Towards an information realm

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Abstract: What is explored here is the issue of how complex information processing (cognition) is coupled to human cognition, or alternatively, whether a de-coupling is possible, and even underway. Starting with the view that cognition need not necessarily be based in the individual person (or computer), we look at the tangibility of information in processing and conclude that abstract information has indeed a character of intangibility. Looking at realms of being, we see that the digital virtual realm, evolving out of the physical and mental realms, opens up great possibilities for a wider scope of information interactions. The informational realm brings in non-human information interactions, i.e. information processing taking place within and between information artifacts themselves. This possibility leads to reconsidering the nature of cognition itself, with the potential for virtual processing in an intangible information world.

1. Introduction

The central issues explored in this paper are what kind of cognition can exist outside of human cognition and what are the implications of asking this question. The answer provided here, an initial one to be sure, sees cognition existing within information artifacts and foresees a future in which human cognition is part of a much larger picture of cognition within the world.

Such an enlarged framework for cognition goes far beyond the current view of extending cognition through networking. The notion of networked minds initially applies to using telecommunications and collaborative technologies to enhance individual human cognition. This very human-centric view may align well with the general philosophy of most computer professionals and scientists today, but does not justify itself within the larger study of cognition, beyond anthropocentric views (Sloman, 1997). Indeed, networked cognition of the near future will involve not only human minds, but the initially limited cognition of autonomous agents (AAs) also. Later on, less limited AAs are likely to play an ever growing role in most aspects of social cognition.

The implications are profound for human identity and the philosophical issues that this raises are even more surprising. The first concerns the place of humanity in nature, an old and ongoing issue. It leads, however, to deeper issues regarding social cognition and ontological questions regarding both cognition and information.

For cognitive technology, the door opens to a much wider and richer perspective than formerly supposed. Human-computer interaction gives way to a much larger field dealing with what can be described as information interaction (Duchastel, 1999s). The latter involves information processing in a society of interactions between humans, autonomous agents, information artifacts, and just plain things. A hierarchy is involved here, but it may not be the one we would expect. The tools that we have invented throughout our history have fashioned our cognitive capabilities (Donald, 1991) and expanded our cognitive frontiers. These tools are now being given a measure of autonomy and we need to ascertain not only what they are developing into, but to see what the possibilities for interaction might also be. This naturally raises the philosophical issues surrounding information and its uses.

In sum, the exploration of the informational realm presented here, while not aimed at challenging the normative human-centric view of cognition (which constitutes an ethical position more than a scientific one), ends up painting a much wider picture of cognition which recenters the focus on the nature and role of information. In this, we go beyond the human enterprise and explore the unclear waters of a scientific enterprise that deals with the human condition within its wider evolving context.

2. Beyond individual cognitions

The issue of social cognition deals with the society of minds question. It asks essentially the question of team cognition: just as a team is often considered to involve more (in ability) than the sum of its members' individual abilities, so too social cognition involves more than the sum of its participating minds.

But what does that mean ontologically? Just as we give a team an identity and begin to think of it as a separate organization (think of the firms and organizations that coalesce around their specific missions), do we begin to think of networked minds as identifiable entities with their own personality and stake in the world. Neurons in individual brains work together to create cognition; do cognitions work together to create some higher-order entity? The answer is of course yes. But it leaves open the nature of that higher-order entity and the implications for the participant cognitions.

Societies (for instance, nations) form independent social cognitions of sorts in that their members share a common culture and act with a more or less national spirit and identity. The homogenous side of society however tends to mislead, for despite membership, individuals within societies generally act as individuals, making decisions that, while constrained by social norms made effective through various means, remain highly oriented to the prosperity of the individual. The push and pull between individualism and community continues to be a social issue of choice in the world, but should not hide the fact that societies up till now have been more collections of individuals striving to a common end than entities with a force of their own.

We may think that this is belied by the endurance of organizations (churches are good examples), but we need to distinguish between true higher level organizations that become entities with an existence of their own, and organizations that simply renew themselves from one generation to another. This seems to be an area for much further analysis.

