Computer-Aided Semiosis. Threads, Trends, Threats.

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Abstract: Being aware of the gap between technological offers and user expectations, the paper aims at illustrating the necessity of anthropocentric designs ("user-pulled") and at revealing the dangers of current ICT designs ("technology-pushed"). Since the gap is deepened because of insufficient innovative use of new agent-oriented technology potential, an affordable manner to "invent new Computer-Aided *x*" application domains is proposed. To substantiate the approach, the domain must be immediately useful, challenging, easy to implement and "as humanist as possible": ***Computer-Aided Semiosis***.

Key-Words: Agent-oriented software engineering (AOSE); anthropocentric trans-cultural interface (ATCI); Computer-Aided Semiosis (CAS); transdisciplinarity.

1 Introduction

A relevant indicator of the relationship between users and agent technology is that even very educated people don't realise the peculiarity of the frequent question (with a lot of variants): "What agent is better?" Strange is not the question itself (for instance, the price-performance ratio can be critical for anyone) but from the weird prioritisation: very few users ask such questions *after* having answers to more burning ones such as: "What could I expect from agents?" or, at least, "If I need *something*, how could agents help?". Scared by esoteric acronyms, "technology-pushed" users are sure that some of these unknown beasts will invade their lives (the only palliative: choose a palatable one). Such "technological determinism" is not distinctive for agents but here the impact is paramount.

User impact of agent technology. Oddly, some of the user impact of ICTs (Information and Communication Technologies) stems from reversing three questions: "What for?" (the *aim*: the needs to be addressed); "What?" (the *architecture*: prospective application portfolio, features, pros and cons, etc.); "How?" (the *structure*: technological basis best suited to the applications). Thus, the paper tries to redress the balance from an end-user stance, proposing a user-centred one: "What for?" (to get help easy, fast and almost for free); "What?" (new application domains become affordable); "How?" (a rather different stance: users should impose their needs instead of surrendering to ICTs). Hence, the negative impact of ICTs is partially rooted in the uncertainty caused by the inability to assimilate the magnitude, complexity, diversity, and pace of new ICTs (above all, agents [1]). On the other hand, increased possibilities to interact with other humans or agents have a definitely positive impact. Clearly, such features widen substantially the field of existing application domains and ease the emergence of new ones (as shown below). Thus, the impact (positive or negative) is wrongly attributed to agent technology *per se*, since it is due rather to its *applications*.

Motivation. The myth of "inexorable technological determinism" (never truly dead but revived by each powerful technology, such as agents) can be expressed as "modern technology is dangerous for human values; hence, it should be avoided or at least denounced". As "Zeitgeist"-component, such myths, widening the gap, impair transdisciplinarity [4]. A possible solution: an anthropocentric perspective.

To be relevant the endeavour should address a noteworthy real-world problem: *Trans-cultural interfaces*, i.e. interfaces able to merge the two complementary premises of a communication between humans belonging to different cultures within the EU: preserve cultural identity; create a common denominator between national identity and the European one. The *threads* (connotation: train of thoughts) try to explain the need as well as the principles of user-centred design, considering the macro-features promoted by agent technologies. The *trends* take into account the near future, extrapolating current developments. Finally,

describing the *threats* is the very means to give a warning that the ground is treacherous. To be credible the caveat shall refer to well known and blatant situations; hence, the approach must be based on (counter)examples from a challenging, easy to implement and "as humanistic as possible" domain. Unable to find an appropriate domain, the paper proposes an original, non-existing one: *Computer-Aided Semiosis* (CAS).

Other motivations are: a) To help designing interfaces for an ongoing project in the closely related domain of e-Learning [12]. b) To suit the trans-cultural communication needs of Sibiu in 2007.

History. The prehistory (before 2004) of this undertaking includes three distinct but interrelated fields: anthropocentric systems; affective interface agents; threats related to the deepening divergence between ICTs and their end users. (Twelve related papers are referred to in [2], [3].) The history (2004-2007) includes some papers in Romanian and calls to more political will to confront the threats regarding e-democracy and transdisciplinarity [4], [6], [11], [13]).

