

# Phatic Systems in Digital Society

## Abstract

In our contemporary society, phatic technologies routinely establish, develop and maintain personal and emotional relationships across time and space. This phenomenon is reminiscent of Giddens' 1990 concept of *abstract systems* – made of *symbolic tokens* and *expert systems* – that disembed and re-embed public and professional life. In this paper, we develop social theory that aims to provide a better understanding of the prominent role of phatic technologies in society. We proceed in three stages: first, we critique and revise Giddens' vague concept of *symbolic tokens* and its implications for *time/space distancing* by introducing novel concepts from measurement science. This focuses on forms of information that are relatively precise and communal. Secondly, building on our new formulation of abstract systems, we propose new sociological concepts, *phatic systems* and *symbolic indicators*, to enable social theory to explore and analyze the rise of phatic technologies. The concepts focus on the personal and emotional. Thirdly, reflecting on the fact that our digital society is held together by software, we introduce concepts from theoretical computer science to relate the abstract sociological idea of phatic systems and symbolic indicators to the concrete nature of digital data.

**Keywords:** abstract systems, symbolic tokens, measurement science, phatic systems, symbolic indicators, abstract data types

## Highlights:

- A critique and revision of Giddens' concept of *abstract systems* and its implications for *time/space distancing*, using novel concepts from measurement science to better understand digital data and digital society.
- The new sociological concept of phatic systems to explore and analyse the implications of the rise of web-based technologies for social theory.
- An exposition of concepts from theoretical computer science to relate the sociological idea of phatic systems and the fundamental nature of digital data.

## 1. Introduction

Today, hardly any area of professional or private life has been overlooked by web-based technologies. At work, we rely on email, video conferencing, professional networking sites and information systems, which involve local and cloud based services. At home, we use retail services, gaming networks, social networking sites and 3D virtual communities. As citizens, we communicate with public bodies and government agencies through the web. As private individuals, we engage with professional web services from shops, banks, utilities, etc. Further, we support our lives with all manner of apps and wearable technologies customised to our particular interests and needs (e.g., transport, entertainment and sport). Spatially aware mobile devices, such as smart phones and tablets, make the web constantly accessible. The processors embedded in our physical environment are being connected to form an internet of things (e.g., [1, 2]). Software and the entities it manages are becoming increasingly autonomous and sentient [3, 4]. Processors attached to, or embedded, in our bodies for healthcare are initiating a new realm of software and internet connectivity [5]. The diversity, scale and depth of software services embedded in our daily lives are striking – we are delighted by our immediate and simple access to information, services and relationships of all kinds. Indeed, quite simply, we can acquire digital lives and live in a digital society.

Certainly, sociologists have been trying to respond to phenomena brought about by the development of the web. First, web-based technologies generated new contexts for the investigation of traditional sociological issues, such as inequality, political participation, gender and cultural diversity (e.g., [6, 7, 8]). Later, these technologies created new phenomena requiring specialised sociological investigations into social networking, virtual communities, cybercrime, surveillance, open data and digital identity (e.g., [9]). Recently, the existence and availability of vast amounts of data about individuals and groups, generated by daily life, have led to some scholarly recognition that ‘life online’ is becoming a coherent field of sociological enquiry in its own right, combining traditional and emerging methods (e.g., [10, 11, 12]). The nature and scale of data concerning our professional and private lives have significant implications for sociological studies. For example, the challenges to empirical sociology have been debated in Savage and Burrows [13, 14], and the web and its future sociology have been discussed in Halford et al. [15].

Social theories provide us with a set of conceptual tools to think about social phenomena around us – providing meaning behind actions cf. [16]. General theories provide conceptual frameworks that concentrate on fundamental ideas and processes, shaping questions and unifying disparate social phenomena. Naturally, general theories of modern society are also challenged by the implications of the web – it is to be expected that either new concepts emerge to better manage and explain the sociological implications of the web, or existing sociological concepts are transformed. Social theorists have formulated various theories to explain modern social life, such as Berger et al. [17], Giddens [18, 19], Bauman [20] and Archer [21]. Most fundamental notions were in place by the end of the last century, and *before* the rise of the web. However, for many, even in some of the early works, technology was considered one of the hallmarks of modern society cf. [17] though it was rarely more than a high level notion.<sup>1</sup> Certainly, the social theories of the late twentieth century did not know of the social phenomena that constitute our digital lives. Two questions arise:

1. How do we understand conceptually the transformations of personal and social behaviour brought about by the rise of web-based technologies?
2. How do these transformations impact on our theoretical understanding of contemporary society and our speculations on its direction of travel?