Psychology has always treated cognition on an individual basis. Even social psychology always comes back to the impact of social processes on individuals. Social cognition, on the other hand, must break away from this individual focus and develop a psychology of the team itself, a psychology for a new entity. This new psychology will share many concerns and theoretical constructs with individual human psychology, but will also likely develop a range of novel concerns specific to its own level of analysis.

What I am attempting to establish here is the crucial notion that cognition need not be tied exclusively to the person. Cognition is generally seen as a process and it is natural to equate processor with person. We generally accept today the notion that symbolic computing involves cognitive processing (that being the whole basis of artificial intelligence - AI), even if it remains comparatively limited in general terms (although often superior in specialized aspects made advantageous via expert systems). The point, though, is to go beyond both individual person and individual computer program into a form of cognitive processing that is transpersonal or, in computing terms, distributed. The philosophical issue concerns who then is doing the processing? Before exploring this further, we need to first look at the status of information in such processing.

3. The tangibility of information cognition

The important issue explored here concerns the nature of information. We often treat it as ephemeral, but yet it is always reified in some form of representation or other. Information processing is processing something physical, even if its form can be at times vague or difficult to describe. Our challenge here is to grasp the tangibility of information, that being tied in with cognition on the one hand and communication on the other.

Information, at its core, has been characterized as organization (Stonier, 1997), which is a fairly intangible aspect of the entity. Examples of such organization are information distributively present in an ant colony and the information structured in a strand of DNA. And yet, any organization is a set of relationships between elements, those elements themselves being fairly tangible. Even concepts, those most platonic of elements, get grounded phenomenologically in the real world down the line, as we are reminded of whenever we discuss the potential for true artificial intelligence (Searle, 1997; Winograd and Flores, 1986).

Consider information now as communication —its process view. That necessarily involves some form of representation and hence tangibility. Even organized bits must course through telecommunication networks and eventual information appliances to reach their destinations. A communication starts with a seemingly

ephemeral idea, but is forced immediately into representation in some medium or other. To recast the McLuhanesque adage in a new meaning context, the medium is indeed part and parcel of the message.

Why this concern with tangibility, one may ask? The insistence on tangibility arises out of the need to ground information in a physical reality before we jump into its less tangible, more relational nature. Without that grounding, we may well be abused for building an informational realm out of nothing.

The reality of information (its ontological status) is what is in play here. Two dimensions need to be examined: the substance/process dimension and the concrete/abstract dimension.

Information as tangible elements that can be processed is seen as substance (a thing), be it a hard piece of data (such as my birthdate) or a thought (such as X causes Y). These are tangible in the very practical sense that if they are to be processed, they had better be manipulatable, whether they be electrons stored in silicon memory or electro-chemical patterns in the brain.

Conversely, processing is seen as manipulating these information elements. Processing is just as tangible, being realized in some physical mechanism. The crux of this matter is that information as substance and as process are but two sides of the same coin: processing cannot occur without substance, just as information substances are pointless without some expected processing, even if only at some distant point in the future. We get involved in more general philosophical issues here.

Well beyond the confines of just information, all events (processes) involve things (consider physics for instance) and all things change over time. These aspects of reality are simply the Kantian space-time structural principles developed in his Critique of Pure Reason that enable us to apprehend reality in the first place. In this sense, they are but two sides of a coin. We can view reality as a set of relatively stable forms that undergo gradual or periodic change, or we can view it as a continuing dynamic process that gels now and again for brief periods of time. These are but two perspectives - two alternative ways of viewing the same reality, each one as valid as the other.

But now consider the concrete/abstract dimension of information. Idealism and rationalism in philosophy have given a greater sense of reality to the abstract, universal character of things (Plato's ideal forms, Leibniz's monadology, Hegel's universal Mind), as opposed to their concrete, particular, phenomenal character. These ideal forms are however intangible, existing in the rationalist perspective well beyond direct human apprehension. And yet, we use them in reasoning and in generally making sense out of the concrete world. As a result of this, we can say that these information elements are processable even though they are intangible. They exist in a realm of their own, even though the processing must itself be tangible.