2 Anthropocentrism Today

The problem will be dealt with in three steps, corresponding to decreasing abstraction levels: A) anthropocentrism in general (concepts and rules); B) anthropocentrism shaped from the perspective of macro-features facilitated by agent technology; C) anthropocentrism as groundwork for designing trans-cultural interfaces.

A) Only the basic ideas necessary for this paper are presented here; details can be found in *Appendix II (Anthropocentrism, from Ptolemaios to IT)* of [2].

Anthropocentric approaches became common in IT, firstly in industrial systems: "balanced automation" tries a reasonable compromise between former technology-based approaches and new, human-based ones. However, despite an emerging consensus that context does matter, human factors in different environments are still ignored or undervalued. The main macro-architectural features looked-for are *flexibility* and *user-friendliness*. An immediate corollary is: anthropocentric interfaces are crucial for any applications involving intensive human-computer interaction (HCI). To meet the challenge, the HCI community developed methodologies for incremental anthropocentric system design. Two approaches can be observed: *consultative design* (let decision-making power to technicians, users being simply sources of information with little or no direct influence) and *cooperative design* (strongly involves selected users giving them the chance to influence the final system). Anyhow, the design of truly anthropocentric systems has to be carried out by interdisciplinary teams including psychologists, teachers, software engineers, mathematicians, system analysts, and specialists of the particular fields involved.

Some principles of "anthropocentric design" are:

a) Work must be easy for humans, not for computers (interface complexity should be the burden of the system).

b) The shift from interacting with *an instrument* towards interacting with *an assistant* has to be acknowledged and promoted.

c) Anything visible to the user regarding system behaviour or structure, excepting the interface, is useless and might become harmful.

d) The design should stimulate users in adopting new working styles and/or acquiring new skills.

To date, the challenge is far from being met.

B) In the case of balanced automation, the conceptual evolution was limited, aiming only at improving overall system efficiency, i.e. the focus was not on *user-friendliness* but on *ergonomics*.

Thus, the slogan "information for everyone, anytime, everywhere" becomes within reach in the near future: information changes its status from a (relatively) costly *resource* to an inexpensive *utility* (i.e., a commodity or service). Unfortunately, this becomes a mixed blessing (see Section 5).

C) Corollaries from A) and B): The greater the application complexity, the more need for an anthropocentric approach. Anthropocentrism manifest itself only by interacting through an interface. An application is anthropocentric *iff* (if and only if) its interface is anthropocentric. Thus, complex applications involving intense interaction require a careful interface design. Trans-cultural interfaces are both complex (mainly, cognitively) and interaction oriented. (It was the main reason to choose them.)

Moreover, like the rest of nature, humans are *multimodal* (i.e., they use a blend of concurrent communication means based on at least two of the main interaction channels: visual, auditory, and haptic) [3]. Whilst nature was multimodal from the very beginning, ICTs become so too (multimodal communication becoming affordable). Hence, anthropocentric interfaces must be *multimodal* [2].

3 Approach: Examples, Not Models

Following the outline in the motivation: a) the approach must be based on (counter)examples; b) to

be blatant those must refer to application species where culture (in its different connotations) has a critical role to play; for instance, CAx (Computer-Aided x); c) to focus on the hard core of users, x should belong to humanities; d) since humanities professionals do not trust (especially new) ICTs such a domain is hard to find; e) if not found, the domain should be invented considering plausible and major worries; "Trans-Cultural Interfaces" is a possible domain and to make it perturbing (or even frightening) too, challenging ideas were necessary to convert it into a yet non-existing "Computer-Aided Semiosis". To accept this mutation, it has to be explained in some detail:

Why "examples"? The quotes try to prevent the question from looking childish. The actual question is: Why can the ideas not be exemplified, as usually, by a functional application and why is it necessary to resort to small pieces of virtual applications as examples? Because of:

- "e-Zeitgeist" repercussions: any application shall be a) "just in time", b) extendable for global use, and c) responding to a socially significant, genuine, and relevant user request/need.
- Commercial inefficiency of "solutions in search of problems": before any request, applications must be designed and eventually implemented as fractions with a limited scope, having just enough functionality to become suitable examples. Any polished design is counterproductive.
- The previous reasons are even more pertinent for an innovative domain yet in embryo where the request itself is fuzzy.