Addressing the first question, to better understand the social and cultural dimension of web-based technologies, in Wang, Tucker and Rihll [22], the concept of phatic technology was introduced and defined as: “*A technology is phatic if its primary purpose or use is to establish, develop and maintain human relationships. The users of the technology have personal interactive goals*” [22: 46]. The paper explained the origins of the concept of ‘phatic’ in anthropology and sociolinguistics, examined what is new about phatic technology in terms of theories about the nature of technological development and looked at some current examples of internet technologies that motivated the investigation. The most popular examples include social networking sites, online gaming communities, and cybercommunities. Phatic technology is a subset of communications technology, where “*the essence of communication is relationship building not information exchanging*” [22: 45]. The Internet was identified as the primary source of *strong phatic technologies*, wherein phatic use is found in the initial design of these technologies and is not an added-on or emergent feature of such technologies.<sup>2</sup>

The sequel Wang, Tucker and Haines [23] sought a sociological understanding of why phatic technologies have risen so dramatically in terms of scale, pace and influence. The paper turned to the field of general social theory and using key notions in Giddens [18], such as *time-space distanciation*, *trust* and *reflexivity*, and explained how the growth of phatic technology exemplified a transformation of personal and social relationships. It was argued that the social phenomena associated with phatic technologies have a similar form to those analysed in the theory of modernity. The manifestations of changes, in terms of scope, scale and speed, brought about by phatic technologies are radical; however, the intrinsic nature of these changes is consistent and continuous with Giddens' theorising [18].

Social theory prior to the web provides ideas with which to understand the growth of phatic technologies. Conversely, we expect that owing to the scope, scale and speed of social changes brought about by digital technologies, new concepts need to be formulated to better accommodate and explain the sociological significance of phatic technologies in our digital society.

In this paper, we develop the ideas in Wang et al. [22, 23] by analysing their implications for social theory. We use the insights to construct new sociological concepts that capture the social consequences of phatic technologies. We introduce a new type of abstract social system, called a *phatic system* that disembed and reembed personal and emotional relationships across time/space. We show that phatic systems are complementary to Giddens' analyses of modern society circa 1990. In Giddens' 1990 theory, an essential concept is that of *abstract systems*, which are the means by which our public and professional lives are disembedded from their immediate locales and reembedded across a potentially vast time-space. Abstract systems consist of what he calls: (i) *symbolic tokens*; and (ii) *expert systems*, which are systems of *professional expertise* or *technical accomplishment* (18: 22, 27). The influence of technology can be readily found in abstract systems. Giddens' theorising, however, was formulated before the launch of the World Wide Web in August, 1991. Of course, abstract systems were not formulated to cover the disembedding/reembedding of personal and emotional relationships. This change is crucial because phatic technologies, by serving our personal and emotional needs, have enabled software technologies to extend their engagement with and influence on most activities of daily life.<sup>3</sup>

This paper proceeds in three stages. In the first stage, we prepare the ideas that constitute abstract systems and phatic technologies. Abstract systems are central to the idea of time/space distancing in Giddens' analysis of modernity. However, the notion remains deficient and neglected despite some two decades of critical interpretations. We provide a critique of abstract systems focused on the barely analysed component notion of symbolic tokens. In particular, we radically extend the portfolio of examples of symbolic tokens, from the only example provided in Giddens [18] – money. This is achieved by demonstrating that symbolic tokens can be conceived as the result of making measurements. By making measurements we mean creating and gathering data in some context, ranging from the quantitative numerical measurements of science and commerce to the qualitative characterisation of social and personal behaviour. This broad interpretation of measurement is fundamental to our later discussion: we argue that an understanding of measurement science is needed to improve our understanding of the nature of digital society.

In the second stage, we consider the impact of phatic technologies. Motivated by Giddens' original definition of an abstract system as combining symbolic tokens and expert systems, we propose a new sociological concept of *phatic system*, which disembeds *private and emotional* life from immediate locales and reembeds these across time-space. Phatic systems involve identity and engagement (sharing and exchanging), and require their own *symbolic indicators*. These social systems are realized through the design and use of phatic technologies. We illustrate our concepts of phatic system and symbolic indicator via a discussion of cybercommunities.

Finally, in the third stage, we reflect on the conceptual basis of software that makes possible a digital society wherein the professional and personal are digitised. Software is the basis of any digital technology. So, if we are moving towards a completely digitalised society, then we are moving towards a society constructed by software. We discuss what exactly is digital data, a term that is widely used and underpins phatic technology. This introduces technical ideas from computing – on the scope of data, how it is represented and on the nature of software. We argue that *any* form of symbolic token and symbolic indicator, if it is to be made of software, must be represented faithfully by a so-called *abstract data type*. This Section 5 is necessarily technical as it is about ideas that are fundamentally mathematical.

## **2. On Abstract Systems and Phatic Technologies**

Giddens' theory of modernity, as expounded in his *Consequences of Modernity* [18], is nothing less than a grand social theory of modern society, one which tries to articulate its most significant characteristics. The theory covers broad aspects of social life; discusses the relationship between the individual and community, and emphasises the role of technology in shaping modernity. It is based upon 'solid' concepts that allow these theories to be used in social enquiry – such as in, e.g., [24, 23] – particularly in contrast to the 'fluid' nature of postmodern theories (e.g., [20]).

For Giddens, modernity is 'double-edged' [18: 10], which is expressed through the main themes of 'security versus danger' and 'trust versus risk' [18: 7]. These themes resonate with contemporary social concerns. For example, the widespread development and application of digital technology have provided opportunities for large-scale control through monitoring and surveillance. On the one hand, this could be perceived as fundamental in building a secure society; on the other hand, the growth of surveillance technologies (e.g., data mining) and hacking (e.g., malware) can also be said to violate personal privacy, erode social solidarity and threaten ontological security.

