Data and Evaluation: Critical Resources for Research in Knowledge Processing

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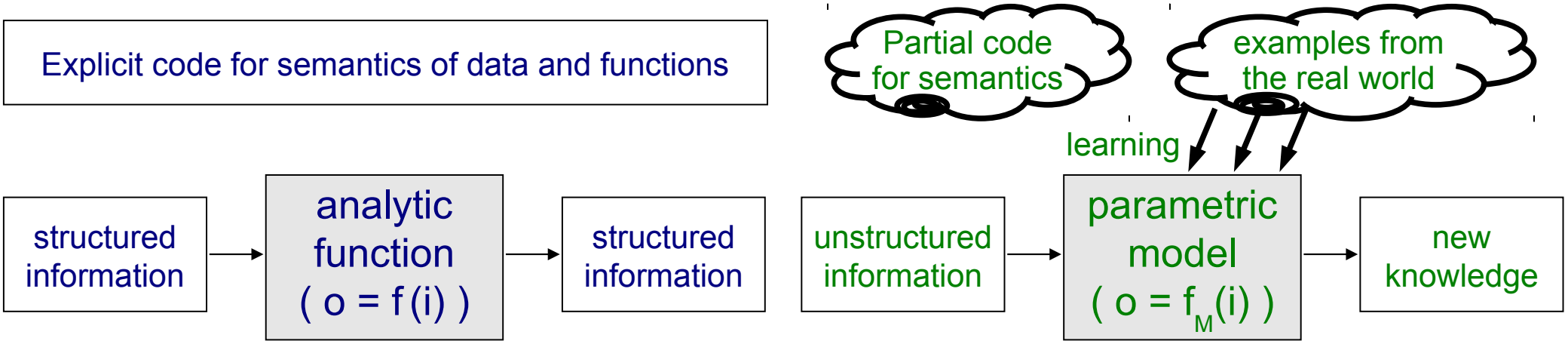
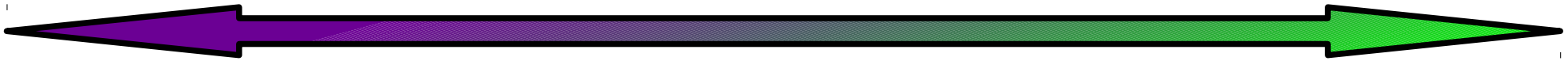
Questions

- From data to new knowledge: what do we mean?
- How to evaluate systems and measure progress?
- How to best support progress?

