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Philippe Bolon

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# LISTIC Technical Report 2023-01

Simplified Model of Intercomprehension

Ph. Bolon / LISTIC / Polytech Anancy-Chambéry / USMB



Title: Simplified Model of Intercomprehension

Author: Ph. Bolon

**Abstract:** The feeling expressed by participants at UNITA meetings is that intercomprehension is effective in 2-person discussions, but that larger groups prefer to communicate in English. A simple model can explain this observation. The choice of language depends on the number of participants, their command of the language and the complexity of the discussion.

### Context:

Intercomprehension is the process that enables two people (or more) of different mother tongues to communicate, each in his or her native language. This process is promoted within UNITA, one of the 44 alliances participating in the European Universities initiative of the European Commission.

The native language of the participants is not English. During a discussion, the alternative to intercomprehension is to switch to English, common language within scientific and academic communities.

### Assumptions:

- the understanding process is independent from one participant to another (even if they have the same nationality);
- the number of concepts that can be exchanged is finite;
- the element of discussion is regarded as successful if all the participants understood which concept was emitted by the speaker;
- misunderstanding consists in understanding a concept different from the one expressed by the speaker;
- the probability of misunderstanding is the same for all participants. It is uniformly distributed across all the erroneous concepts;
- the probability of misunderstanding between English and non-English languages is proportional to the probability of misunderstanding between non-English languages. The proportionality coefficient, denoted  $\lambda$  and which could be called 'understanding ratio', is less than 1;
- the probability of understanding is a decreasing linear function of the complexity of the discussion;
- the complexity of the discussion ranges from 0 (very very simple) to 1 (excessively complex).

### notations:

- P: number of participants;
- c: complexity of the discussion;
- N: number of concepts in the element of discussion;
- $P_{IC}$ : probability of communication success in the intercomprehension mode;
- $P_{EN}$ : probability of communication success in English.

Without loss of generality, the speaker is participant #1, having native language L1. L2 to LP are the native languages of the other participants.

### meeting in intercomprehension mode

The block-diagram of the discussion is given in Figure 1.

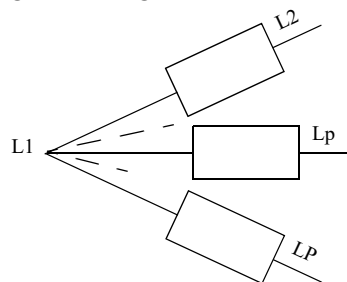


Fig. 1: Block-diagram of intercomprehension mode

The probability of communication success is:

$$\text{Eq. 1} \quad P_{IC} = [1 - c]^{P-1}$$

It is a decreasing function of the complexity and the number of participants.

### meeting in English

The block-diagram of the discussion is modified as shown in Figure 2. Speakers have to translate concepts from their native language into English. Listeners translate from English into their native language..

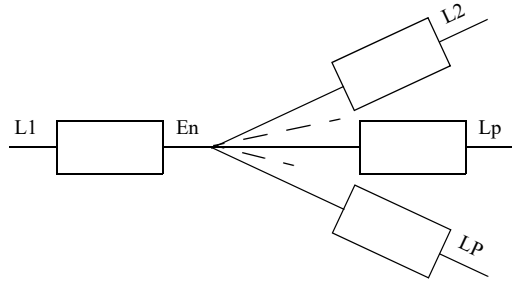


Fig. 2: Block-diagram of English mode

The probability of communication success is:

$$\text{Eq. 2} \quad P_{EN} = [1 - \lambda c]^P + \frac{[\lambda c]^P}{[N - 1]^{P-1}}$$

The second term of the right hand side corresponds to a paradoxical success by means of the compensation of translation failures. In realistic situations, this term can be neglected.

### experimental results

Let P = 2 to 10;

Let  $\lambda = 0.75$ ;

Let us define the intercomprehension efficiency gain by:  $G = P_{IC} - P_{EN}$ .

