COMMUNICATION WITHOUT SENDER OR RECEIVER? ON VIRTUALIZATION IN THE INFORMATION PROCESS

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ABSTRACT

A communication process can be described in terms of a sender transmitting information to a receiver. What happens if one of the two subject roles in this process is virtualized, i.e. substituted by a machine? Is it still appropriate to refer to this as an *information transfer* even if its source or target is missing? Can information originate from an unknown sender or be transmitted to a (completely) unknown receiver?
Before examining these questions and answering them, one has to clarify what is understood by *information*. As it turns out, different interpretations of this term lead to considerably different answers and consequences to the initially raised questions.
We consider these questions particularly important since the ongoing dissemination of so called *information and virtualization technologies* changes the human communication processes fundamentally. These changes are part of the ongoing formation of an *information society* and may eventually lead to the formation of a new *image of man*.

1 INTRODUCTION

Man-machine interaction is a core issue of information technology and is often regarded as a form of communication process. A simple and useful model for communication consists of a sender subject transmitting information to a receiver subject (cf. fig. 1). In case of continued communication, the subject roles may change. If machines – and in particular computer systems – come into play, the question arises what is their precise role or in other words, how do they fit into this model: Can a human *communicate* with a computer? Or do computers merely *assist* communication between humans?
Writing an email, we can usually assume that the computer systems assist us in doing so. But what about receiving an automatically generated email: Is the sender of this message a machine? Is in this case a human communication partner actually substituted by a machine or does it rather act on behalf of a human? When reacting to a dialog prompt of a computer program containing a message or a question, do we really communicate with the computer system or are we merely following the path prescribed by the system's programmer?
What exactly are the consequences if a communication partner in the role of the sender or receiver is replaced, i.e. *virtualized*? In order to answer this question we consider communication as an *information process*. In this regard it is worth noticing that the concept *information* has raised much controversy with no definitive clarification as to its meaning (for discussions see e.g. [1], [3], [6], [8]). Depending on the understanding of the information concept one may come to different answers to the question whether and to which degree the sender or the receiver in a communication process can be virtualized by a technical system.
If machines are not acknowledged as (virtual) communication partners, this has several implications. For instance, an *anthropomorphic* view on machines has to be rejected in this case, instead users of machines have to be advised on their technical limitations in a transparent way. As an example, we consider search engines that accept natural language requests. For experts it is clear that these systems are not able to (completely) process such requests, let alone to comprehend their (full) semantic implications. An "understanding" of such requests by a machine can only be considered metaphorical. In a case like this, the user should be notified on how the request was interpreted and which parts were not "understood" (e.g. ignored).
On the other hand, if machines are accepted as communication partners, this has severe consequences as well. It would, for example, imply to grant them (to a certain degree) authority and responsibility and – at least in the long term – would strongly influence the image of man.
A systematic analysis will point out the terms under which a virtualization is possible. In principle, either communication role (sender or receiver) may be substituted by a machine. A special case is the virtualization of both of

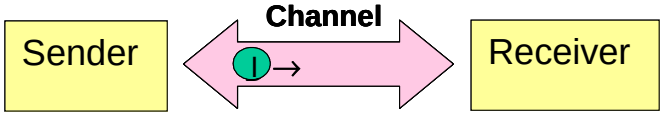

Figure 1: *Sender-receiver model for communication.*

them. Examining each alternative in combination with the different information concepts will show their practicability and reveal some inherent problems.

A further distinction concerns the substitution of communication partners by a technical system (e.g. a robot or an agent) or their complete absence or at least anonymity. Evidently, such substitutions or "anonymizations" influence the essence of what communication means – up to the point where the term "communication" is no longer appropriate or merely metaphorical. Any receiver of "virtual" information – e.g. from the Internet – places his trust in messages from unreliable sources: sent by an unknown third party or generated by inscrutable and possibly proprietary search engines.

On the other side, the sender of messages to "virtual" or unknown receivers usually makes assumptions about the willingness and abilities of the receiver in regard to reception, interpretation and cooperation. Ultimately, communication processes in which both parties are virtualized bear manifold risks, e.g. uncontrollability and (as a result) erroneous as well as blocking behavior, waste of resources etc.

2 DIFFERENT CONCEPTS OF INFORMATION

In fig. 2 we cite three exemplarily selected definitions for "information" that illustrate the bandwidth of the different possible interpretations for this term.

Definition 1: In connection with computing *information* is an aggregate (n-tuple) of binary elements.