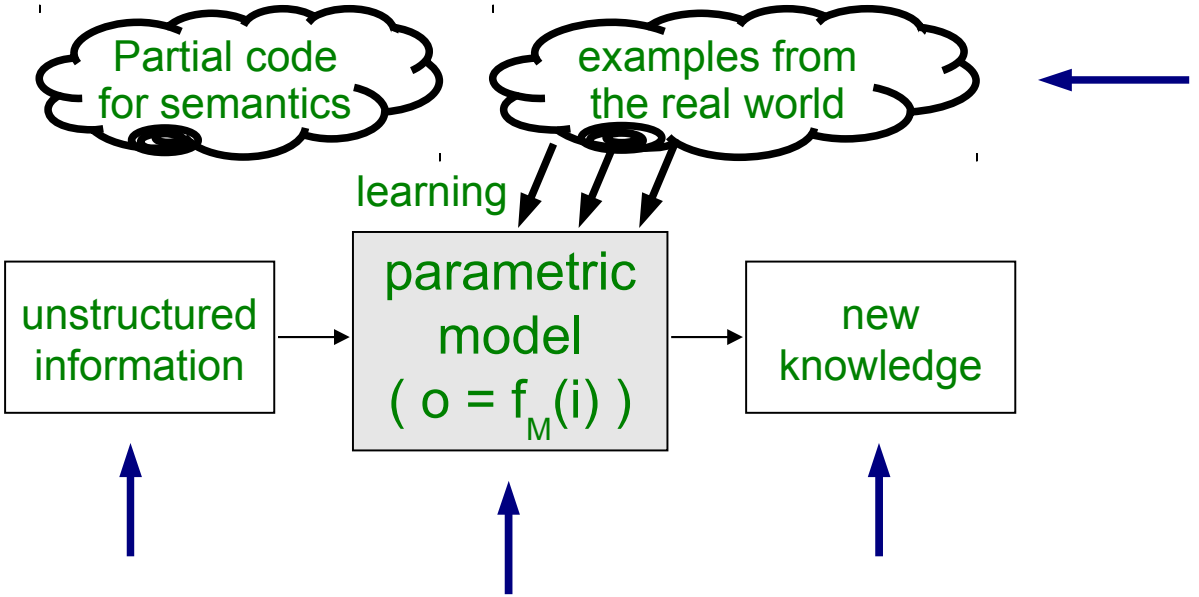
From data to new knowledge



The data express the semantics through an *explicit* code	The data is not enough to derive the semantics, which are partially *implicit*
The data are *transformed* using an explicit mathematical function (rules, etc.)	The data are *interpreted* using a mathematical model of the world (probabilities, etc...)
Theoretical approach (model is the mathematical proof)	*Experimental* approach (model is natural science)
Trigger keywords: *data* processing, *computing*	Trigger keywords: *intelligent* / *semantic* processing of digital / multimedia *content* / *knowledge*