The natural development of abstract, intangible thought from more tangible moorings in the world is fascinating in itself. Analysts of cognitive modes of interpretation, such as Bruner (1996), attempt to categorize these differences and characterize them formally. Traditional modes of thought, such as intersubjective (shared intentional stances), agentive (motivated actions), and deontic (social norming), lead to externalized representations that are narrative in character in that they celebrate the individual in context. The propositional mode of meaning making then emerges from generalizing these narratives, evolving into a mode "dominated by the formal necessities imposed by the rules of the symbolic, syntactic and conceptual systems that we use in achieving decontextualized meanings" (Bruner, 1996, p. 98).

This decontextualizing and universalizing mode of thought, while evolving out of earlier modes (as described by Donald, 1991), takes on a form that is abstract, and hence distant from the phenomenal. As Bruner illustrates (p. 101), "The meaning of hypothenuse in plane geometry is given by operations performed on an idealized 'right triangle', operations indifferent to who carries them out under what circumstances —a king or a commoner, a Hottentot or a Harvard mathematician, whether hypothenuses are ritually holy or repellent". The latter of course would be central to the narrative modes of thought.

Underlying these two modes of thought are information elements with different tangibilities. We conclude for the time being with the idea that there is an aspect of information that is intangible, yet processable, and that the substance/process dimension of information might be key to this. To further explore this issue, though, we must first look into the hypothesized informational realm in relation to the better known ones in which we operate.

4. The realms we inhabit

We can consider that there are four realms we live in, the informational realm being one of them. They are presented in table 1.

Realm	Interactions between...	Characterized by...
Physical	• Things • Things and humans	The pre-human world
Mental	• Humans • Humans and their cognitions	The human world
Virtual	• Humans and digital artifacts • Agents and humans • Agents	The digital world
Information	• Digital artifacts • Cognitions	The cognitive world

Other theorists will cut up the pie differently, depending on the focus of their analysis. Jencks (1995), for instance, carves up the 15 billion years of the universe into four eras characterized by the appearance of new self-organizing forms. These are the eras of energy, matter, life, consciousness, each one emerging unpredictably from its predecessor. His analysis underscores the organic, mysterious flow of the evolution of the universe, as described in the new sciences of complexity, themselves a form of the science of organization. His analysis maps onto the first two of the realms presented above, but does not project into the future.

The first two realms (Physical and Mental) are well-known. Indeed, they have formed the basis of the Cartesian dualist split that has led to the Enlightenment and modern science, and has caused much concern in contemporary philosophy. The cognitive interactions in the mental realm do not limit themselves to conceptual processes, but include as well the more private processes associated with imagination and belief.

The virtual realm arises out of the digitization of our world, a process that we are currently undertaking. We are in the process of representing all we know and all we do in digital terms, which become henceforth not only more processable, even autonomously so in many instances, but also extendible. Enhanced processability enables not only increased and enriched interactions with information embedded in a variety of digital artifacts (from web pages to avatars), but also the automatization of numerous processes to be carried out by both dumb and increasingly intelligent programs. The latter become autonomous agents, which not only extend our human capabilities beyond time and space through delegation, but also create a new interactive environment in which to operate (Palmer, 1995; Hu and Wellman, 1998).

The principal extension offered by the virtual realm, however, does not reside in simply replicating digitally our physical world, but lies more importantly in creating new digital worlds in their own right. These additional worlds, even if virtual and perhaps fanciful in many cases, create new settings for interactions, settings that have to be mastered if we are to operate in them successfully. Considering the very wide potential for creativity in this realm and the great amount of time we humans take to master our physical world through simply growing up, there is great opportunity here for innovative forms of non-human processing. Indeed, the virtual realm must be considered beyond the usual anthropic entertainment-oriented efforts that have come to characterize it. The scope for extending cognition is wide open at this time.