A key characteristic of modernity is the process of *time-space distanciation*, which involves the separation of place from space and their restructuring. The disembedding of a social system is the lifting out or abstraction of its social relations from some local contexts of interaction; and their re-embedding is their re-construction in a form that spans space and time without local restrictions [18: 21]. Disembedding and re-embedding are accomplished by means of what Giddens calls *abstract systems*, which have two components *symbolic tokens* and *expert systems*.

Symbolic tokens are "media of interchange which can be 'passed around' without regard to the specific characteristics of individuals or groups that handle them at any particular juncture" [18: 22]. The canonical example of symbolic tokens is money; indeed, unfortunately, it is the *only* example provided in Giddens [18], leaving the notion vague and difficult to use – in the next section (Section 3), we offer a detailed critique and re-construction of symbolic token using the modern conception of measurement. Expert systems are systems of (a) *professional expertise*; or (b) *technical accomplishment* "that organise large areas of the material and

social environments in which we live today” [18: 27]. These are exemplified by banking and legal systems,<sup>4</sup> and it is not difficult to develop many more examples.<sup>5</sup>

Giddens’ observes that: “*The nature of modern institutions is deeply bound up with the mechanisms of trust in abstract systems, especially trust in expert systems*” [18: 83; emphasis in original]. This is best explained by separating trust relations into two types – *facework commitments* and *faceless commitments* [18: 80]. In traditional societies, much social interaction is face-to-face and trust is expressed in, and sustained by, facework commitments – direct interactions with other individuals in circumstances of co-presence. In modern society, there is a ‘transformation of intimacy’ that explains individuals’ trust towards non-face-to-face interactions brought about by disembedding mechanisms that characterise modernity.

The character of trust has changed radically with the emergence of modernity. Although many relations of trust in family and local community are still direct and personal, the essence of modern institutions is evident in the nature and scale of faceless commitments. Trust in systems, independent of persons, *is* the manifestation of individuals’ trust in abstract systems. In many cases, faceless commitments toward abstract systems are initiated or supported by facework commitments toward the *access points* of these systems. Access points are ‘points of connection between lay individuals or collectivities and the [people acting as] representatives of abstract systems’ [19: 88]. Thus, the extent of trust that an individual user is willing to place in an abstract system is heavily influenced by his or her experience with people at its access points. However, twenty-five years later, this last postulate is far less true.

Online we are *not* dealing directly with people at access points. We are dealing with proxies that are simplified substitutions. These proxies are a source of symbolic tokens. We view symbolic tokens as serving the needs of expert systems – so a symbolic token exists in the context of one or more systems of expertise. Without these expert systems, symbolic tokens have no meaning. To develop an understanding of abstract systems for public and professional life, we need a far better understanding of symbolic tokens. We need to understand where they are to be found; what they can do; and what they are. The opaqueness of Giddens’ concept is long standing. We will present our critique of the notion in the next section (Section 3). This is needed to clarify the original theory and in particular, to related it

to public and professional activities online. Furthermore, our revised interpretation is needed to construct our new notion of phatic system (in Section 4) focused on personal and emotional life.

Abstract systems depend upon technologies. Although it is clear that technology belongs at the heart of Giddens' analysis on modernity, technology is neither conceptualised nor explored. It is clear that Giddens uses the term with wide scope, and includes material artefacts and bureaucratic systems. In fact, the term technology has long been defined rather widely. Weber et al. [25] used the German word *technik* to cover both physical artefacts (tools and machines) and intellectual artefacts (methods). Developing this view, Ellul [26] used the French word *technique* in the same way as *technik*: technology consists of (i) tools and machines and, especially, (ii) general methods to accomplish tasks in society. More recently, to facilitate the understanding of how technologies evolve in a society, Hughes [27] introduced the general idea of *technological systems*. These contain messy, complex, problem-solving components including physical artefacts, organisations, social components usually labelled scientific, environmental, financial and legal. Thus, there is a rich classic literature on social studies of technology mainly conceived as products and services serving public good. Such classics have been advanced by extensive studies covering user-producer co-construction, often referred to as the social construction of technology (SCOT) literature [28, 29]. The SCOT approach explores how different user and producer groups influence the development and final form of products. Different groups of users can construct quite different meanings for a technology; in time, 'the interpretive flexibility' [28, 29] of a technology will vanish as a predominant meaning emerges among users.

In contrast to technologies of products and services for public good, phatic technologies focus on the individual and the private. A phatic technology must involve communication. Thus, it is an example of a communication technology, but one where 'the essence of communication is relationship-building not information exchanging' [22: 45]. Although they may begin as methods of information exchange, many communication technologies – from telegraph to telephone to mobile phone – come to exhibit degrees of phatic use. Such technologies have attracted interesting social studies of non-use [30, 31]. However, some of these should be considered as *weak* phatic technologies because the phatic component acts only as an 'add-on' feature. The technology is not created for phatic purposes, although it may have phatic uses



depending upon the way it is used by different user groups. Of course, it is the user groups that are key to understanding phatic technologies.