Examples of domains: *formal languages*, traditional *signal processing*	Examples of domains: *natural language and speech* processing, *scanned documents, image and video* processing, information *fusion*



Need n°1: Manually annotated data



A task is defined by a representative sample data set

A good model should agree well with the observed data

Data is also important for training models

Example of metric (for speech transcription)

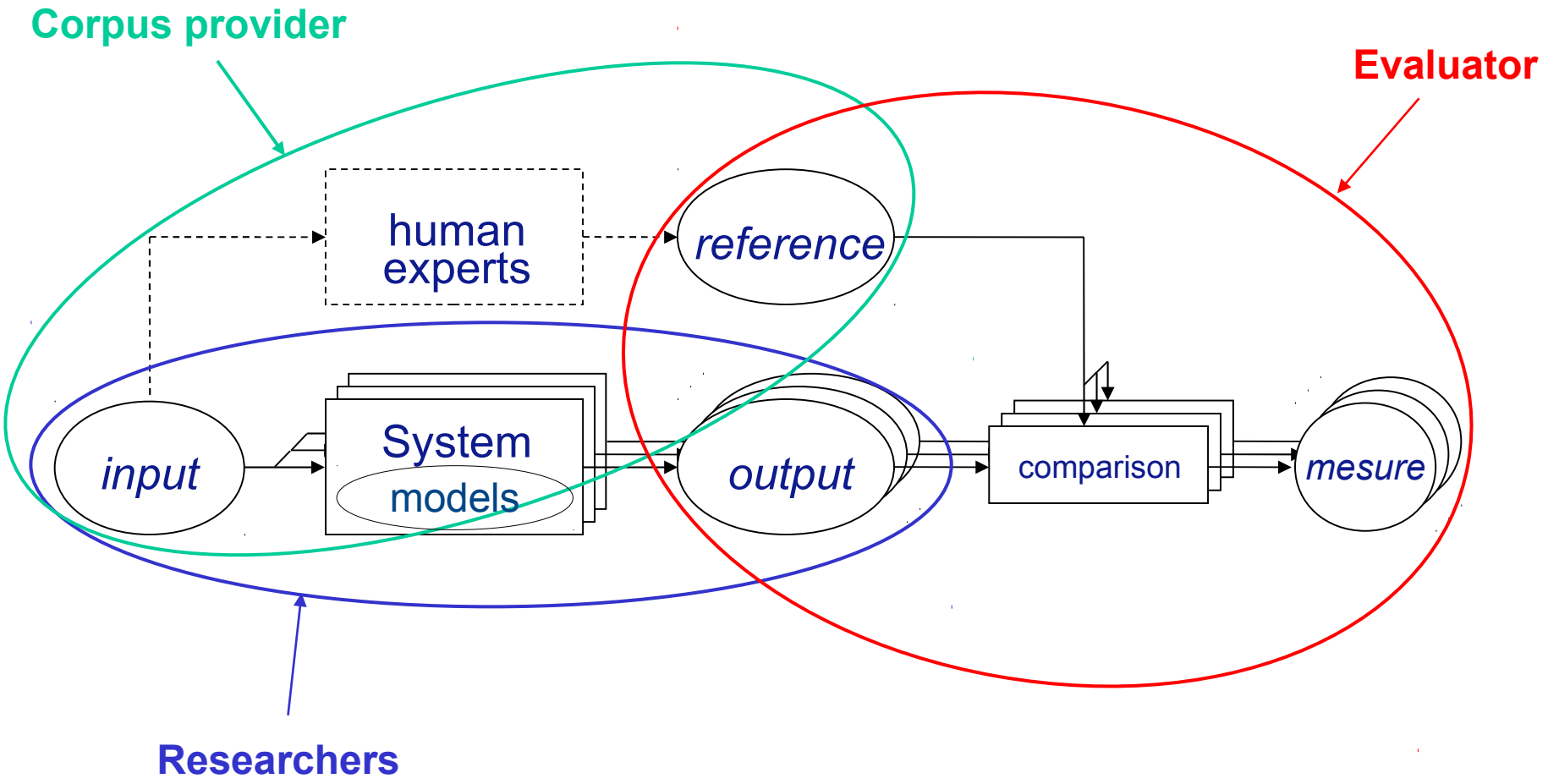
"I *would* *like to go to* *London* *tomorrow morning* *hum*"

