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CAB COMPUTER-SPEAK LANGUAGE: DEVELOPING MULTILINGUAL AUDIO AND VISUAL COMMUNICATIONS SYSTEMS FOR TRANSMANCHE TRAINS

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ABSTRACT

High-speed BR, SNCB and SNCF trains will run through the Channel Tunnel from mid-1993 to link Brussels, London and Paris with a regular passenger and freight service. Drivers and controllers will use a common, tri-lingual (Dutch, English, French), in-cab, computerised, display system with a bilingual (English, French) radio-telephone back-up to regulate train movements along the whole route. In this paper, the two systems are outlined and their role in ensuring safe and efficient multilingual communication is described.

INTRODUCTION

All transport systems have evolved communication procedures with similar characteristics to deal with a common problem; how to ensure that moving vehicles (aircraft, ships, trains) proceed on course, safely and efficiently. These two criteria (safety and efficiency) are, inevitably, in opposition to each other. It would be possible to devise a system of communication which was highly efficient (fast and without repetition or any other kind of redundancy) but unsafe, since it did not allow for error introduced by the medium of communication or the users themselves. There is, clearly, a trade-off between the two requirements and the ideal, actual system would be a rational compromise between them.

The majority of rail travellers probably assume that cabbies, airline pilots and engine drivers are all in constant electronic or voice contact with ground control; dispatchers, air traffic controllers and signallers, respectively. So it comes as a bit of a surprise to discover that, despite the railway's admirable safety record, this is far from the case and that, paradoxically, the majority of trains are still controlled by a technology which betrays its 19th century origins (semaphore signals) or its 20th century up-dates (light signals or track-circuit indicators).

With the advent of high speed trains - the current TGV speed record in France is 515.3 kph (310 mph) - operating across linguistic as well as political frontiers, has come the inevitable demand for a far more sophisticated control and communication system if the service is to be run efficiently and safely into the 21st century.

Although sea, air and rail traffic have to be controlled in similar ways, the context of their use greatly influences the kind of communication system that has evolved in each case. Essentially, it is a question of physical dimension; aircraft move in three dimensions, ships in two and trains in only one. The implications of this are important in themselves but assume far greater significance when combined with other variables, particularly the nature of the interaction (one-to-one, one-to-many) and the quality of the medium employed (variability of signal strength, for example).

In the 1980s, the demand for the international regulation of both air and maritime traffic led to the design and universal acceptance of internationally recognised limited varieties of English - *Airspeak* and *Seaspeak* [Weeks 1988], respectively - and, now, a similar limited system deriving from them for railway use is in course of being created by a consortium of British and French applied linguists (in London and Nancy).

RAILSPEAK

The international language of rail traffic control which is currently under development [Bangs et al 1992] shares, as might be expected, many characteristics with air- and sea-speak but, equally, differs from them in a number of highly significant ways:

1) It is limited to driver-signaller interaction

2) It operates only through a single channel radio -telephone

3) It acts as the verbal realisation of previously agreed operating procedures

4) It has been designed in accordance with agreed

linguistic principles for the creation of limited languages.

5) It is, uniquely, realised in two forms; English and French.

While the automatic messages displayed on the driver's VDU can be received by moving trains, actual voice contact is only possible when trains are stationary. The reason for this is not a defect in the system but a safety requirement tied irrevocably to an order of actions which is completely fixed and imposed by the regulations: STOP-SPEAK-WRITE-REPEAT-DISPLAY-AUTHORISE.

The in-cab computerised and radio-telephone systems which Transmanche trains will use is described below.