By contrast, in a strong phatic technology, sociality is both primary and explicit. Its phatic use is deeply embedded in the process of design by the producers and is modified by its users. The Web is the primary source of strong phatic technologies, such as advanced 3D cybercommunities (e.g., Second Life and Minecraft) and social networking sites (e.g., Facebook and Twitter). The formulation of the concept of phatic technology was born out of in-depth studies of advanced cybercommunities, such as Second Life [24]. The producer, Linden Lab, only creates the landscape and some core elements; *everything* else is constructed by the users [32]. In this case, the users themselves become the producers. Second Life, for example, has become a holistic online community with its own culture (and subcultures) and even its own economy. Other strong phatic technologies, such as Facebook and Twitter, have also generated their own cultures among their user groups. Their massive popularity is attracting academic attention, not least for their negative effects (e.g., [33]) and non-use (e.g., [31]).<sup>6</sup>

### **3. Measurement as Symbolic Tokens: A Critique**

Examples of systems of professional expertise and technical achievement abound and so there is a need to better understand the symbolic tokens that serve them. Today, our society is increasingly digitalised – our professional and personal activities are increasingly faceless. These faceless activities are enabled by a range of algorithms and software devices that exchange data. Thus, twenty-six years after Giddens' work [18], in our digital society, the disembedding and re-embedding of everyday life could simply be understood as the creation, storage and exchange of everyday data.

What is everyday data? Today, the scope of the term data is very broad and is still expanding. *Traditionally*, data originates as one of many forms of measurement: data comes from comparing, benchmarking or calibrating against standards, norms or averages taken from the world [34]. However, we will argue that the notion of a measurement is broader, more abstract and general. Indeed, in this interpretation, a measurement system can constitute a canonical type of symbolic token that serves expert systems, providing information that is the basis for action by members of a group. Later, when we focus our discussions on data and

digital environments, we will further argue that an understanding of measurement science is useful in understanding the nature of data and digital society.

We begin our critique by discussing Giddens' only example of a symbolic token – money. For centuries<sup>7</sup> we use a currency that is a product of a system of technical accomplishment – that includes minting and assaying – and is managed by systems of financial expertise – including banking. Money is a measure of value and even in the simple case of a material object, the nature of value varies and is a social invention. An object may have a value based upon its material composition, as with early coinage; and more abstract monetary units may be created based upon material value, as with paper money based upon a gold standard. Normally, the value of an object is calculated by attributing the costs of material, process, infrastructure, and the people and services involved in creating and distributing it, as with manufactured products. However, and most abstractly, the value of an object can also be determined by the social life of a changing market, as with property. Taking a web example, the virtual currency bitcoin produces a good example of this [35]. Attempts at virtual money are not new. For example, in the UK, the Mondex Card was conceived in 1990 by the National Westminster Bank as 'electronic cash'. It allows the immediate transfer of value from one party to another immediately via electronic media [36]. Usually, money is a physical token, but it is also a measurement with a scale – a measurement of value. Value is a form of information. The measure of money is, of course, very complex because it is old, abstract and social. Practically, money is realised as currencies that are local to societies. Moreover, currencies exist in networks of other currencies where their relative values change constantly. The relative value of a currency reflects an evaluation of a society in some way. Indeed, the policies governing the currency, and the behaviour of the networks and markets, change with the perceptions of a society.

Abstract systems use many more symbolic tokens than money. Money is a system of tokens founded upon complex systems of measurement, exemplifying our proposition that:

*Systems of measurement provide forms of information for expert systems. Systems of measurement, in general, qualify as systems of symbolic tokens in the Giddensian sense of the term.*

What *is* measurement? The question lies at the heart of the natural and social sciences and has led to *measurement science*. Measurement science is about *all* aspects of measurement, quantitative and qualitative. Originally, it was motivated by the fundamental and ubiquitous development of instrumentation for the physical world.<sup>8</sup> In the physical sciences, quantitative measurements of great sophistication are commonplace. There measurement is based upon standards whose units are formulated mathematically and are rigorously maintained.<sup>9</sup> Physical units can also be more qualitative, based on banding on scales (e.g., wind speed, earth tremors): a convenient survey of measurement is Robinson [37]. In wrestling with the notion of measurement in the social sciences, measurement science found deep similarities and new general perspectives [38]. The search for norms in behaviour – using surveys and statistical methods – creates various new forms of units that provide a calibration of individuals in a society, and help us to understand and interpret their behaviours. At the individual level, these quantitative units can be used to derive qualitative social norms.

The rise of technologies for sensing and measuring has added industrial, commercial and legal and social motivations for measurement that brings together much of the knowledge and experience of the modern world. Thus, measurement science embraces subjects from the timeless and ubiquitous technical and regulatory problems of weights and measures<sup>10</sup> to the latest technical developments shaping sociological issues, such as the connected socio-technical world of the Internet of Things (e.g., [1, 2]).