I will like to go to lone done tomorrow morning

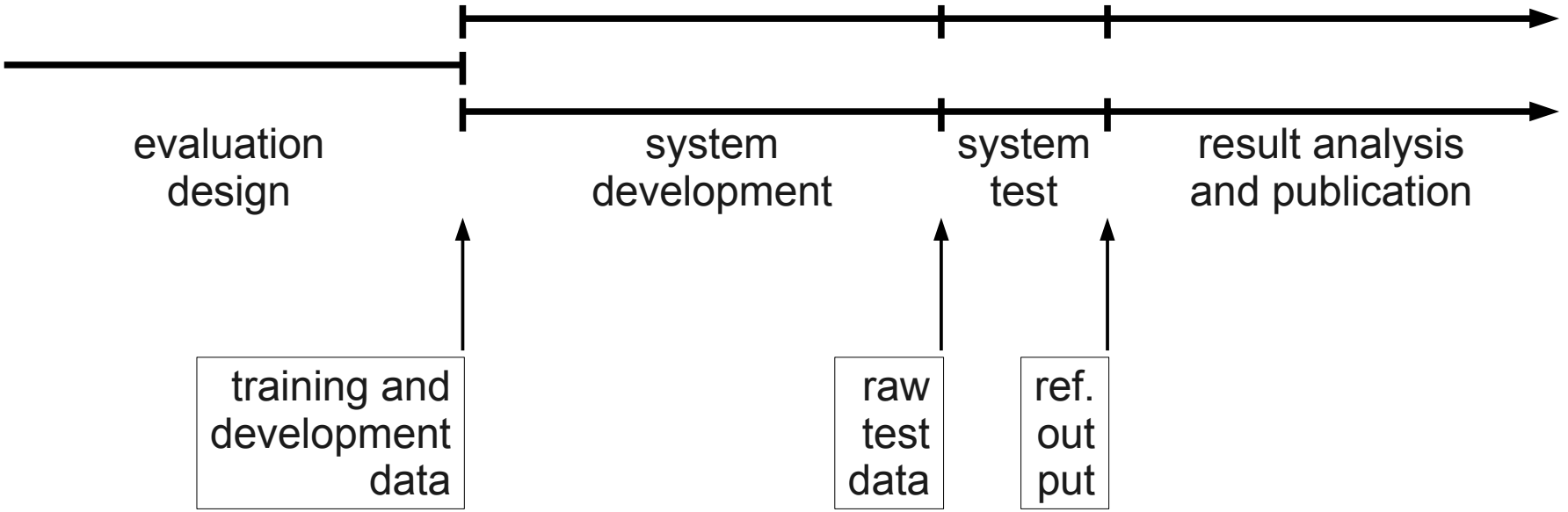
Error rate = (2+1)/10 = 30%

Error rate = edit distance between an hypothesis and a reference or a set of references