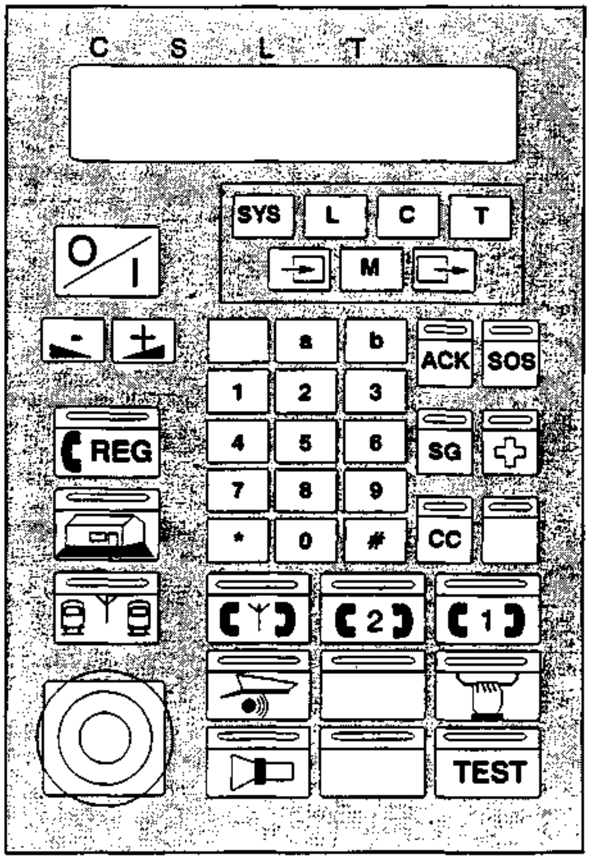
THE COMMUNICATION SYSTEMS

Belgian, British and French trains will all be regulated by the same visual and audio systems which will link drivers and signalmen through VDUs and radio-telephones. The driver's VDU will provide both an automatic display of technical information about the train itself - it will monitor the state of its engine, the speed it is travelling at etc - and a display of information and instructions from the signaller who will have an almost identical display - plus a message library - in the signal-box. In addition, there will be a dedicated radio-telephone link between cab and signal-box which will permit spoken communication between the two on a single closed channel.

In actuality, there are several differences between the systems used on the three networks - SNCF messages consist of fixed acronyms and expansions *(BEST-PROC: divagation bestiaux selon regu* i.e. animals on line; proceed as ordered by signalman), while BR messages can have variable data inserted in them; spoken communication in the SNCB area has to be through trackside telephones rather than, as in the cases of BR and SNCF, from the cab itself - but these differences are (one imagines) minor and/or temporary, so we shall limit ourselves to what is common among the three systems and, in particular, to driver-signaller communication.

The driver will control both the visual and the audio systems with a panel of the type shown in figure 1 below.

Figure 1
Driver's control panel



AUTOMATIC VISUAL MESSAGES

The automatic messages which appear on the VDU in the cab and originate from the signaller and are limited in ***content*** (single fixed field messages or one fixed and one variable field messages), ***form (*** two lines with a maximum of 16 characters per line) and ***number*** (54 are currently installed for British Rail systems), though there is ample spare capacity (sufficient for a further 105 two-line messages)

Since the system is to be used by drivers who normally communicate in one of three languages - Dutch, English and French - the displays are available to drivers in all three. There is, of course, a parallel here with the language choices - English, French, Spanish - users can make to call up the instructions messages on Mercury telephones.

A typical set of examples would be:

ENGLISH	FRANÇAIS	NEDERLANDS
PASS SIGNAL AT DANGER W XXXX	FRANCHISSEZ SIGNAL "AT DANGER" W XXXX	OVERSCHRIJD SIGNAL "AT DANGER" W XXXX
PROCEED AT CAUTION TO SIGNAL AD XXXX	MARCHEZ "AT CAUTION" JUSQUE SIGNAL AD XXXX	RIJD "AT CAUTION" TOT SEIN AD XXXX
COAST PANS DOWN AS RCC INSTRUCTS	BAISSEZ PANTOS SELON ORDRES RCC	LAAT PANTOS NEER NAAR BEVEL RCC

AUDIO MESSAGES

In keeping with the absolute and over-riding priority of safety, the automatic system has to be backed up with a spoken system not only in case of failure but also because of the limitations inherent in it as a communication system.

The automatic system is certainly very efficient and an enormous advance on present means of communication but it suffers from being what it is; an automatic and highly sophisticated signalling system. It therefore possesses the limitations of being a closed, restricted and only crudely context-sensitive system - an artificial language - which lacks the flexibility, open-endedness, vitality and creativity we expect and find in the highly context-sensitive system we know as natural language. The automatic system's drawbacks are that it can cope only with the predictable, has no way of extending its scope when faced with the unexpected event and lacks the resources to expand its structure to provide explanations or deal with unexpected queries.

The spoken - RAILSPEAK - system is being designed with in-built characteristics which will neutralise the inevitable weaknesses in the automatic system which would otherwise reduce the accuracy and quality of communication between driver and signaller. It is, in a particular sense, also restricted in that there is a fixed one-to-one relationship between the structure of the message ***form*** - its syntax and lexis (grammar and vocabulary)

- and its ***function*** (meaning). For example, the verbal realisation of the automatic display PASS SIGNAL AT DANGER AD 0125 must have the form "You are authorised to pass signal W one two fife at danger" and no other. Natural language alternatives such as "You can/may/pass the signal..." will not do.

A reduced, limited language of this kind can be justified in several ways; 1) the potential ambiguity and uncertainty of unconstrained natural language is avoided, since each message is uniquely associated with and realised by a single message form and each message form has a single unique meaning and 2) the learning load for the driver who is operating in a foreign language is greatly reduced, as, indeed, are many of the otherwise inevitable difficulties of comprehension on both sides. After all, it is important to keep in mind the context in which this communication will take place; highly stressful moments of departure from the normal routine during which the driver and signaller are fully - and rightly - occupied with dealing with the problem which has disrupted the routine and cannot afford to be distracted by irrelevant uncertainties introduced by the communication system itself.