In making our argument we engage with the philosophical foundations of measurement, which is a technical subject, created by problems in the philosophies of physical science and behavioural science.<sup>11</sup> Recent debates on measurement continue to seek general notions and theories that embrace new developments in natural and social sciences (e.g., [39, 40, 41, 42]).

A recent reflection on the concept of measurement by Finkelstein can serve as a suitable and convenient starting point, with this contemporary working definition of measurement [39: 1271; our italics]:

“Measurement will be defined in the wide sense as a process of empirical, objective *assignment of symbols to attributes of objects and events of the real world* in such a way as to represent them, or to describe them.”

In particular, conceptions of measurement are based upon abstract qualitative descriptions expressed in symbolic systems. From these qualitative descriptions numerical quantitative notions may or may not be derived. Such an abstract view, wide in scope and independent of numbers, is at the heart of theories of measurement. That measurement is a fundamental source of examples of symbolic tokens follows from reflecting on the characteristics of measurements themselves. Again, guided by Finkelstein's [39] perceptive analysis, these characteristics can be summarised using the following three categories of nature, use and symbolism:

(i) *Nature*: Measurement provides a description of some attribute of an object or process. The descriptions are designed for a group to use so they must be understandable and stable. Measurements must be repeatable and verifiable. The measurement process must be transparent and based on an empirical process of observation of the world that can be shared by the group.

(ii) *Use*: The purpose of measurement is to provide information. The value of this information is determined by its relevance and the ways the group interprets and uses it. Measurement of an attribute provides descriptions that allow us to compare a range of occurrences of the attribute. Measurements are descriptions that are concise and precise; and numbers and units are perfect in this regard. The measurements of the sciences are native to systems of professional scientific, engineering and medical expertise.

(iii) *Symbolisms*: Measurement exists in the context of a well-defined symbolism. A measure of a property enables us to express facts and conventions in a formal symbolic language, which is necessary for any system of symbolic tokens. Measurement describes attributes by symbols, which can be represented and processed by machines.

These characteristics map the current understanding of measurement. In this broad conception, measurement can be seen to be pervasive in contemporary society. Pervasive measurement plays an essential role in our digitalized social order: it enables the 'chronic reflection' on the functioning of society [18], and services the daily activities that make up public and professional life – and indeed, the personal and emotional life – of individuals. Thus, an understanding of measurement is foundational to understandings of the nature of our

digital society. Later, in Section 5, our discussions of data and digital environments will show that measurement theory fits quite comfortably inside the more general setting of the theory of data. Now, we address phatic systems, which process relationships that are personal and emotional.

#### **4. Phatic Systems: Abstract Systems for Personal and Emotional Life**

Phatic technologies have changed social behaviour. They have created social phenomena that we have interpreted as examples of disembedding and re-embedding of the personal and emotional, and having the characteristics such as trust in faceless abstractions [23]. Giddens' theory was not formulated to cover such phenomena. The idea of phatic technologies categorizes certain software technologies. Now, we introduce the general sociological concept of *phatic system*, which reconstructs the concept of abstract system, customising it to the individual and his/her relations that are personal and emotional.

Essential to a phatic system are component sub-systems for (i) *representing personal identity*<sup>12</sup> and (ii) *engaging in relationships*, which can be individual, group or community based. Symbolism abounds in human relations and to these components we add what we call *symbolic indicators*.

A human community is formed 'on the basis of symbolic language and on the level it is maintained' [43: 97]. A key concern of sociology is the manner through which individuals assemble meaning, including how they define and present themselves, their feelings, emotions, behaviours, situations and perspectives on the wider social order. Although norms are constantly changing through interaction, in any instance a certain degree of normalcy is achieved by a set of stabilised norms. The maintenance of these norms – in terms of appearances, gestures and behaviours and through the mediation of identifiable symbols (e.g., [50]) – provides a sense of security for individuals. Indeed:

“Man cannot have a relationship with another save by the intermediary of symbolization. Without intermediary symbols, he would invariably be destroyed by raw physical contact alone. The 'other' is always the enemy, the menace. The 'other' represents an invasion of the personal world, unless, or until, the relationship is normalised through symbolization” [45: 210].

Individuals' trust in abstract systems is dependent upon access points. Since phatic systems process the private and emotional, individuals' trust in these systems is likely to be more comparable with face-to-face trust relations than their trust in expert systems that deal with the public and professional spheres. These access points depend on identifiable social norms and other human cues for trust, such as appearances, gestures and behaviours. We term these identifiable social norms *symbolic indicators*. The indicators enable phatic systems to bring information, meaning, mutuality and intimacy to – reembed in – personal lives of individuals involved. Phatic systems maintain personal stability at a time when communications are increasingly faceless. Some popular symbolic indicators in Facebook include operations 'Like', 'Comment', 'Share' and 'Pokes'. We recall that Giddens' [19: 18] idea of symbolic tokens is 'media of exchange which have standard value, and thus are interchangeable across a plurality of contexts'.