Why Computer-Aided Intellectual Activities (CAx)? There is always a "new frontier" (new research horizons at hand): as regards anthropocentrism in IT an old battlefield exists from the early 70's. Thus, the role of algorithmic reasoning transcended the borders of narrow data processing, penetrating "Computer-Aided x", where x stays for almost any intellectual activity. As a result, "algorithmic reasoning", instead of being perceived as a side effect of "analogue humans loosing the battle with digital computers", became a deeply rooted reasoning paradigm. (Thus, an innovative approach is welcomed [5].)

On the other hand there are previous threads related to CAx representing conceptual seeds for CAS such as semiotics of: maps, architecture, design, scenario and music (musical notation, composition and conducting). However, semiotics as theory of signs, despite its major role, has a limited number of end users. On the contrary, the message receiver understands the meaning of the message through the process of semiosis, i.e., thus the receiver "fills the message with significance" [8]; hence it is vital for any communication and is strongly dependent on the cultures involved [7].

Why Trans-Cultural Interfaces? The reasons are linked and somehow embedded. The essential one is that ICTs (mainly broad-band) allows an easy implementation of multimodal interfaces. Besides, the broader "Perceptual Bandwidth" (name for the palette of sensorial experiences accessible to humans) obtained as a consequence allows the use of also other languages than the spoken/written ones (for instance, body language) [3].

Since some of those sign languages are "more trans-cultural" than speech, trans-cultural interfaces should be used as technological infrastructure for the new kind of "less data-oriented computing" (labelled by Zadeh as "computing with words") could be extrapolated to "computing with gestures". Besides the reasons above, research can be linked to more general trends in modern IT (for instance, software adapted to the semantic web or to e-Learning).

4 Architecture

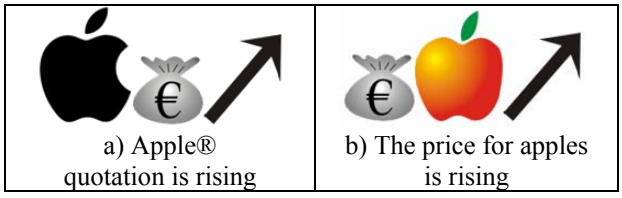
In the intention to narrow the existing gap between the two stances – the technocentric perspective and the anthropocentric one – tools must be created to make the most of AOSE. Main macro-architectural feature: translation will progress from textual, semantically correct, to multimodal, culturally adequate, based on common concepts and "grammar" (rules to combine them into meaningful sentences).

The ATCI should be able to "translate" the terms using tools designed by a transdisciplinary team. The example in Figure 1 illustrates a correspondence depending on the conversation context (for instance the moneybag put at the right of the apple symbolises a stock exchange context for Apple Computer Inc., Figure 1.a, whereas the same moneybag at left symbolises the market price, Figure 1.b).

The apple is chosen as (counter)example since:

- As an item per se (fruit) it is known all over Europe (apple = pomme, Apfel, mela, manzana ...).
- Being known from prehistoric times it generated a lot of metaphors, symbols, sayings and even traditions (apple alone = fruit, associated with snake = temptation, associated with arrow = struggle for freedom or even the image of Wilhelm Tell).