Evaluation data flow



Need n°2: Synchronized evaluations



Data should be shared for the sake of reproducibility

Tests should occur almost simultaneously to avoid bias

Evaluation design should serve the community

→ Evaluation campaigns

Benefits of evaluation

1. Explicit problems
2. Validate new ideas
3. Identify missing science
4. **Compare approaches and systems**
5. Determine maturity for a given application
6. Facilitate technology transfer
7. Incite innovation
8. **Organise the community**
9. Support competitiveness
10. Assess public funding efficiency

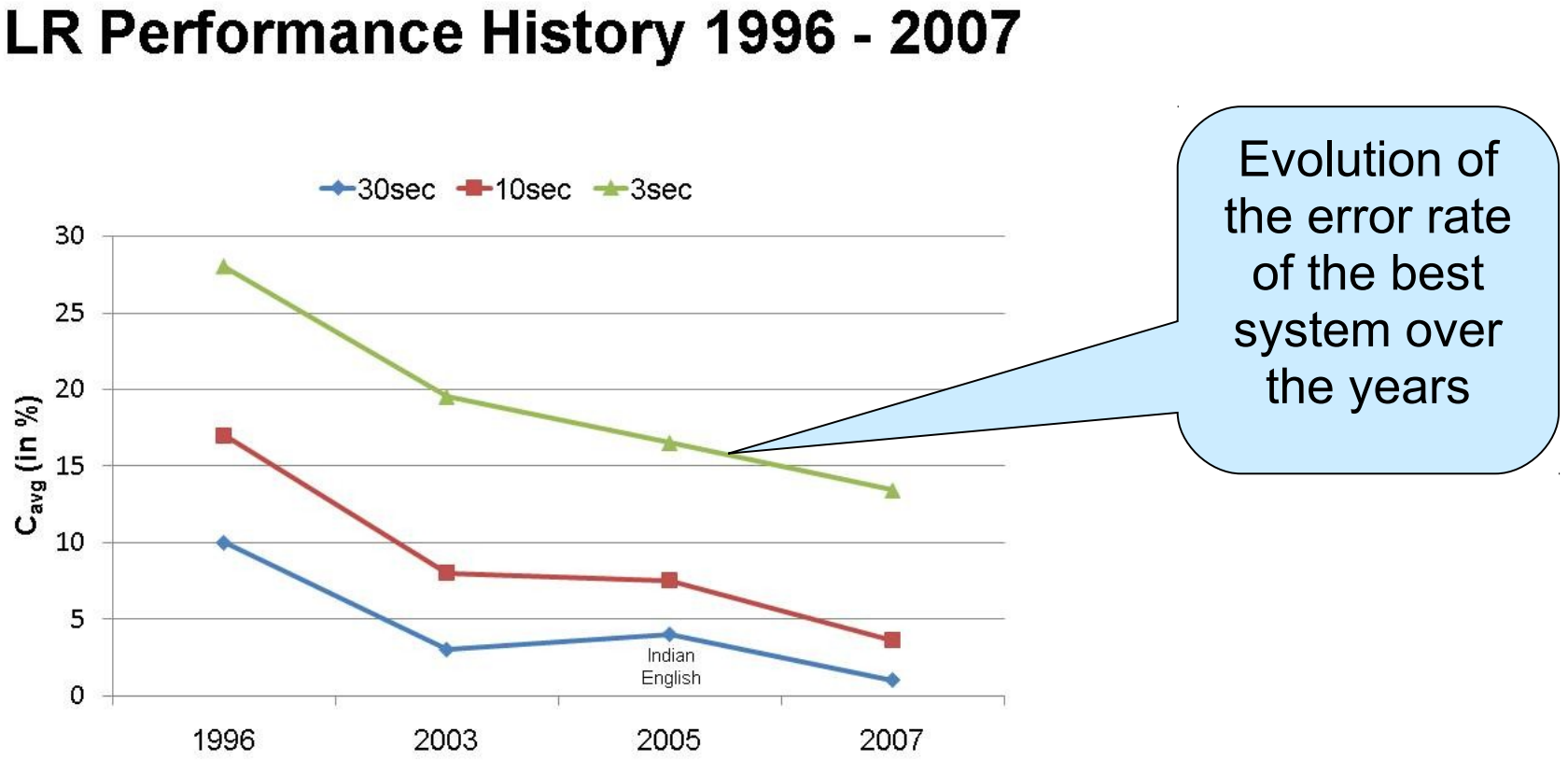
History

Late 70's	**NATO** Research Study Group on Automatic **Speech Recognition** (ASR) produces a common benchmark database in several languages
Mid 80's	After failure of earlier programs, the **US** (DARPA ans NIST) introduce systematic objective performance measurement in ASR programs
Early 90's	DARPA and NIST extend evaluation to automatic **Textual information processing** (TIPSTER program, then TREC, MUC, DUC, …) and opens its evaluation campaings to non-US participants
Mid 90's	First **European** program including evaluation (SQALE program on ASR)
Late 90's	First **French** evaluation program on speech and language processing, followed by a larger one in the early 2000's (Technolangue) First **Japanese** evaluation on information retrieval (NTCIR)
2001	DARPA and NIST extend evaluation to **Machine Translation**
2003	The major European programs on language processing (TC-STAR, CHIL) include evaluation
Mid 2000's	Evaluation methodology gradually extends to **Image processing** (TRECVid, US-EU CLEAR evaluations, French Techno-Vision program, ...)