An understanding of phatic systems could also be achieved by a discussion of cybercommunities. Early research on cybercommunities questioned whether these social gatherings qualified as communities (e.g., [46, 47]), largely due to a total lack of physicality, i.e., a lack of face-to-face communication. Subsequent research, however, has shown that, like communities in the real world, cybercommunities are networks of informational and emotional exchange, and channels for establishing, building and maintaining social capital (e.g., [48, 49, 50, 51]). This change largely owes to technological improvement in the software. Through advanced technologies, an individual could feel secure in a virtual social context by extending normal appearances, gestures, routines and mutually understood interactions in ways consistent with the physical world. It is indeed "The *routines* individuals follow, as their time-space paths cross in the contexts of daily life, constitute that life as 'normal' and 'predictable'" [19: 126; our italics]. The normality and predictability serve as a protective cocoon, which enables the continuation of real world human relationship and intimacy online.

For example, the advanced 3D cybercommunity Second Life is built from all kinds of data (e.g., text, video, audio), which symbolically represent all kinds of behaviours. Using symbolic representations, users of Second Life have generated genuine social communities, where people can live an authentic alternative virtual existence via their 3D avatars (e.g., [32]). Many individuals in Second Life create avatars (digital presentations) based on real

world physical models. They are able to instruct their avatars to express various gestures and emotions, which help them to communicate with others in much the same way as they would communicate in the real world. The set of bodily gestures available in Second Life could be seen as a means to help these individuals achieve a sense of normality. This is done by symbolic indicators, such as the operations ‘Blowkiss’, ‘Cry’, ‘Getlost’, ‘Repulsed’, etc. The sense of normality is also supported by phatic features, such as systems of ‘Friendship Cards’, ‘Partner’, ‘Local chat’ and ‘Instant message’, which enable participants to reembed emotionally – to the extent of forming intimate personal attachments – in an environment that is created from software. So, “if the nature of modern institution is deeply bound up with mechanisms of trust in abstract systems, especially trust in expert systems” [18: 83], then in a world that is increasingly digital, personal and emotional relationships are deeply bound up with mechanisms of trust in phatic systems.

The phatic technologies of the web are made from software. Tokens and indicators that symbolise information of any kind are represented in software, which is made from concrete alpha-numeric symbols that, in turn, are represented in strings of 0s and 1s.<sup>13</sup> In both the professional and the personal, these representations and re-representations lead to deeper questions about syntax and semantics encountered in linguistics, logic and computing [52, 53]. Interestingly, the fundamental role of language for technology in general was noticed in Ellul [45].

## **5. Data and Digital Society’s Direction of Travel**

We live in a digital society, one that is held together by software. Its key feature is the digital representation and communication of the ingredients of life as digital data. In the previous sections, the sociological meaning of the ubiquitous use of digital data in professional and personal life were addressed by the concepts of abstract and phatic system. But what exactly is digital data? What is its role in the development of a contemporary social theory? To address such questions, and better understand abstract and phatic systems, we introduce ideas from theoretical computer science.

Contemplating the diversity, scale and depth of digital services embedded in our daily lives, clearly, software plays a primary role in faceless interaction – some might say *drives* the rise of faceless interaction.<sup>14</sup> Expert systems and phatic systems depend upon software. Consider

symbolic tokens and symbolic indicators that serve expert systems and phatic systems, respectively. Through a common understanding and consensus in what they symbolise, symbolic tokens and indicators are needed to build trust in software.

The connection between the sociological concepts of abstract and phatic systems and their realisation in software is important to theorise. To be represented in software, symbolic tokens and indicators, and the conventions for their use, must be made explicit. Can concepts in computer science help to analyse abstract and phatic systems? We turn to the key ideas of *abstract data types* and *software hierarchies* from theoretical computer science.

#### Figure I: Data and Processors`

The *raison d'être* of computers and software is to represent, store, create, transform and communicate data. Data is a general concept that has different meanings for users, programmers and computer engineers.<sup>15</sup> But data is *always* representable by means of *systems of marks or symbols* of different kinds. In particular, there is a hierarchical structure in which higher level symbolic systems are coded by lower level symbolic systems, finally reducing all representations to encodings by binary symbolic systems based upon 0 and 1 (see: Figure I).

Computer scientists have long understood these various levels of symbolic representations. They have created general theories about: specifications of what users have in mind; programming languages to make software that meets users' specifications; and tools to translate the software into binary codes that machines can execute. In particular, computer scientists have created unified theories of data based upon the idea of *abstract data type* – a notion that encapsulates just those properties of data that are essential to the description of a user's computing problem. The idea is summarised by:

$$\textit{abstract data type} = \textit{data} + \textit{operations on data} + \textit{tests on data}$$

The operations transform old data into new data, and the tests answer questions about data. The collection of operations and tests alone determine what can and cannot be done with the data in computations.



In the theory of data, users have access to the data *only* via the operations and tests. Their knowledge of the data is based upon a specific set of properties – called a *specification* – that the operations and tests of the data type are assumed to obey. The set of properties that specifies that data type is thought of as a collection of axioms or laws that spell out what can be assumed about the data. These specifications belong to the user and what the user knows is determined by what reasoning can reveal from the specification. How they are implemented as software by the programmer is left unspecified and is unknown to users. Insulated from implementation details, users act at their chosen level of abstraction close to their tasks, and the technicalities of implementations can be varied without disturbance; specifically the software is *portable*, successfully operating on a diverse collection of machines.<sup>16</sup>

The scope of the theory extends to *all* data. The data must be represented symbolically and must allow algorithms on the symbols to compute both the operations and tests to be of any use, i.e., they must be computable. Ultimately, the data is made of binary symbols 0 and 1, and it is this property that defines the notion of *digital object* – text, sound and visual images.