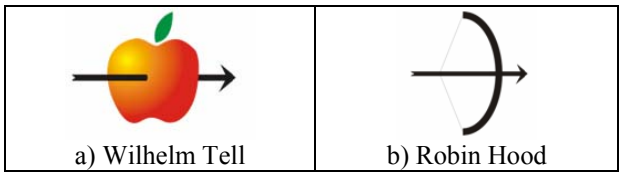
- Linguistic and/or cultural differences are imprinting a particular style in speaking (connotations, subtlety of language) and, moreover, the use of such metaphors stemming from different cultural environments and heritages. Some of them are common to almost all European peoples (e.g. the apple symbolising or suggesting: temptation, computer logo, and so on, see Figure 1 and 2).
- Nevertheless, some of those metaphors are rooted only in some regions or, if they are widespread, they are relevant only for subpopulation with a higher degree of education; thus trans-cultural interfaces help against distorting the "intentions" (according to Eco: "intentio auctoris", "operis" and "lectoris"). Otherwise, the 'intentio lectoris' could be so altered that the communication process is a failure [3] (see Figure 2).



a) Apple® quotation is rising | b) The price for apples is rising

Fig. 1. Two ways to 'translate' the item apple as 'common denominator' metaphor

Figure 2 is meant as a counterexample, revealing the necessity of anthropocentric interface design. Thus, if the conversation context is "struggle for freedom" the cultural differences between the continental German cultural tradition and the English one cannot be neglected: the apple (suggesting Wilhelm Tell) had to be put in correspondence with a bow (suggesting Robin Hood); otherwise, treacherous equivalence can destroy the communication process.



a) Wilhelm Tell | b) Robin Hood

Fig. 2. A third way to 'translate' the word apple. The apple and arrow icons usage taking into account cultural differences.

As shown in several surveys [10], [15] people from different countries tend to accept diverse kind of icons depending on the nature of their design (from realistic to abstract). The images in Figures 1 and 2 are only partially abstract. Special attention must be paid when designing such an interface, first of all to the icon sets used. As shown in [14] icons are straight-forward when they represent nouns or objects but rather hard to understand when representing actions or verb forms. Moreover, if new icons should be designed they have to satisfy quality standards, to be classified as successful [9]. Also, designing new icons can be a threat because they can lead to a potentially confusing situation where different symbols have the same meaning or, vice-versa, have different meanings in different cultures; thus, existing icons should be used whenever possible. That is why trans-cultural interfaces are difficult to conceptualize albeit they are easy to implement.

Figure 1 is somehow inspired also from ancient Maya communication techniques, where more subtle differences can be expressed: semantic value is assigned to the iconic space itself. The icon relative position has *syntactic* role (in line with ontology rules) and *semantic* role for CAS (to reduce the differences between 'intentio auctoris' and 'intentio lectoris') as depicted in the Figure where the icon pairs 'moneybag + apple' and 'apple + moneybag' have different meanings. This kind of multimedial ontology based on visual rules can be further enhanced by using animations instead of images.

5 The mixed blessing: agents help, their misuse may be a threat

Since agents cannot be assessed without several functional applications, below are presented only the most likely facets that can be expected:

Potential benefits. The most obvious benefit is the possibility to use "face-to face" languages. (Better said "to use again", after being leaved out for more than a century by telephone and later by radio too.) Just one example how signs can weaken the well-known Babel-Tower hurdles, so active in our arabesque-like Europe: an already internationally widespread gesture is the simple placeholder for "quotation marks", "Anführungszeichen", and so on, the long way to the Basque "gakotxak" [3]. Moreover, the Perceptual Bandwidth enables a much better semiosis when different messages express the same meaning in the same time (synchronous multimodality), because a combined stimulus generates amazing synergy (the reaction time is under the minimal value for separate stimuli).

Another benefit is the chance to reduce drastically the risks of "Traduttore-traditore". Thus, a bullfighter image can ease French-Spanish communication since "toreador" is not a Spanish word (it has to be replaced by "matador" or "torero", see Figure 3). Multimodal interfaces allow also humans to get rid of the pressure of (spoken or

written) text, enabling a major upgrade in communication granularity: one *idea* instead of (many) *words*. Of course, that is even more valuable in trans-cultural communication.