Excitement over the virtual realm arises in just this emphasis on the possible. Whereas the physical realm is constrained by the principles of reality that govern it (it 'offers resistance', in Levy's terms), the virtual realm is the land of the possible (Levy, 1998). Possible worlds can be actualized that do not conform to the natural world's resistances, thus opening up whole new avenues for expression and involvement. While the resulting complexity may well create practical difficulties, the enhanced openness can be extremely creative.

5. The information realm

We come now to the most interesting of the realms, the informational realm. While current experimentation in virtual reality is gradually operationalizing the virtual realm, this is not the case with the informational realm, which remains as of yet largely conceptual (Duchastel, 1999o).

This is the realm in which information transactions take place largely outside of our human sphere of influence, between information artifacts themselves. It does not mean that we humans are excluded from such interactions, just that we are only a part of a much larger set of interactions. Some will involve humans, many will take place between other actors. Autonomous agents are precursors to the actors that will populate this realm.

Such exclusion is not new to us. We each individually live in our own world, our own sphere of influence, and we are not surprised by all that goes on around us as it is influenced by other spheres of influence. Social adaptation is indeed principally the intermingling of those spheres, with the give and take of social intercourse.

What is implied by the informational realm, though, is purposeful activity that is in the sphere of no individual at all. It lies in fact outside of the usual social setting as we know it, although some form of new 'social' setting will be called for if the whole enterprise is to avoid chaos (the term social may not be the most appropriate for the new setting, though).

Interactions between digital artifacts are not new. When a database (such an artifact) is called upon for information by a program (another artifact), an autonomous information transaction occurs. This simple interaction will give way to more complex interactions as symbolic computing continues to progress. Object orientation in computing has essentially created a world of transactions between artifacts and as the latter grow into active agents, such as meeting rooms that schedule themselves (Rosson, 1999), we enter the more complex world of ever more autonomous agents.

The interesting aspect of this potential development is that such agents need not follow an anthropomorphic line of development. Just as an automobile does not transport its riders like a horse does, or an airplane fly like a bird does, so too agents need not resemble humans, neither in form of intellect, nor in intellectual function. This potential departs from current efforts to understand digital intellect in the mold of human intellect (Sloman, 1999) and ushers in an entirely new need for perspective on how we consider cognition.

Going beyond individual cognition, as we have considered earlier, is one step in this direction. Not only will the future deal with non-human intelligent processes, in forms that differ widely from our own, it may also deal with cognitive entities that are distributed over a wide network and that are constituted by a large range of sub-entities, each representing a cognition in its own right.

This begs the question of redefining cognition. Just as the personal computer (a digital jack of all trades) may give way to information appliances of more limited scope (which however communicate with each other - Norman, 1998), cognition understood as an autonomous, general purpose intelligence may give way to a networked society of more limited intellectual functions, which act and interact in a very rich information world. Research in distributed computing and autonomous agents (Sycara & Wooldridge, 1998; Joshi & Singh, 1999) serves here as a model of future possibilities in this direction.

These non-biological cognitions made up of information and dealing in information form interactive entities in the informational realm. We humans will be part of this cognitive world, alongside other cognitions.

6. Patterns in the realms of being

Let us consider again the four realms of being introduced earlier in this respect. Placing them in a table as follows, we can see certain organizing principles latent in their relationships:

	Concrete	Abstract
Historical	Physical	Mental
Emerging	Virtual	Informational

Thus, the physical and virtual realms deal in sensory reality of the touch and feel kind. In contrast, the mental and informational realms deal with thought, i.e. with the manipulation of abstract representations. The contrast represents a pattern of interaction with the world. On the other axis, we see a temporal pattern, itself of lesser significance but merely announcing an evolution. The physical and mental are our usual realms. The virtual is taking shape currently, while the informational promises for the future.

Now, these patterns are not cleanly delimited —they should be considered more prototypical than categorical. The physical realm involves many mental artifacts —books for instance— and the mental realm is mostly grounded in the physical world, even if not entirely, as illustrated since the middle ages by unicorns. And while merely mental, unicorns are nevertheless concrete, in that they refer to particular animals. The interplay between the physical and mental is largely the story of humanity, the rules of this interplay being codified in the last century in psychology, as well as illustrated in the arts.