The hierarchy applies to all software. The programs are formal texts written in a programming language obeying precise rules about what symbols are allowed and how the symbols may be combined.<sup>17</sup> This is true of programs at all levels of the software hierarchy. Whilst at all levels of abstraction, the software is symbolic; the primacy of 0 and 1 is far more than an accident of technology.

In 1936, Alan Turing began his scientific career with a fundamental analysis of the nature of computation. His analysis asked what can be represented by symbols, and what can a human being do with these symbols using precise rules to manipulate them.<sup>18</sup> His analysis led to a formal model – the *Turing Machine*. Turing's analysis has been at the heart of the philosophical and technical foundations of computer science. In our sociological context, it is important to note that Turing's theory of computation is fundamentally a *human-centred or anthropic* view of computation:

*Computation is what people can do with symbols when following rules or instructions.*

Measurement produces data and systems of measurements form data types. Indeed, most strikingly, the mathematical theory of measurements (e.g., [54]), uses the same algebraic

methods as the mathematical theory of data types.<sup>19</sup> Thus measurement theory as it currently stands fits inside the more general setting of abstract data type theory quite comfortably. Practical connections between measurement science and computer science have been discussed in Finkelstein and Finkelstein [55].

Thus, abstract data types are able to unify abstract and phatic systems by modelling scientific measurements, financial transactions, flirtatious banter, phatic noise, ... , expressed in texts, images, audios, videos – the fabric of our digital society.

## 6. Conclusions

In this paper, we have proposed that time-space distancing, disembedding and re-embedding can explain the profound social phenomena arising from the hegemony of software technologies. The notion of abstract system was designed to explain how disembedding and re-embedding operates. The vagueness of notion of symbolic token meant that the concept had limited use. However, the social change that is most significant is in the domain of the personal and emotional, made possible by software technologies that are phatic.

We have developed the notion of phatic systems to extend the mechanism of abstract system to cover time-space distancing in personal and emotional life. Indeed, in contemporary society, software technologies have made sociological abstractions more prominent and easier to understand, especially the growth of faceless commitments in disembedding, and the importance of trust in re-embedding.

### Figure II: Map of Concepts

Specifically, we have (i) proposed that systems of symbolic tokens can be broadly understood as systems of measurement; (ii) introduced new concepts of phatic systems with their symbolic indicators; and (iii) argued that the concept of abstract data types can unify the analysis of expert and phatic systems with their symbolisms. Because abstract data types encapsulate the properties of data that are relevant to a user's computing problem, it is an essential notion in our digital society; wherein one key social phenomenon is the rise of software to process the data that can be generated in our daily lives.

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Reflecting on technological change, we see further uses of these systems in new developments in social theory, such as the emerging large-scale research agendas of web science [56, 57] and digital sociology [11, 12]. We expect that enriching social theory with insights from technology studies, measurement science, and the theory of data and software would lead to theories that provide a deeper understanding of our digital society.<sup>20</sup>

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**All tables and figures:**

Figure I: Data and Processors

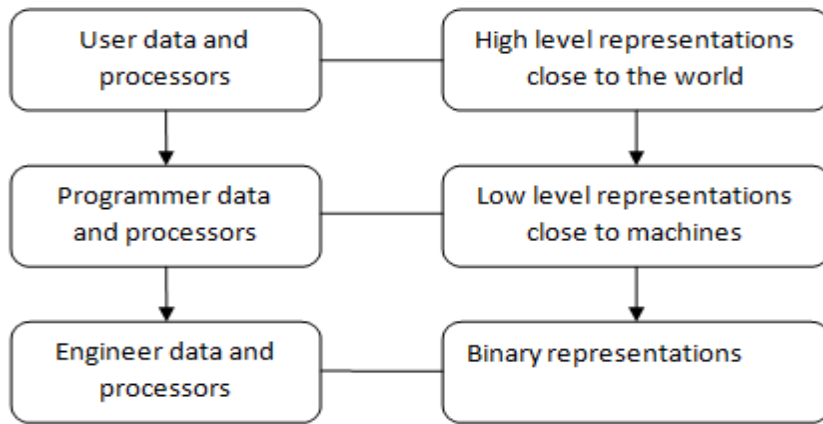
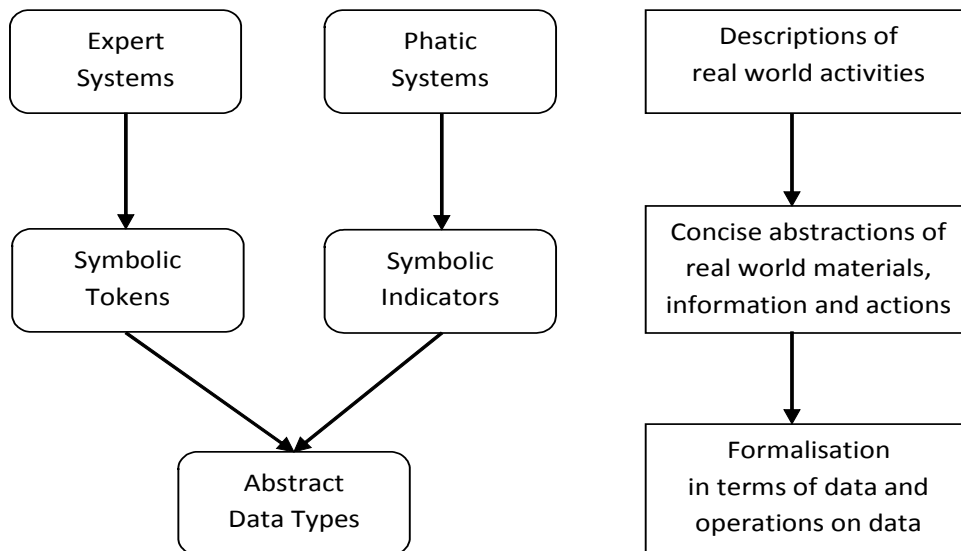