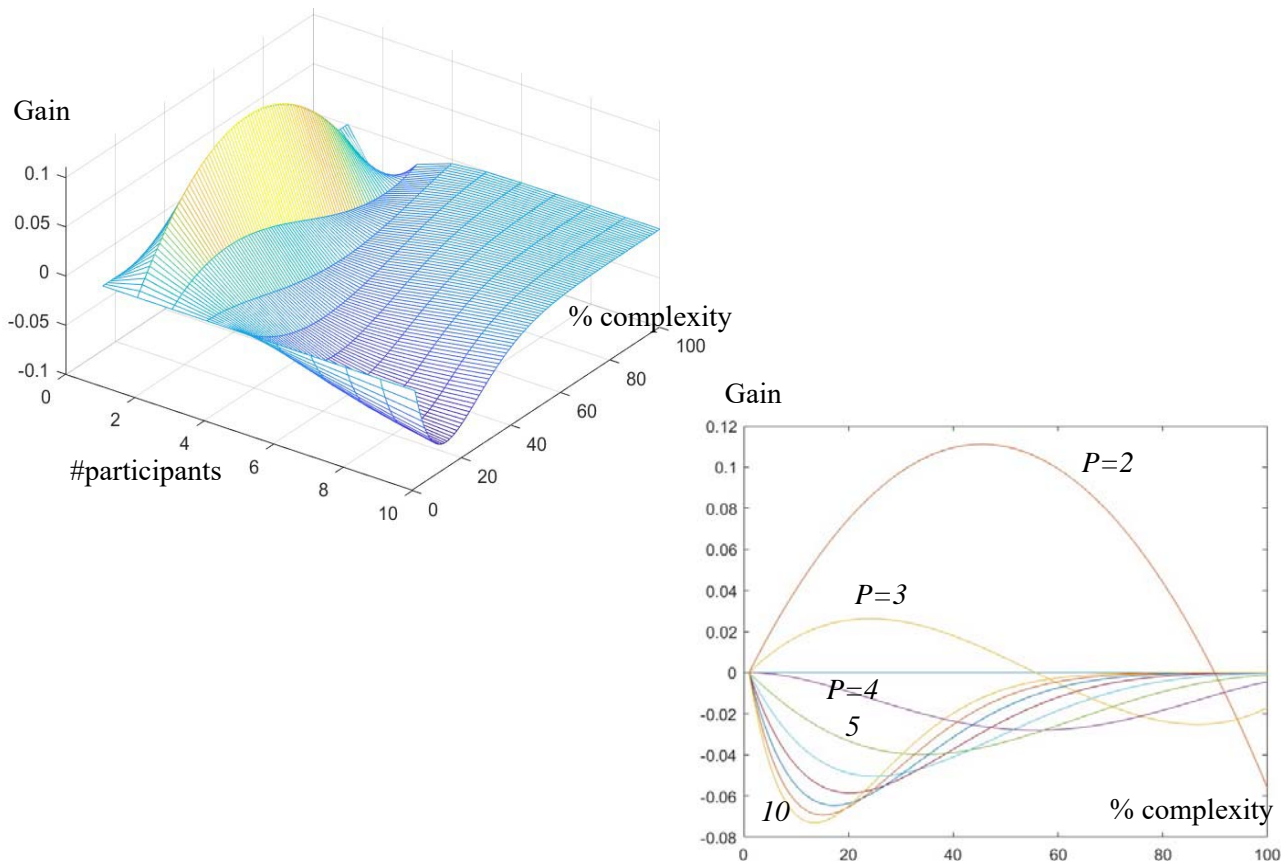


Fig. 3: Intercomprehension efficiency gain as a function of the number of participants and of the discussion complexity

Figure 3 shows that for lower numbers of participants and reasonable discussion complexities, the intercomprehension efficiency gain is positive, meaning that using natives languages is more efficient than switching to English.

It can be shown that, for any complexity level, there is a maximum number of participants for which intercomprehension is the best solution.

Conversely, for a given number of participants, there is a complexity threshold under which intercomprehension is the best mode.

Threshold values depend on parameter  $\lambda$ .

### conclusion

The concept of discussion complexity and its impact on the probability of successful communication should be refined. Nevertheless, though the communication model is simplistic, it allows to justify the feeling expressed by participants at international meetings and the interest of intercomprehension studies.

### Appendix 1: Participant number threshold

For any complexity level  $c$  and understanding ratio  $\lambda$ , there exists a threshold  $P_0$  such that, if the number of participants  $P$  is less or equal to  $P_0$ , then the interncomprehension mode is more efficient.

$$\text{Eq. 3} \quad P_0 = \left\lfloor \frac{\ln\left(\frac{1}{1-\lambda c}\right)}{\ln\left(\frac{1}{1-c}\right) - \ln\left(\frac{1}{1-\lambda c}\right)} \right\rfloor$$

with  $\lfloor P \rfloor$  denoting the floor function.

Figure 4 shows that the participant number threshold is an increasing function of the understanding ratio and a decreasing function of the discussion complexity

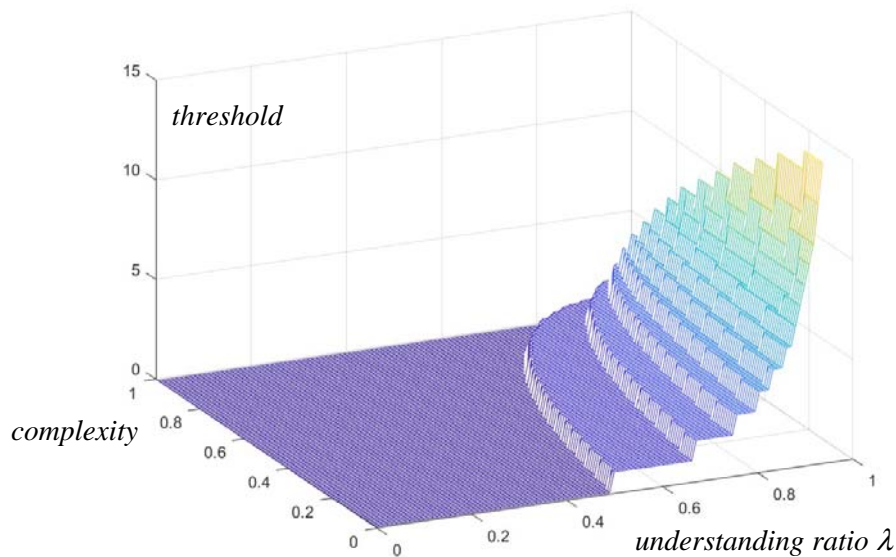


Fig. 4: Participant number threshold