The virtual realm, while emerging in strongly sensorial modes of interaction via head-mounted-displays and other related technologies, banks heavily on the feeling of presence, and hence intentionality, and will likely take on a more and more social, and hence mental, role in human interaction as well. The virtual realm's openness to less-constrained reality (as in performing reality checks), and thus to other possible realities, clearly encourages the imaginative mode, itself part of the mental.

The issue of whether we are moving to a blurring of the realms is an important one, although with strong sociological undertones, some of them already being expressed, for instance by Lanier (199) or Virilio (1994). This issue of blurring, despite its normative aspects (which need a different forum for their discussion), is important in articulating the distinctions between the realms, for it impacts particularly the informational realm.

Indeed the informational realm, despite its mostly future potential, already has a long past, and shares a lot with the virtual realm as well. The emphasis in the previous discussion of the informational realm was placed on non-human cognitive processing of information —this indeed nicely brings out the character of the informational realm, as well as the evolutionary turning point that we are beginning to witness and leading to an age in which that realm will likely have priority over the others. The philosophical consequences of this evolution are immense.

As pointed out earlier, information has a physical substrate in that it is in some form. But also, it can only be interpreted within the 'interpreting frameworks' of the cognitive agent. In the case of humans, that involves the mental, as has been generally accepted since Kant made the case for it two centuries ago. In sum, information has a physical aspect, but its most interesting aspect is its intangible, relational one derived from its eventual processing (the reason it is placed under Abstract in the table above).

Now, information shares with the virtual (and with the mental) its representational character, its attribute of representing something else. The virtual, indeed, creates, even if fictitiously (virtually is a better term), a physical world of sensations —one that I can see, touch, turn around in, and so on. Even though the imaginative possibilities are wide open, a certain representational adequacy is needed if I am to derive any meaning out of experiencing the virtual world before me. I might 'walk through' objects before me, but still, they must be 'objects'.

Representation here reflects not only the surrogate nature of the symbol / object (sign in Peirce's semiotic terms), but additionally, what might be called ontological coherence, i.e. continuity with past experience and with concurrent events. Violations of such coherence, beyond a certain level or a certain number of them, will destroy one's sense of reality and one's ability to effectively act. It is through representation that the virtual has antecedents, as suggested by Levy (1998), in language and technical processes. But then, so does information. What this amounts to saying is that all representation is a form of virtual, including not only objects in a virtual world, but also mental representations and information.

Yet, the distinction between the virtual and the other realms does serve the purpose of focusing this type of representation on created concrete worlds, as opposed to the more abstract worlds of the mental and informational realms. Interestingly, a compelling precursor to today's virtual realm is visual art, particularly sculpture.

Much remains to be disambiguated with respect to the informational realm as it evolves out of the physical and mental realms. The reason it is constituted as a full realm, rather then as a category of some other realm (as in the past), lies in its growing importance in today's information age, as well as in its potential to blossom fully in the near future. It is still an emergent realm, but yet with long roots and budding potential.

7. Concluding thoughts

This is a speculative paper that explores a variety of facets of complex information processing, trying to determine the nature of the stage of evolution currently unfolding and how we relate to it. I conclude here with an attempted synthesis of the various strands that were explored, realizing full well the tentative nature of these conclusions.

In summary form, we come to the following viewpoints:

> 1. It is analytically useful to get out of an anthropocentric perspective and thereby gain some evaluative distance from what is being considered.

> 2. Transpersonal (collective) and distributed cognition point out the difficulty of identifying who is doing the processing, and hence the potential for an intangible information processing.

> 3. Tangibility of information is associated with substance rather than process, but the concrete/abstract dimension of information further points to intangible information processing.

> 4. The virtual realm we are currently building shares with the physical realm a sense of tangibility, whereas the informational realm aligns itself with the abstract nature of the mental realm.