Translated from: W. Händler, Lexikon der Datenverarbeitung, cit. cf. [11]

Definition 2: Information (from lat.: *informare* = forming, giving a form) is a potentially or actually usable (or used) pattern of matter or some energy form that is relevant for some observer within a certain context.

Translated from: Wikipedia: „Information"(German version), [13]

Definition 3: Information is knowledge on certain facts and/or processes which are part of the perceived or imagined reality. Information consists of communicated and received particles of knowledge. These are derived from (linguistically articulated) knowledge and communicated by means of linguistic tools. On the one hand side they represent (subjective) knowledge of the originator and on the other hand they can actualize or extend the (subjective) knowledge of the addressee.

Translated from: Barkow et al. in: Lexikon Informatik und Datenverarbeitung [9]

Figure 2: *Definitions for the concept of information.*

Examining these definitions shows their different qualities and foci, in particular with respect to the three semiotic dimensions of *syntax*, *semantics* and *pragmatics* (cf. e.g. [4] for a semiotic access to information and information systems). Definition 1 is limited to the syntactical aspect of information (*data*) and in that it follows largely Shannon's concept of *syntactical information* [10]. This notion also conforms to materialistic and naturalistic approaches on information (see e.g. [12] and discussion in [6]).

At the opposite end of the spectrum, definition 3 describes information by its semantic and pragmatic aspects, that is its meaning and effect on some observer (*originator* or *addressee*) – ignoring any connection to syntactic qualities. This definition implies qualities such as consciousness and intelligence on the observer(s) side. Related conceptions place information in a human-centered, culturalistic context (cf. [4], [5], [6]) and often are reminiscent of the classical educational aspect of information (cf. [3]).

The concept of information from Definition 2 lies in between the two extremes discussed. It integrates most of the naturalistic and some of the culturalistic aspects: Information is an independently existing pattern. In contrast to the purely naturalistic view this pattern needs to be (actually or potentially) useful for some observer. But unlike the culturalistic conception, little is said about creation or (re-)construction of the meaning of information, i.e. there are no concrete restrictions on relevance, sense, meaning etc.

3 VIRTUALIZATION

So far, the roles of sender and receiver in the presented standard model are played by human *subjects*. Likewise, in the definitions given above observers (sender and receiver) are (explicitly or implicitly) assumed to be human. At least, they are at the source and target position of – possibly complex and multistage – information processes and responsible for giving meaning to the data being transferred.

Virtualization / Inf. concept	Virtualized sender	Virtualized receiver	Virtualized sender and receiver
Definition 1	(Non-human) operator as signal generator	(Non-human) operator as signal receiver	Data interchange between systems
Definition 2	Agents as artificial pattern- and signal generator in inf. systems	Agents in databases, inf. systems, search engines, data warehouse etc.	Agent communication, feedback between (several) inf. systems
Definition 3	Artificial „intelligent" sender	Artificial „intelligent" receiver	Communication between autonomous (AI-capable) systems

Figure 3: *Examples for virtualization in the information process.*

However, we have got used to include non-human actors in processes for exchanging, storing and transmitting information. Often, they are awarded human capabilities such as sending, receiving, searching, finding and sorting in a metaphorical way.

Here the question arises which are the consequences if sender or receiver or even both are omitted or replaced, e.g. by anonymous actors, devices, proxies or other non-human sources. In the case of virtualization, sender or receiver are replaced by an artificial instance which plays a functionally equivalent role – with respect to the interpretation of information – of a human sender or a receiver (cf. fig. 3).

The information concept of definition 1 poses no constraints on "virtualizing" sender or receiver by a computer system: In this context, binary data is just information.

This turns out quite differently if we take the culturalistic conception of information in definition 3. Here information is inextricably linked to an entity capable of consciousness and operating in terms of *meaning* and *validity* – concepts which do not occur in Shannon-like conceptions of information. Furthermore, definition 3 (indirectly) suggests that the emergence of information is necessarily coupled with *intelligence*: Information is the result (or process) of *understanding*. Thus virtualization of the sender or receiver needs to come along with some kind of *Artificial Intelligence (AI)* – this requirement holds regardless whether or not AI is possible or has even been realized yet.

Definition 2 demands some *relevance* and *usefulness* of a pattern for an *observer* in order to become information. Key in this conception is the observer: Information is what he or she *conceives* to be a pattern and what is relevant to him or her: Note that there is no objective instance required to decide what is a pattern or not – only the (subjective) perception on part of the observer is important. The constraint of *relevance* for the observer is much weaker than that of *understanding* and leaves it open for all kinds of interpretation.