Examples of evaluation campaigns today

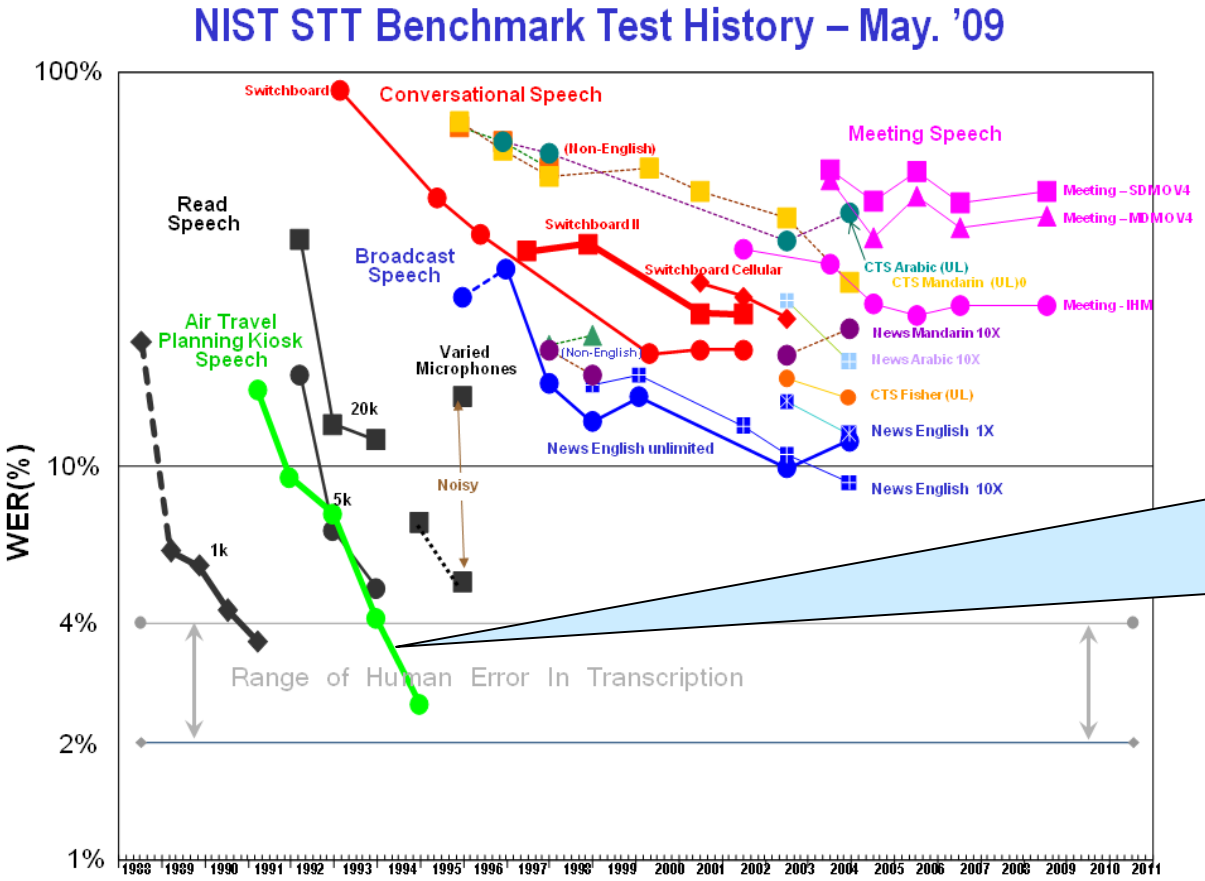
Funding	Organisers	Name	Topic
DARPA, DoC	NIST	Rich Transcription	Speech transcription
DARPA, DoC	NIST	Text REtrieval Conference	Documents retrieval
DARPA, DoC	NIST	OpenMT	Translation
DoC, ...	NIST, ...	TRECVid	Video analysis
DoC, IARPA, FBI	NIST	SRE, LRE	Speaker and language recognition
DoD	NIST	Text Analysis Conference	Natural language
NII, NICT, U. Tokyo	NII, NICT, U. Tokyo	NTCIR	Information retrieval
EU	U. Pisa, Delft, ...	CLEF, MultiMediaEval	Crosslingual, ...
OSEO	DGA, LNE, IRIT, UJF, LIPN, GREYC	Quaero	Multimedia document processing
DGA	DGA	RIMES, ICDAR	Handwriting recognition
Trento	CELCT, ...	Evalita	Natural language

Impact on the evolution of performances (example of spoken language recognition)



Source : NIST

Impact on the evolution of performances (example of speech transcription)



When a problem (one colored curve) is considered as solved, move on to a more difficult one