> 5. The informational realm involves information processing irrespective of the nature of the processor, the latter being either human or an autonomous agent.

> 6. An evolution is underway in which priority will eventually belong to the information realm.

In sum, the evolution of life and of our species, particularly in terms of information processing, is leading towards an informational realm that will leapfrog beyond current realms into a style of information interactions that will likely be very different than those we currently engage in.

Lest this speculation appear wildly undisciplined, it must be emphasized that it is but an extension of the trends that are currently being developed in the fields of artificial intelligence (Sloman, 1999; Minsky, 1986), autonomous agents (Joshi & Singh, 1999) and artificial life. It does remain speculative, of course, and is presented not as a course that will necessarily occur, but rather as one that is likely to do so.

It adopts a non-ethical perspective in examining what is becoming known as cognitive technology. Not only does it not seek to orient the developments to come (arguing this stance is a whole other polemic in its own right), but it looks beyond the anthropocentric framework to see how cognition might evolve. The jump into

cognition as portrayed by Jencks (1995) and within our own cognitive evolution, as theorized by Donald (1991), is certainly a harbinger of potential directions for an ever more rapid evolution of cognition in the future. Interesting speculative work in this regard is the recent look into the future by computer scientists / futurists like Paul & Cox (1996) or Kurzweil (1999).

Just as computer science is having to adapt to a changing context for computing (Gelernter, 1997; Duchastel, 1999s), cognitive technology will have to take on an expanded role as its own context changes. It will have to deal not only with the integration of cognitive tools with human cognition, but also with the wider picture of integrating human cognition within the informational realm. This will significantly broaden its scope, while at the same time enabling it to better clarify the role it accords to human identity in a technology-driven world.

Fundamentally difficult issues remain as we seek ways to integrate humans, cognition, and information. Whether one is optimistic about the result (as is Levy – 1998) or generally pessimistic (Virilio, 1994) matters little as we explore the issues. These issues involve humanity, but go far beyond it too.

What I have attempted to do in this paper is only to lay the foundations for the informational realm, but the most puzzling issues surrounding information remain and will continue to emerge as we further informationalize society. What are these emerging issues, hinted at or implied in the preceding discussion? Consider the following…

What is information? An old question, but one generating renewed interest as we digitize our world ever more. Information has something to do with embodiment of knowledge (a wider term than the usual 'representation'), it deals with structure (mirroring knowledge here), and it is processable (by humans via communication, and increasingly by computers).

> What are the possible forms of embodiment? Textual and graphical representations are the traditional forms (very concrete ones), but digital information will largely outplace them. What are its attributes? Can information exist in some disembodied form, similar to Leibniz's monads? Simply as structure, perhaps etched in the environment?

> Knowledge is founded on coherence, an aspect of structure. Just as life replicates structure, can likewise technology engender replicating information? Is knowledge but the validator of the process? But how does that fit the different realms of being?

> Communication is a processing of information to achieve some goal. As focus is reduced following the transmit/access flip in communication, what will communication turn into? Can processing outride human agency altogether?

This all depends in part on how we define our terms. It also depends on imagining new forms of information and new processing modes. And, as always, it will depend on how we conceive of the human factor in relation to the enterprise. But what is this enterprise surrounding information?

Who are the information processors? Information has only been of use traditionally to alive beings, particularly humans. As computer agents are created and begin to evolve (still mere beginnings at the moment), agency expands and changes. What processing will take place, and by whom?

> Can we foresee automatic information processing? As symbolic processing by computer gets richer, will automatic processing extend to knowledge? How much can knowledge creation be automated? These issues raise the very question of automation, not its potential but its goal.

> Autonomous computer agents really mean additional forms of life. We must be witnessing the creation of new species, albeit non-biological ones. Does it lead to different forms of consciousness? Does it permit disembodied agency? Are we moving to an evolutionary climax?

These are far from insignificant issues and they are not for faint-hearted humanists. They explore our deepest relationship with the world and in so doing, may go as far as to offer a redefinition of humanity.

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