France)*

Calvignac 2023, *Médecine du Sommeil*

Some clinicians may use complementary and contextualized objective assessements of symptoms

Some clinicians may use complementary, **transparent, validated** and contextualized objective assessements of symptoms

# Lessons from self-tracking data

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Gabriels et al. 2018,
*JMIR*

# GP & Cardiologists

Patient autonomy



Patient behavior changes

*"There is the danger that patients will play doctor themselves. They will themselves decide whether or not to increase their blood pressure medication or diuretic pill. » GP*

*Doctor 12 (a cardiologist), however, believes this is not a major problem, as long as patients act within certain limits. For example, patients with diabetes already adjust their medication based on their daily self-tracking of blood sugar levels, which is described as a positive evolution.*

Gabriels et al. 2018, *JMIR*

# GP & Cardiologists

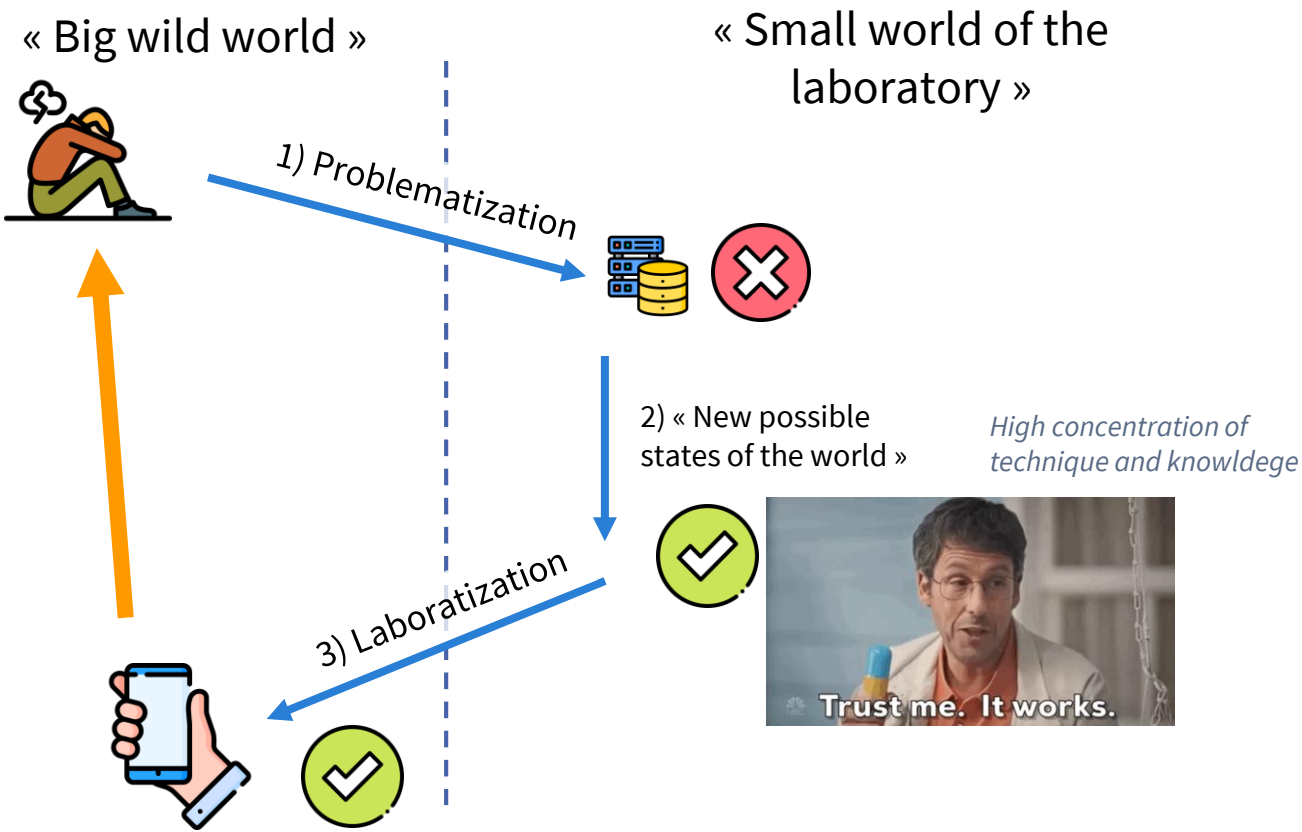
Patient autonomy

> *I have the feeling that they do measure their parameters and that they are subsequently more aware of the problem, but [that] this does not really lead to behavioral changes.*
> *[4, GP]*

Patient behavior changes

Gabriels et al. 2018, *JMIR*

# Health performance and health obsession




Callon, Lascoumes, Barthes *Agir dans un monde incertain*

# Health performance and health obsession

*"Now we all want to be on the same model. People ask you in consultation: 'How many hours should I sleep?' 'What time should I go to bed? They love rules. […] That's the perverse effect of this type of application, this type of connected object, is that you're given objectives that don't necessarily correspond to your physiology"*
*(Interview 8, pulmonologist, private sector, 30 years' experience, Île-de-France).*

Calvignac 2023, *Médecine du Sommeil*


## Orthosomnia

*"Clearly, when the Excel spreadsheet is beautifully crafted, when the graphs are meticulously detailed, we can clearly see the patient's obsessive nature […]"*
