NRC·CNRC

Institute for Information Technology

Evaluating Productivity Gains of Hybrid ASR-MT Systems for Translation Dictation

Alain Désilets

Marta Stojanovic

Jean-François Lapointe

National Research Council of Canada

Richard Rose

Aarthi Reddy

McGill University

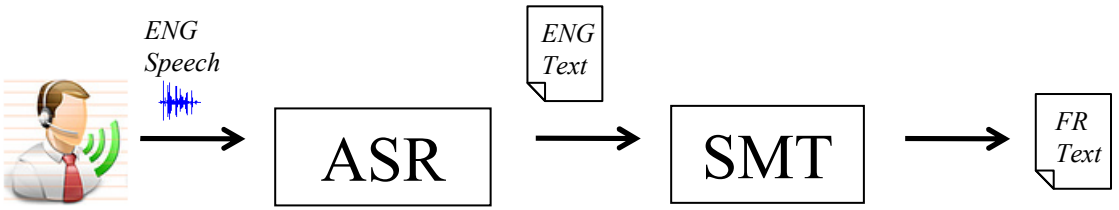
National Research Council Canada | Conseil national de recherches Canada

Canada

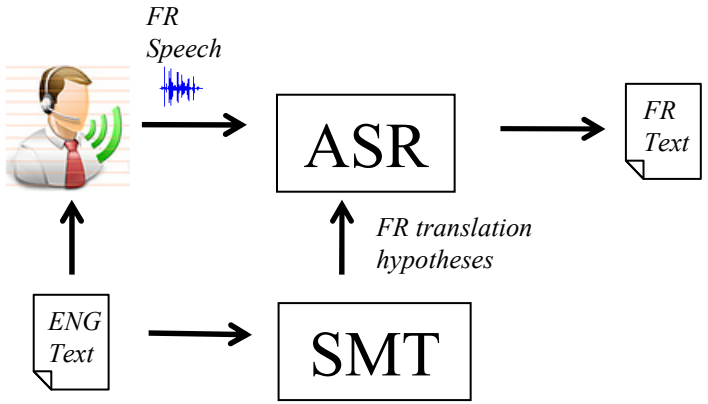
NRC·CNRC
Institute for Information Technology

Spoken Language Translation (SLT) vs Translation Dictation with ASR

SLT



Translation Dictation with ASR



NRC·CNRC
Institute for Information Technology

Spoken Language Translation (SLT) vs Translation Dictation with ASR (2)

For example, say a French source sentence is:

"Je suis en avion en ce moment" (i.e., "I am in a plane right now")

Translator utters:

*"I'm in **a plane** right now"*

Which is one of the ASR's hypothesis, but it thinks it might also have heard:

*"I am in **pain** right now"*

SMT gives high very high probability to word *"a plane"*, given that the source sentence contains French word *"avion"*. Can the ASR system exploit that information?

NRC·CNRC
Institute for Information Technology

Why is this important?

Translation industry is a $ 500 million affair in Canada alone!

Anecdotal reports that translators dictating are MUCH MORE productive than those typing.

> "*I'd guess that with the above setup [two monitors, Trados with capable Translation Memory, and a multi-button mouse],* ***I'm three times more productive*** *than I would be with just Trados and a single monitor. I'd guess that SR is 50% of that boost*"
>
> -- Posted on the SR for Translators mailing list

> "*Speech recognition allows me to input* ***two or three times as many words per hour***"
>
> -- Posted on the SR for Translators mailing list

NRC·CNRC
Institute for Information Technology

Why is this important (2)?

*"My first boss translated using a dictaphone, and he **could keep three human transcribers busy** full time with his recordings alone."*

-- Anecdote collected from a translation professor

*"One experiment that has come to the attention of the Committee indicates that a rapidly dictated translation is almost as good as a "full translation", and takes only about **one fourth the time**"*