Source : NIST

The transformative power of evaluation

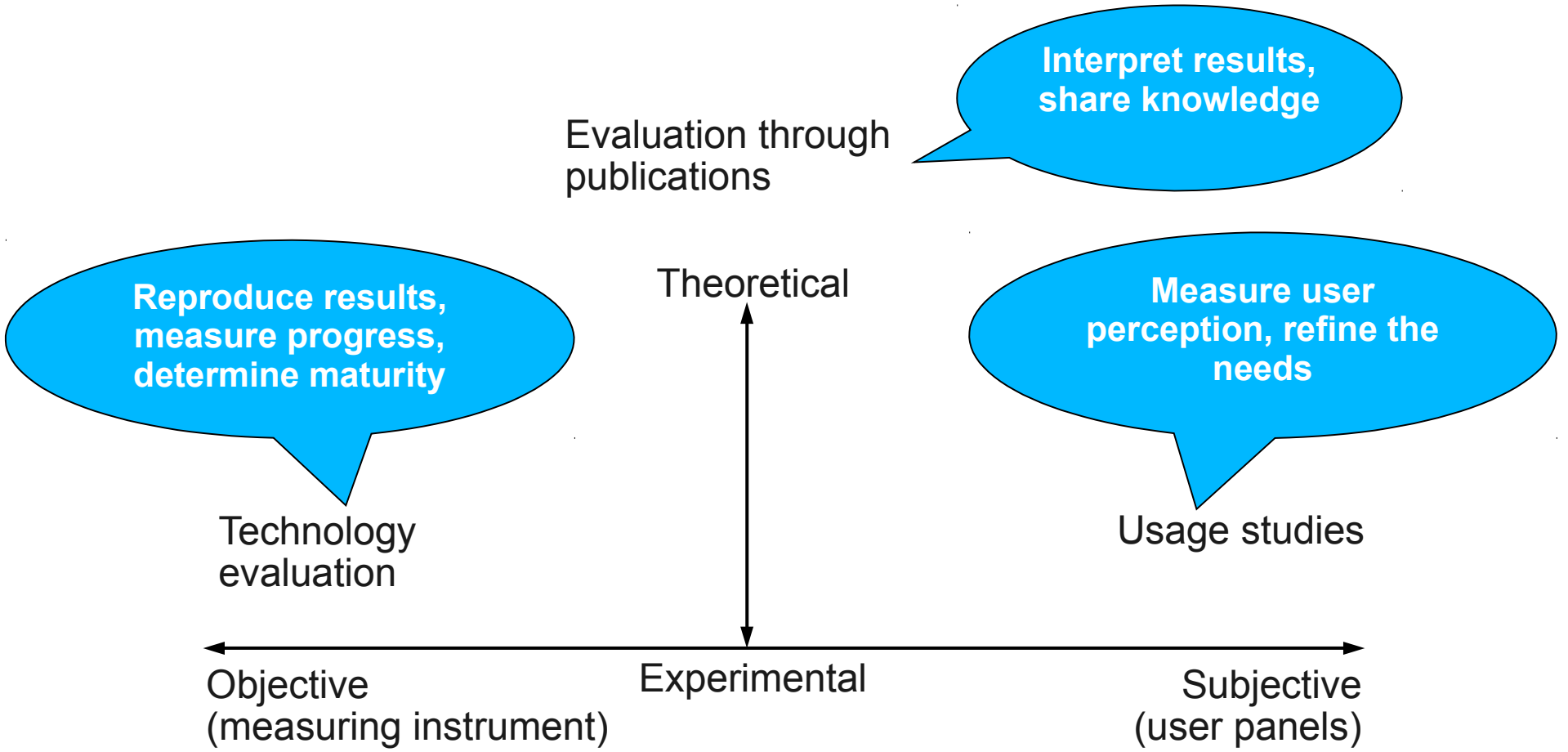
Before

After

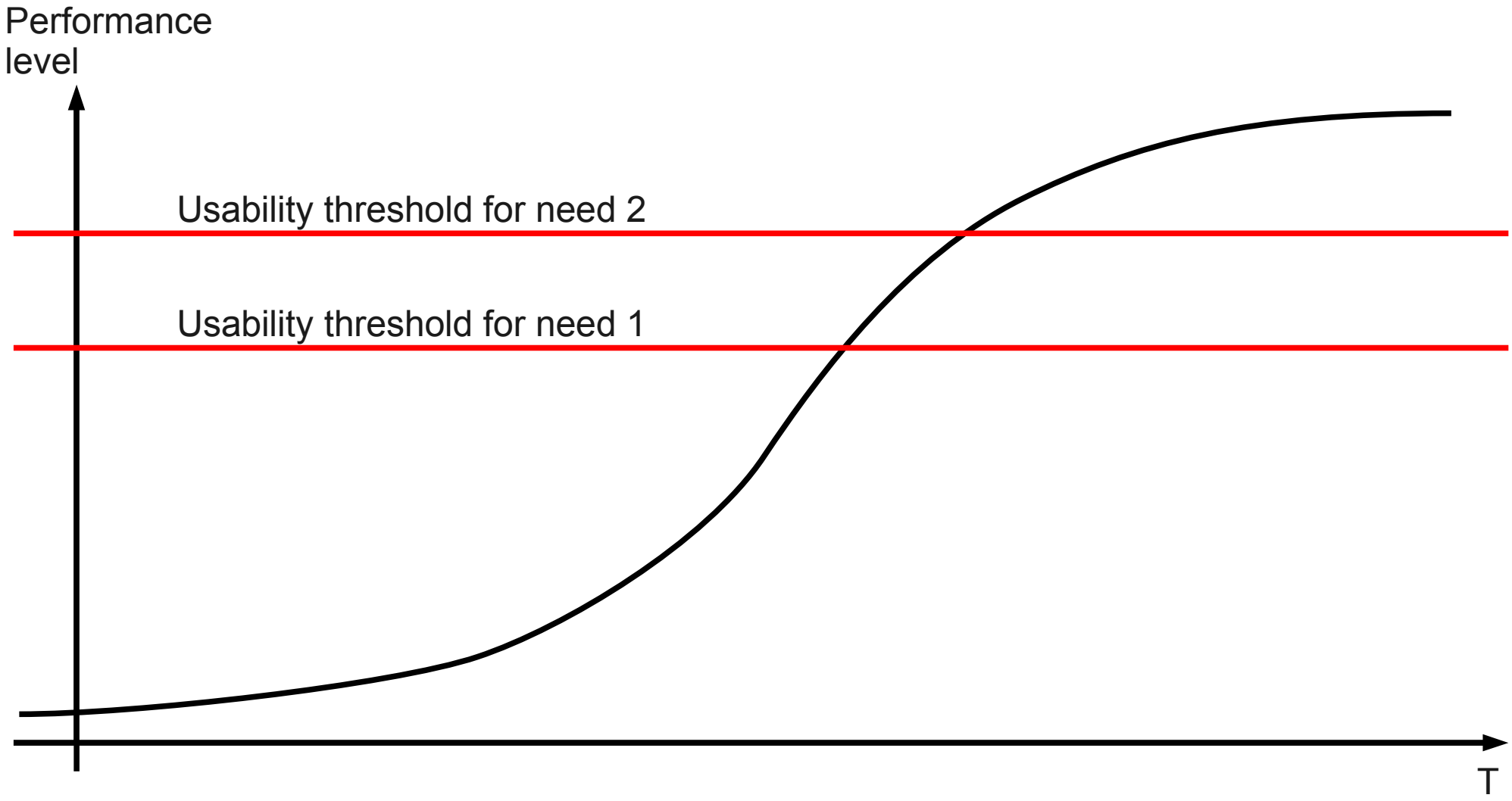
Issues

- Why evaluate?
  - "*We did without it until now. Why change?*"
  - "*It is not a research activity. Why bother?*"
  - "*It creates additional constraints...*"
- How to evaluate?
  - "*It works on the examples shown in the demonstration.*"
  - "*The algorithm is mathematically proven. Isn't that enough?*"
  - "*We conducted user tests. Isn't that enough?*"
  - "*There are publications. Isn't that enough?*"
- Why so much debate?
  - A relatively young science with an even younger metrology
  - A relatively unknown economic model

Technology evaluation vs. usage studies



Technology performance vs. satisfaction of user need



Need for a strong incentive

- A critical component...
  - It represents only a few % of the investments
  - It dramatically increases the return on these investments
- … which must be funded by those who want to see the field make progress as a whole...
  - Campaigns must be organized regularly to measure progress
  - Most of the costs are fixed ones
  - The infrastructure must be open to all to support scientific progress
  - There is no direct return on investment for the party doing the measurements
- … and must be prepared early in project design
  - Data, evaluation and R&D activities are tightly linked and should be jointly designed in integrated projects

Conclusions

- A relatively large but homogeneous domain
  - characterised by the interpretation of data using a model of the world to create new knowledge,
- with a need for manually annotated data
  - representative of the task under study
- and for synchronised evaluations
  - in the form of evaluation campaigns,
- both deserving special attention
  - to really happen and serve the research needs

Thank you for you attention