*(Interview 1, neurologist, public sector, 12 years of experience, Occitanie)*

Calvignac 2023, *Médecine du Sommeil*

# Health performance and health obsession

**Worried well cohort**

*Yes, I expect that health disparities might increase because those who will use it [self-tracking tools] are the ones that are already part of the privileged class.*
[2, GP]

**Entertainment medicine**

*"On the one hand I know it [digital self-tracking] will be very useful for certain groups that we currently do not sufficiently reach. […] But with these apps you perform a whole lot of 'entertainment' medicine."*
[7, GP]

Gabriels et al. 2018, *JMIR*

# Tech billionaire who spends $2 million a year to look young is now swapping blood with his 17-year-old son and 70-year-old father

BY ORIANNA ROSA ROYLE
May 23, 2023 at 12:42 PM GMT+2

"Young blood" infusions are part of Johnson's $2 million a year anti-aging routine.
KYLE GRILLOT—BLOOMBERG/GETTY IMAGES

https://fortune.com/2023/05/23/bryan-johnson-tech-ceo-spends-2-million-year-young-swapping-blood-17-year-old-son-talmage-70-father/

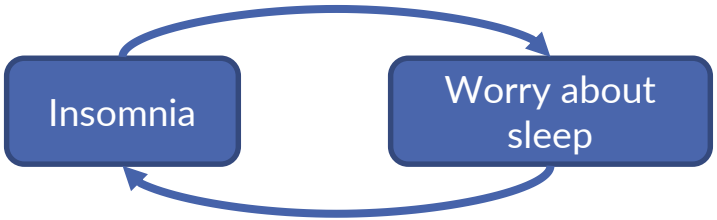
# Health vs. performance of health

## Stop using these tools

*"But then, when people really use them, self-measurement technologies are more of a factor in fixing symptoms in the wrong sense of the word, rather than a help. [...] on the contrary, we're going to teach them ... well, we're going to ask them to detach themselves from these tools."*

*(Interview 13, psychiatrist, private practice, 40 years' experience, Paris region)*

Calvignac 2023, *Médecine du Sommeil*



# Health vs. performance of health

## Tool of self-investigation

*They [the patients] come and say, 'my phone states that I am not sleeping well enough', then I ask 'well, are you tired?' [the patients answer] 'no I am not' [then I ask] 'do you have a problem then?' [laughing]*

Haase et al. 2023, *SSS*

*[...] People need to get to know themselves. It's also our job [...] to explain to them how to get to know themselves."*
*(Interview 8, pulmonologist, private sector, 30 years' experience, Île-de-France).*