A taste of how this will work is given below; the procedures and communication involved in passing a BR signal at danger.

PASSING A BRITISH RAIL STOP SIGNAL AT DANGER

[Driver brings train to stand at signal.]
[Driver presses SG key.]

[Audible alarm sounds in signal-box.]
[Signalman's VDU shows:]
[9002 *AD 0123 standing at signal*]
[Signalman calls driver.]

[Driver's radio display shows:]
[*SPEAK*]

D Hello. This is the driver of train
niner zero zero wun at Signal
Alpha Delta zero wun too three.

Over.

S Hello driver niner zero zero wun.
This is Ashford Signals.

International Procedures Book
page zero four wun.

Over.

[Signalman calls up his message library.]
[Sets up both messages with variable data.]
[Signalman's VDU shows:]
[*Procedures book 041*]
[*Pass Signal at danger AD 0123*]
[Proceed *at caution to Signal AD 0125.* }
[System prompts:]
[*Is this correct?*]
[Signalman presses Y]

[Driver opens procedures book to page 041]

D This is driver niner zero zero wun.

International Procedures Book
page zero four wun.

Pass your message.
Over.

S Driver niner zero zero wun.

There is a Track Circuit failure ahead.

Pass Signal Alpha Delta
zero wun too three at danger.

Proceed at caution to
Signal Alpha Delta zero wun too fife.

Display follows. Wait.

[Driver completes the tear-out segment]
[of page 041 in the Procedures Book]
[Signalman presses **ENTER**]
[Signalman's VDU shows:]
[*Calling - await driver data*]

[System sends message to driver:]
[Driver's radio display shows:]
[*Enter variable data.*]
[Driver uses key pad on]
[radio to key-in:]
[*0123* and *0125*]
[Driver presses * button.]

[System sends signal-box:]
[*0123* and *0125*]
[System verifies electronically]
[Signalman's VDU shows:]
[*Pass Signal at danger A D 0123*]
[*Proceed at Caution to*]
[*Signal A D 0125*]
[Signalman checks accuracy]
[System prompts:]
[Press *ENTER to send*]
[Signalman presses **ENTER**]

[System sends to driver:]
[*Pass Signal at danger A D 0123*]
[*Proceed at caution to*]
[*Signal A D 0125*]

[Signalman's VDU shows:]
[*Message sent*]

[Driver reads and understands.]
[Driver presses **REG** button]
[to call signal-box]

[Signalman's VDU shows:]
[*9001 AD 0123 calling*]
[Signalman sends:]
[*Speak*]

D This is driver niner zero zero wan.

Message reads

Pass Signal Alpha Delta
zero wun too three at danger.

Proceed at caution to Signal
Alpha Delta zero wun too fife.

Over.

S Driver niner zero zero wan.

Affirmative.

You are authorised to proceed.

Goodbye.

Out.

RAILSPEAK is still in its infancy and there is a good deal left to be resolved; particularly how we are going to match English and French realisations of the same messages in a consistent way which facilitates communication and learning. We are hoping that the differences between us are minor but are given pause by the SNCB colleague who declared that, for him, 'Franchir un signal à danger; ça c'est entrer dans une autre philosophie ferroviaire' (passing a signal at danger gets you into a different railway philosophy!). Clearly, we have not found all the answers yet but are working rapidly towards them in concert with colleagues in France and Belgium and need to come to a satisfactory conclusion quickly, since we have an absolute deadline to meet. The system must be available - piloted and revised as necessary - when services through the Tunnel start and, indeed, well before that, since those involved will have to be trained in its use and to a level of competence which precludes error.

The challenge is enormous and, as linguists whose discipline is so often thought of as dry and academic, we are delighted that our knowledge and skills are being harnessed in such a socially useful way.

And now, as the Train Captains will soon be saying:

Ladies and gentlemen. The buffet is open.

Mesdames et messieurs. Le snack-bar est ouvert.

Transcription conventions

1. Non-verbal communication and other actions are enclosed in square brackets: [D presses SG key]

2. VDU/Radio display messages are shown in italic: *9001 AD 0123 standing at signal*

3. S = Signalman.

4. D = Driver.

5. The international VHU broadcasting conventions are used for a) the exchange procedure ("over" etc) and, b) the pronunciation of letters and numbers: "Alpha", "niner" etc

Bibliography

Bangs, P., et al. 1992, *"En train de parler;* testing the French of Channel Tunnel train drivers" 10th GALA Congress, Thessaloniki.

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