Figure II: Map of Concepts



## Endnotes:

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<sup>1</sup> The vagueness of the notion of technology and its influence in social theory might be due to the nature of technologies of the day – most of which were associated with industrial and, to a lesser degree, commercial processes – encouraging a rather narrow understanding of technology, distant from core questions of social theory. The involvement of the details of particular technologies is somewhat rare in theory making.

<sup>2</sup> A fuller account of the origins, nature, development and examples of phatic technology can be found in Wang et al. [22, 23].

<sup>3</sup> Not all web-based technologies have engaged harmoniously. Phatic technologies bring with them problems of surveillance and privacy (privacy social media) and emotional dislocation (e.g., [31, 33]).

<sup>4</sup> In using Giddens' term expert systems, we wish to avoid any confusion with the software tools known as expert systems that became prominent in the 1980s.

<sup>5</sup> Another expert system that surrounds us in our daily lives is the transportation system: when an individual takes the bus, he/she enters a large network of expert systems, such as the construction of the bus and the roads, and the traffic control systems... [58].

<sup>6</sup> Perhaps, for phatic technologies that penetrate social life, financial factors are sociologically significant. For example, as Doug Laney [59] observed in 2012, Facebook's nearly one billion users had become the largest unpaid workforce in history.

<sup>7</sup> One thinks of the well-documented history of the Tudor coinage with its struggles with manufacture, debasement, corruption, and the emergence in the British Isles of advanced continental methods of financing trade and banking [60]. For the general history of money, see Davies [61].

<sup>8</sup> This motivated the founding of journals such as *Measurement science and technology*, by the Institute of Physics in 1924.

<sup>9</sup> Quantities can be easily observable (length, mass) or rather abstract (force, energy, power); their units (metre, kilogram, newton, joule and watt, respectively) are never straightforward to define and standardise. For example, mechanical power depends upon energy, which depends upon force, which depends on Newton's Second Law.

<sup>10</sup> Archimedes discovered his Principle while struggling to solve a weights and measure problem about a ruler's crown.

<sup>11</sup> It begins in the nineteenth century in Helmholtz [62] and acquires a logical axiomatic basis early on, making it mathematical and abstract, as firmly established in Hölder [55]. A

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synthesis of approaches in Suppes [64] led to a coherent mathematical theory of measurement, which explains how numerical representations of qualitative attributes are possible: see the magnum opus Kranz et al. [54]. An interesting survey of the challenges facing the theory is Luce and Narens [65]. See Darrigol [66] and Diez [67, 68] for detailed histories.

<sup>12</sup> When interacting ‘facelessly’ via phatic systems, an individual needs to give over some data representing his/her identity to distinguish himself/herself from others.

<sup>13</sup> Various standard sets of written symbols have been used in computing such as versions of the *American Standard Code for Information Interchange* (ASCII) (first published in 1963) and the international *Unicode* (first published in 1991).

<sup>14</sup> Society’s appetite for performance measurements, benchmarking, targets and league tables in the work place is one expression of this phenomenon.

<sup>15</sup> For modern users, data include all sorts of things made from numbers, texts, images, videos and audios.

<sup>16</sup> The literature on the theory is very technical. An early exposition is Liskov and Zillies [69]. The mathematical theory begins in earnest in Goguen et al. [70]. The scope of the theory is discussed in Meseguer and Goguen [71].

<sup>17</sup> Programming languages have precise syntax largely defined by formal grammars in the style of Noam Chomsky’s theory of grammars.

<sup>18</sup> See Section 9 of Turing’s paper reproduced in Copeland [72] and the commentary Petzold [73].

<sup>19</sup> For example, both theories are based upon axioms; algebraic models that satisfy the axioms; and mappings called homomorphisms that compare models.

<sup>20</sup> We thank the referees and the editor for useful comments that have improved an earlier version of our paper.