Calvignac 2023, *Médecine du Sommeil*

# Mechanical vs. Situated objectivity

**Mechanical objectivity**

= *evidence that is 'uncontaminated by interpretation'*

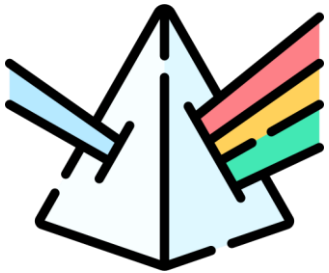
*Mechanical objectivity transforms life, in all its ambiguity and messiness, into something manageable*

**Situated objectivity**

= *everyday x (mechanical objectivity + trained judgement)*

*The objectivity that people apply to evaluating measurements transforms numbers and charts into 'qualitative metrics'*

"*living by numbers*" vs. "*living with numbers*"

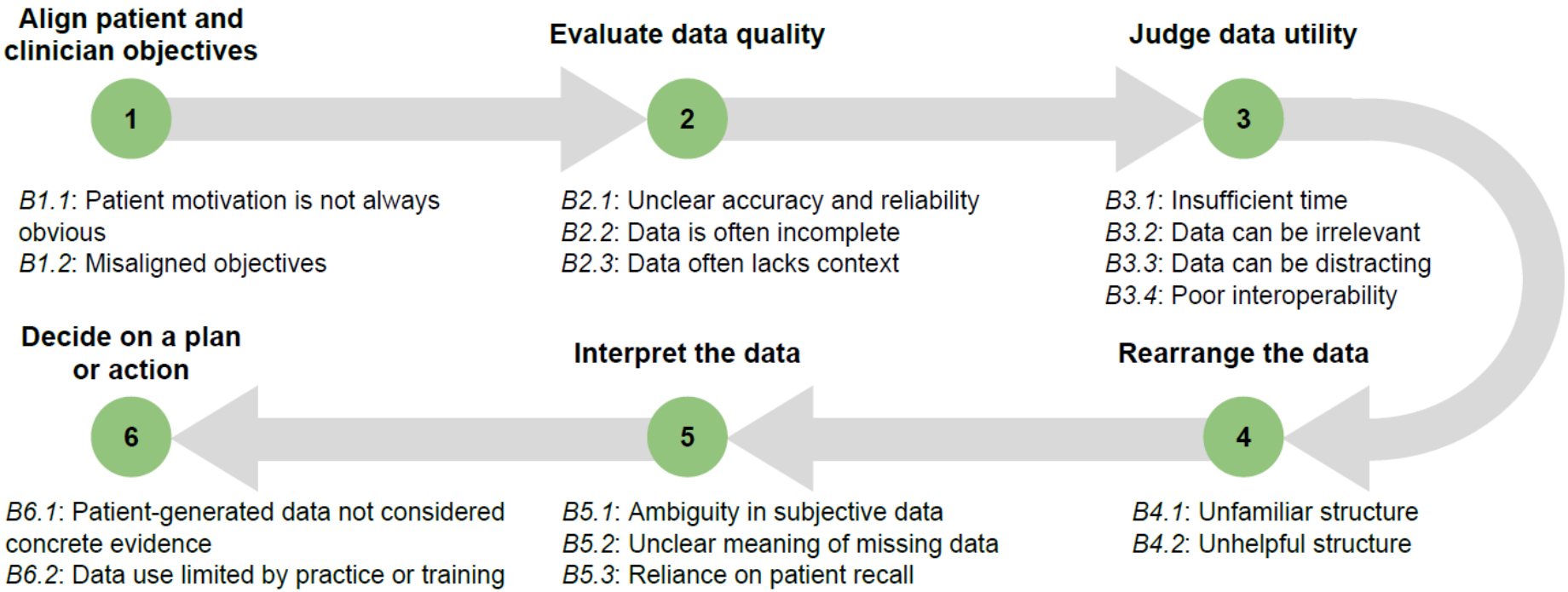


Pantzar et al. 2017, Digital Health

Some clinicians may use complementary, transparent, validated and contextualized objective assessements of symptoms