-- ALPAC report, 1966

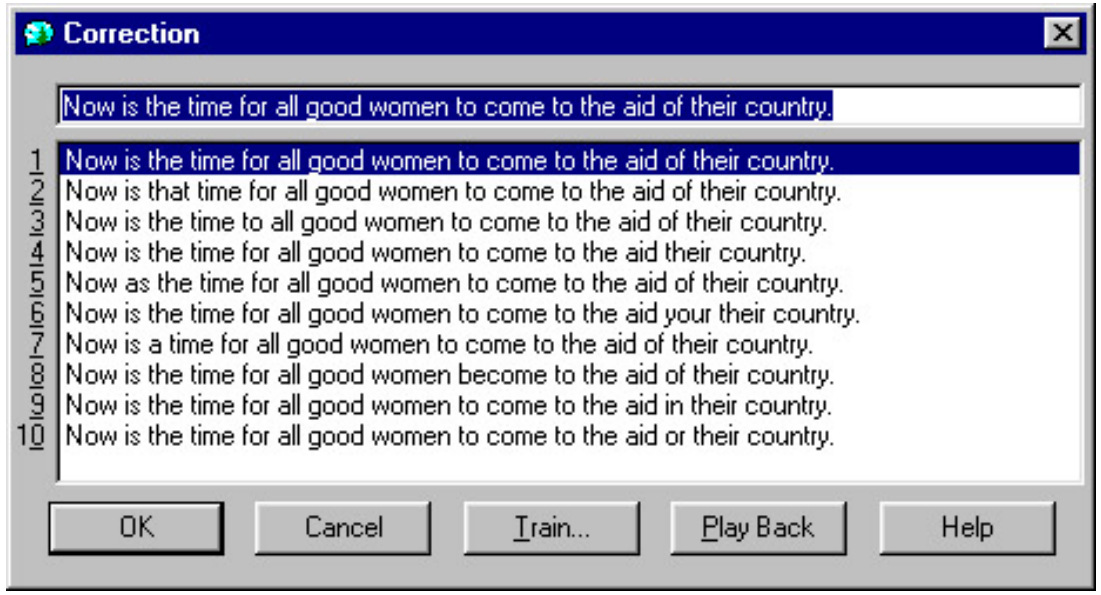
Is this real, or just reports from over-enthusiastic users of SR, or confounded with other variables (ex: experience of the translator)?

NRC·CNRC
Institute for Information Technology

Is this real?

Users of desktop ASR often report that dictation is less productive than keyboard, even with accuracy as high as the lower to mid 90%.

Reason: Error correction is a very time consuming task!!! Fixing a single error can easily require 15 to 30 seconds.



NRC·CNRC
Institute for Information Technology

Research Questions

- **Question 1:** Are current off-the-shelf commercial ASR systems sufficiently accurate to provide a productivity gain for professional translators? And if so, what is the order of magnitude of that gain?

- **Question 2:** Can the productivity gains be increased by combining ASR with Statistical Machine Translation (SMT), in such a way that the SMT system provides hints to the ASR system as to what the translator is likely to utter when translating a particular source text?

NRC·CNRC
Institute for Information Technology

Related work

Question 1: Productivity gains of off the shelf ASR systems for translation dictation

Sinaiko et al.,1963 (cited in ALPAC), is only study, but:

- Description of experiment so vague to be meaningless
- Not done in an ASR context

NRC·CNRC
Institute for Information Technology

Related work (2)

Question 2: Productivity gains of ASR+SMT combinations

Much work done since 1994:

- Brown et al., 1994, Brousseau et al., 1995, Paulik et al., 2005, Kadivi et. al, 2005, Reddy et al., 2007
- Different hybridisation strategies used:
  - Language Model Interpolation (LMI), N-best list re-scoring, word-lattice integration (tight integration)
- Clearly demonstrated improvements in WER

- **But is it enough to improve productivity of translators?**

NRC·CNRC
Institute for Information Technology

Data Collection Protocol

Conducted experiment with 8 professional translators to collect productivity and audio data.

Subjects characteristics:

- Six with >15 yrs expérience, 2 with < 5 yrs.
- 1 using ASR in her work, due to Repetitive Strain Injury (Note: did not impeed her typing speed).
- 1 using dictaphone in her work.
- 2 had used dictaphones during several years in the past.
- 2 had tried ASR before, but not adopted it.

NRC·CNRC
Institute for Information Technology

Data Collection Protocol (2)

Translation task in English->French direction

- Most representative of Canadian, and international situation (English rarely the target language for translation).

Intra-subject protocol

- each subject translated two documents (ST1 and ST2)
- one text translated with ASR, the other with mouse and keyboard.
- text of comparable difficulty and length.
- texts on same subject (Canadian Hansard debate on the involvment of Canadian troups in Iraq).

NRC·CNRC
Institute for Information Technology

Data Collection Protocol (3)

Precautions taken to avoid systematic bias due to choice of text, and order of input modalities.