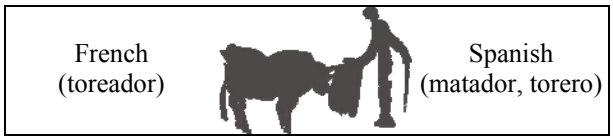
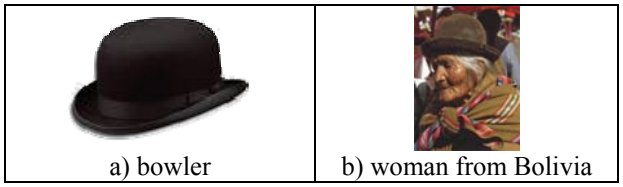


Fig. 3. The bullfighter as common denominator

Hidden threats. Here "hidden" means both "unknown" and "concealed". The main threat is the temptation of gadgets: since implementation becomes so easy, technologists are tempted to develop (almost effortlessly) multimodal interfaces, beyond their expertise in the application domain. If multimodal interfaces are designed by technologists (and not by social scientists and/or humanities professionals) i.e., if dilettantes are involved in "translations", the danger is to blur the crucial difference between creative *metaphor* and *deadly equivalence*.



a) bowler b) woman from Bolivia

Fig. 4. A bowler as cultural symbol and as possible confusion

Some examples of occurrences of hidden threats:

- At the highpoint of the West-Berlin blockade, when President Kennedy came to Berlin, he made a (rather cultural than) grammatical error by saying "Ich bin ein Berliner". Kennedy should have said "Ich bin Berliner". By adding the indefinite article "'ein", he referred to himself not as a citizen, but a non-human Berliner, a common pastry.
- The word "hamburger" comes from Hamburg. Because "ham" stands for meat, a California chef cooked the first cheeseburger, transforming thus "burger' in a suffix.
- Chinese translation for Coke proved difficult. The Chinese first tried "'Ke-kou-ke-la" because it sounded roughly like "Coca-Cola". After trying 40,000 Chinese characters, Coke came up with "'ko-kou-ko-le" which translates roughly to the much more appropriate "happiness in the mouth".
- The bowler (Figure 4.a.) was the traditional headwear of London city gents and has become something of an English cultural icon. However, most young English people nowadays have never seen a bowler hat. The threat is when deciding what gender wear that hat, because in Bolivia women wear it too (Figure 4.b.).

6 Conclusions and intentions

The modular nature of the experimental model at this stage does not allow drawing clear cut conclusions as regards end user evaluations. Thus, the conclusions refer to the approach and the architecture.

- Agent technology, as both stage and trends, is in line with user information and communication requirements. It increases substantially the effectiveness of existing CA*x* domains and facilitates the emergence of new ones.
- The new domain of CAS responds to actual trans-cultural communication needs for both wide-ranging EU targets and confined bilateral translation. Research in this area must be *trans-disciplinary* (if not yet in content, at least in spirit and profile) and *anthropocentric* (in perspective).
- It seems unavoidable that ICT users, as communicators, have to share a coherent communication paradigm – no matter the technological infrastructure involved. Thus, trans-cultural communication based on multimodal interfaces will be necessary.
- *If* social scientists and/or humanities professionals dare to become a kind of users' "ombudsman", *then* they shall promote anthropocentric interfaces in order to enable the users to take advantage of agents as their assistants, *else*, users will remain prey of "technological determinism".
- Users should press for a brand certificate ensuring "User-Need inside" (instead of "Intel inside"), to be awarded only when the interface is designed involving them from the beginning (applying the Scandinavian method or the ethnographical one).
- The generic architecture is undemanding, except the new "visual rules" attaching semantic value to the iconic space.
- Albeit risky to generalise after implementing just a few examples, it seems that the design effort is very unbalanced: about 10-15% for software engineers and the rest for sub-domain specialists.

The following intentions are strongly dependent on possible collaborative work:

- Refining the "apple" example and proposing other relevant pairs of (counter)examples, based on "visual ontologies" shared by agents and humans.
- Founding a framework for CAS as CA*x* research sub-domain and in particular for: a) helping

simultaneous translations in EU meetings; b) improving current e-Learning interface agents.

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