**For some patients**, some clinicians may use complementary, transparent, validated and contextualized objective assessements of symptoms

# To go further




West et al. 2018, CHI

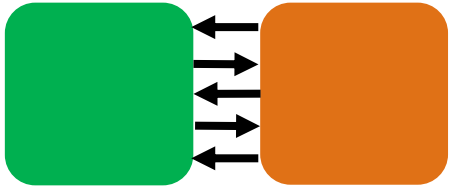
# Conclusion

## PLURIDISCIPLINARITY

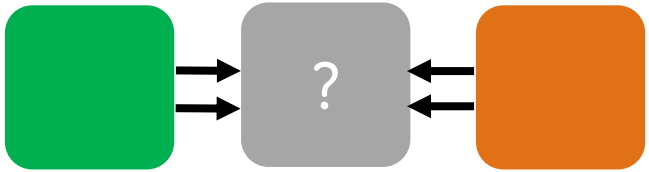
Application of digital technology to health

Telemedicine

## INTERDISCIPLINARITY



## TRANSDISCIPLINARITY




HEALTH

DIGITAL

Clinicians need objective assessements of psychiatric disorders

For some patients, some clinicians may use complementary, transparent, validated and contextualized objective assessements of symptoms

# Conclusion

*[…] the GPs spend little or no time judging the quality of an app before suggesting it to the patients.*

*"Because I have tried to download it and it seems manageable. Ehm, and it is purely random."*

*Note how Lene suggested apps when the interface was nice and the app 'free', not based on an assessment of clinical relevance and validity*

*Despite suggesting a specific app, Benedicte apparently considered the sleep apps on the market as equal. She did not want to spend time on analysing apps, and she was not paid to do so.*

Haase et al. 2023, *SSS*

Instead of asking the people involved in a problematic situation, developers, educators, technologists and sociologists get their information about 'what these people really want and need' from theoretical studies carried out by their esteemed colleagues in what they think are the relevant fields. **Not live human beings, but abstract models are consulted; not the target population decides, but the producers of the models.**

Paul Feyerabend, *Against Method* (1975)

Heterogeneity of disorders

Interference with therapeutic relationship

EPISTEMOLOGY

SOCIOLOGY

No improvement in follow-up

PSYCHIATRY

Responsability of clinican decision

ETHICS

Voice biomarkers of DISORDERS

COMPUTER SC.

INNOVATION

Accessible

Regular

Ecological

Heterogeneity of disorders

EPISTEMOLOGY

Clinicians stay at the heart of the care

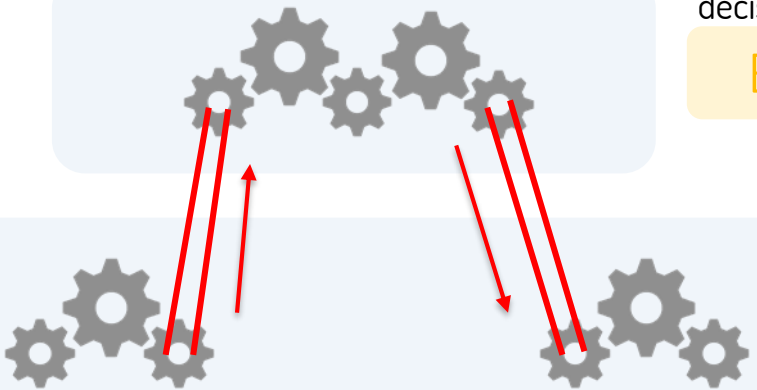
SOCIOLOGY

Supplementary information

PSYCHIATRY

Clinicians remain decision-makers

ETHICS



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# Vincent P. MARTIN

vpmartin@proton.me

Vincent-P-Martin