	ASR first	ASR second
ASR used for ST1	2 subjects	2 subjects
ASR used for ST2	2 subjects	2 subjects

ASR was Dragon Naturally Speaking 8 (DNS8), French edition

NRC·CNRC
Institute for Information Technology

Data Collection Protocol (4)

Preparatory tasks:

- Measure base typing speed.
- Standard DNS8 audio enrolment (avg. 6 mins audio per subject).
- 15 minutes demo on how to dictate translations (included vendor recommended error-correction procedure).
- 15 minutes practice session, dictating translation of a similar document to ST1 and ST2.
- Read ST1 and ST2, and carry out terminology and phraseology searches (max 30 mins). This is a standard best practice for translation dictation.
- **Domain Adaptation using vendor provided facilities:**
  - 3.9 million words of Canadian Hansard, for days immediately preceding (but not including) the day for ST1 and ST2

NRC·CNRC
Institute for Information Technology

Data Collection Protocol (5)

Data collected:

- 49 mins enrolment French speech
- 81 mins French speech from the ASR task, once long pauses were removed (5478 words)
- screen capture for both ASR and Keyboard tasks.
- audio from debriefing interview

Productivity measure

Not Word Error Rate!!! (but we still measured it)

Translated Words per Minute (TWPM) is what translators care about:

TWPM = W / T

T = D + C

- W = number of source text words translated
- T = time taken for translation
- D = time spent dictating (for ASR task only, includes time spent thinking)
- C = time spent correcting ASR errors
- Separation between D and C done by viewing screen capture.

NRC·CNRC
Institute for Information Technology

Productivity measure (2)

Interpolation used to compute TWPM‘ of ASR with any given WER‘.

Assume correction time of each subject is proportional to WER:

$$C' = C_B [1 – (WER_B – WER') / WER_B]$$

Indicative model only:

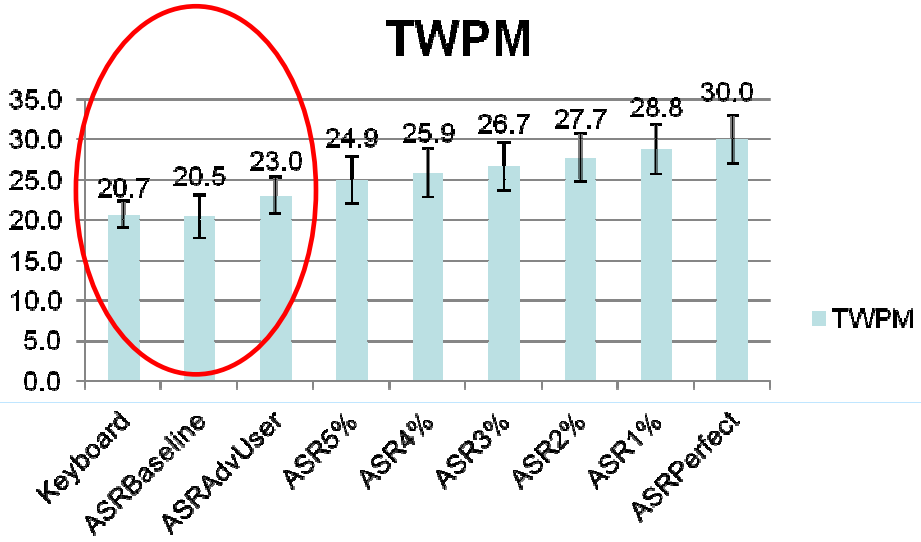
- Assumes relative improvements are the same for all subjects.
- Assumes that all type of errors will improve at same rate.

NRC·CNRC
Institute for Information Technology

Question 1: Are current off-the-shelf commercial ASR systems sufficiently accurate to provide a productivity gain for professional translators? And if so, what is the order of magnitude of that gain?