Thus the semantic dimension – getting the meaning of information [7] – is highly dependent on the kind of *observer*. Take for example a scenario of perceiving differences in temperature: If the observer is a human, the patterns signaling the temperature can be assumed to have a semantic dimension. If we chose a technical temperature sensor this assumption no longer holds, but following definition 2, we are still allowed to call its measurements information, since temperature differences are patterns relevant to the sensor which reacts to them in a defined manner.

Taking this interpretation in its widest sense all processing of data can be termed information: Data are *patterns* for computer systems which deem them *relevant* for their own reactions.

4 ANONYMITY

A question related to virtualization of sender and receiver is concerned with *anonymity*: What can we say about information processes where the sender or receiver are unknown (cf. fig. 4) – be it temporarily or even forever.

An example for an anonymous sender is the Rosetta Stone with its hieroglyphic scripture – that holds at least for the time between its discovery and its decipherment by Champollion in 1822. In this case, the anonymity of the (apparently human) sender could at least partially be uncovered by its decryption – lifting its content from the syntactic (data-) level to the semantic (information-) level which was accomplished due to successful interpretation.

Patterns and structures of animate and inanimate matter are ubiquitous and their interpretation often ambiguous or arguable. Among the biggest mysteries for mankind are questions about the universe, earth, nature and life, their origin, meaning, purpose and end. Patterns found by geologists, archaeologist, biologists etc. are believed to give us answers to these mysteries – "received" by scientists, but never been "sent" by any human source.

Another example of anonymous "information" construed from celestial structures are the star constellations. As we know today, they do not convey any "semantic meaning" in form of animals, heroes or gods since often there are big distances between stars belonging to one and the same constellation. The geocentric perspective takes only the two angular coordinates polar angle and azimuth into account, but not the distance.

A well-known example of an "information process" with unknown receiver is the Pioneer mission from 1972. The plaque placed on board of the Pioneer 10 spacecraft features a message from humankind addressed to potential aliens.

On closer inspection of that example, one might come to the conclusion that the sending of information in its semantic sense to a completely unknown receiver turns out impossible. There are always certain assumptions about the receiver to be made which are prerequisite for a

Anonymization / Inf. concept	Sending without explicit receiver	Reception without explicit sender
Definition 1	Broadcasted radio signal	Received signals by radio telescopes
Definition 2	Signposts, cultural monuments, e.g. *plaque of Pioneer 10 spacecraft*	Discoveries (archeology), geological outcrops (geology), constellations (astronomy)
Definition 3	NA *(only indirectly possible)*	NA *(only indirectly possible)*

Figure 4: *Examples for anonymous sender and receiver in the information process.*

reconstruction of the information sent. In case of the plaque, these are of physiological and cognitive kind and concern not only the ability to perceive the gravure on the plaque, i.e. the presence of appropriate sensor organs but also a rather profound understanding of mathematical and physical facts and relations.

5 CONCLUSION

Considering (partly) virtualized information and communication processes supports our thesis that man is replaceable by machine only to a very limited degree. If e.g. a superiority of machines to men is conjured by exponents of the strong thesis of AI, one has to inquire whether and to which degree their abilities go beyond pure adaptation and acceleration of technical tasks and services as e.g. combing through and rearranging huge amounts of data.

Without any doubt, conducting such complex information processes can be supported, accelerated and may even be qualitatively improved. But, mostly decisions are to be made as e.g. concerning the relevance or priorities during selection, editing and representation of results of search engines. Most probably, these problems and limitations will not completely be overcome by an upcoming *Semantic Web* [2]. These issues should be highlighted and alluded to the users by clever computer systems instead of hiding them behind dazzling advertisement slogans and nebulous metaphoric talk. Rich interaction facilities have to provide human users the control and transparency they need to make the responsible decisions they require and deserve.

In this context, the question of responsibility recurs from a new perspective. An extensive and – even worse – *irreversible* delegation of responsibility to computer systems conflicts both with the occidental idea of man and that of Enlightenment. Not only that man would voluntarily abdicate his self-proclaimed role as the *pride of creation* but also that he would jeopardize his release from his self-incurred tutelage (in terms of Kant) by ceding responsibility to "superior" machines. Accepting the proclaimed "informational superiority" of machines to men would entail a new image of man no longer compatible with the ideas of humanism.

These reflections reveal a strong impact of Man-machine interaction, information and communication processes on existing and future self-images of man. Hence, the penetration of virtually all areas of life by computers and "information technology" should raise our sensibility for autonomy and responsibility issues when conceiving and designing new applications, interfaces and systems – and makes a deliberate reflection about possible consequences and implications indispensable.

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