NRC·CNRC
Institute for Information Technology

Productivity of ASR vs Keyboard



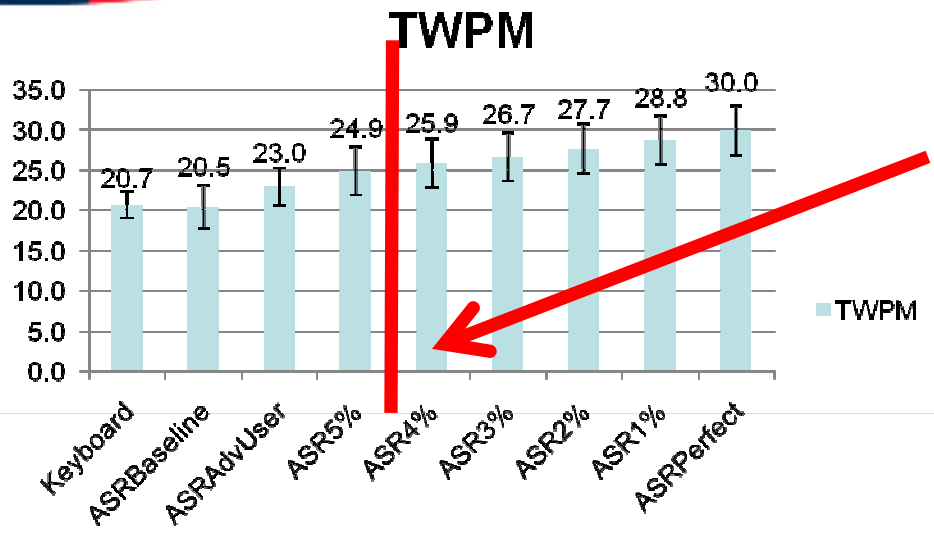
Baseline WER = 11.7%.

ASR no better than keyboard, even when compensating for subjects' lack of familiarity with error-correction procedure (*ASRAdvUser*).

ASR productivity lower on average, and for 5 of the 8 subjects in particular.

NRC·CNRC
Institute for Information Technology

Productivity of ASR vs Keyboard (2)



Statistically significant breakeven point.

ASRs with WER <= 4% would have exhibited statistically significant productivity gains.

Order of 25.1% to 44.9% relative gains.

NRC·CNRC
Institute for Information Technology

Productivity of ASR vs Keyboard (3)

Sheds serious doubts on the very large two or threefold productivity increases claimed anecdotally.

Even the most conservative estimates put relative gains at 44.9% TWPM at the maximum.

The three subjects for whom ASR was better, exhibited improvements of 34.8%, 37.8% and 17.6%, which still falls way short of those claims.

This included one subject who had been using ASR in her work for many years.

NRC·CNRC
Institute for Information Technology

Productivity of ASR vs Keyboard (4)

At a typical 1% WER, current off-the-shelf English ASR systems would be *39% faster for writing first draft of a translation.*

But text entry only about half the work, which also includes:

- Pre-reading
- Terminology and phraseology searches
- Self-revision
- Gain for the whole end-to-end translation task might be closer to 20%.

NRC·CNRC
Institute for Information Technology

Productivity of ASR vs Keyboard (5)

Numbers may not tell the whole story

- *2 subjects used to dictation (ASR or dictaphone) more productive with ASR than keyboard.*
- Debriefing interviews indicate that subjects liked the technology and would consider using it.
- Even though they had pretty realistic evaluation of the productivity gain they experienced (or lack thereof).
- Faith that things will improve with time?
- Will this faith remain after short honeymoon period?

NRC·CNRC
Institute for Information Technology

Question 2: Can the productivity gains be increased by combining ASR with Statistical Machine Translation (SMT), in such a way that the SMT system provides hints to the ASR system as to what the translator is likely to utter when translating a particular source text?

ASR+SMT combinations

Different ASR variants evaluated

ASRBaseline: Domain Adaptation (DA) based on 3.9 million words of Hansard, using the vendor provided facilities (normally used to adapt based on user's email and word-processing documents).

NoDA: No Domain Adaptation performed.

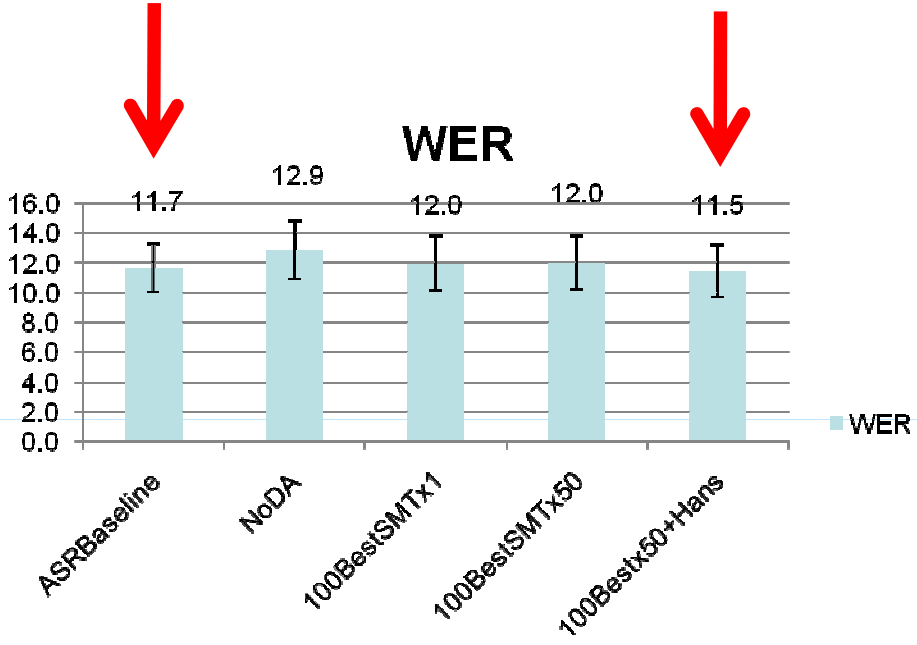
100BestSMTx1: DA based on 100 best translations proposed by SMT system (PORTAGE, NRC), for each of the source sentences. No DA based on Hansard.

100BestSMTx50: Same as above, except used 50 copies of the 100 best translations, to simulate weighted Language Model Interpolation (LMI).

100Bestx50+Hans: Same as above, plus DA based on Hansard.

NRC·CNRC
Institute for Information Technology

ASR+SMT combinations (2)



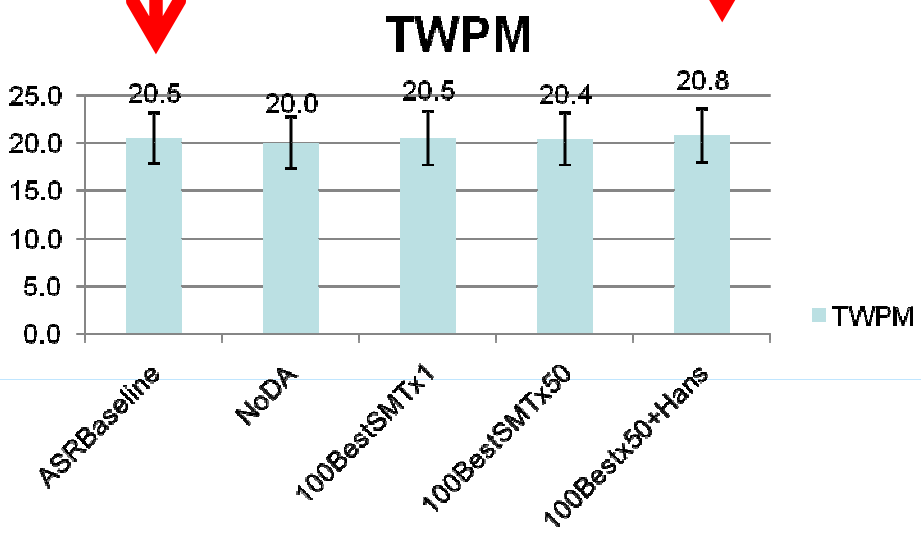
DA based on SMT outputs only had no effect!

Only ASR variants that included Hansard DA were found to be significantly better than *NoDA* variant.

Also, effects of Hansard and MT DA not cumulative

NRC·CNRC
Institute for Information Technology

ASR+SMT combinations (3)



Similar trend if looking at TWPM

Conclusion: ASR+SMT combinations using the ***very limited vendor provided*** Domain Adaptation facilities does not improve WER nor productivity.

NRC·CNRC
Institute for Information Technology

ASR+SMT combinations (4)

Could tighter ASR+SMT integration make a difference?

Maybe…

- Our maximum relative improvement of 11.7% is much smaller than what was reported by Reddy et al (avg 20.8%) for tighter integration, over a similar benchmark.
- But even a 20.8% relative improvement in WER **would not have resulted** in a statistically significant increase in productivity
- More research needs to be done to actually evaluate tighter integration scenarios.

NRC·CNRC
Institute for Information Technology

Conclusions and Future Research

Very large, two to three-fold productivity gains reported anecdotally, are probably greatly exaggerated.

At WER=11.7%, we found Current French off-the-shelf ASR to not provide statistically significant productivity gains for subjects overall.

But users with dictation experience might still get gains with current technology as is.

Users for whom WER <= 4% should experience a productivity gain in the order of 25-45% for entering text of a first draft.

Users of recent English ASR in particular, can expect gains in the order of 39%.

NRC·CNRC
Institute for Information Technology

Conclusions and Future Research (2)

Limited vendor-provided Domain Adaptation facilities insufficient to improve WER or productivity through ASR+SMT combinations.

More research is needed to evaluate impact of tighter integration on productivity.

NRC·CNRC
Institute for Information Technology

Questions?