Technology's In-Betweeness

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One of the most obvious features that characterises any technology is its *in-betweeness*. Suppose you live in Rio de Janeiro, not in Oxford. A hat is a technology between you and the sunshine. A pair of sandals is a technology between you and the beach on which you are walking. And a pair of sunglasses is between you and the bright light that surrounds you. The point may be phrased slightly differently, in terms of what exactly a specific technology relates. Perhaps a pair of sandals relates not you, but just your feet, and not to the beach, but just to some of its sandy surface. Yet this is hair-splitting and, in its essence, the idea of such an in-betweeness seems clear and uncontroversial. However, it soon gets complicated.

Because of our anthropocentric concerns, we have a standard term to describe one of the sides of technology's in-betweeness: it is the *interacting user*. However, we seem to lack a term for the other side of the relation, what invites a particular usage or enables some interaction. I suggest we call it *affordance*, even though this is a term that may have other technical connotations in other specific contexts. Here, it means that the sunshine is an affordance for the hat, the beach is an affordance for the sandals, and the bright light is an affordance for the sunglasses. An inventor is someone able to devise an artefact that may satisfy a user's need by taking advantage of some available affordance. As you can see, I am slightly stretching the word 'affordance', hopefully without breaking it.

When technologies are in-between *human* users and *natural* affordances (natural objects, processes, or phenomena), we may qualify them as *first-order*. Listing first-order technologies is simple. The ones mentioned above qualify. More can easily be added, such as the plough or the wheel. The axe is probably the first and oldest kind of first-order technology. Nowadays, a wood-splitting axe is still a first-order technology between you, the user, and the wood, the affordance. An hourglass is between you and the regular flow of sand. A saddle is between you and a horse. Nail clippers and hunting bows are other instances of such first-order kind of technology, which

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need not be simple, and can be technology-dependent and technically very sophisticated, like an assault rifle, which is sadly a first-order technology between two human sides, as both users and affordances.

At this point, the word 'tool' may come to mind as appropriate, but it would be misrepresentative, because tools do not have to be first-order technologies, as I shall explain presently.

Many non-human animals are able to make and use simple, first-order technologies, like modified sticks or shells, to perform tasks such as foraging, grooming, fighting, and even playing. This discovery determined in the past the end of a naïve interpretation of *homo faber* as *homo technologicus*. True, we are the species that builds, but the point to be made is slightly more subtle, because many other species also create and use artefacts to interact with their environments. Like in the case of our use of natural languages and other symbolic forms of communication, or the creation of artificial languages, e.g. to programme machines, the difference between us and other species is incommensurable not because it is a matter of binary presence or absence of some basic abilities, but because of the immensely more sophisticated degree in which such abilities are present in us. It is the difference between a colouring book with which a child has played using some crayons and the Sistine Chapel. Insisting on continuity is not mistaken, it is misleading. In the case of technologies, it is preferable to talk about *homo faber* as *homo technologicus* inventor and user of *second-* and *third-order* technologies, in the following sense.

Second-order technologies are those relating users no longer to nature but to other technologies, that is, they are technologies whose affordances are other technologies. This is a good reason not to consider the concept of tool as being coextensive with that of first-order technology. Consider the homely example of a humble screwdriver. Of course, it is a tool, but it is between you and, you guessed it, a screw, which is actually another piece of technology, which in its turn (pun irresistible) is between the screwdriver and, for example, two pieces of wood. Other examples of such second-order technologies include keys, whose affordances are obviously lockers, and vehicles, such as motorbikes and automobiles, whose users are (still) human and whose affordances are paved roads, another piece of technology.

Some first-order technologies (recall: these are the ones that satisfy the scheme humanity-technology-nature) are useless without the corresponding second-order technologies (humanity–technology–technology) to which they are coupled. Roads do not require cars to be useful, but screws call for screwdrivers. And second-order technologies imply a level of mutual dependency with first-order technologies (the drill is there because of the drill bits) that is the hallmark of some degree of specialisation, and hence of organisation. You either have nuts *and* bolts or neither. Such interdependencies, and hence the appearance of second-order technologies, are usually associated with the emergence of more complex forms of human socialisation, and hence some kind of civilization. Whereas some non-human animals are able to build their own artefacts to some extent, e.g. by sharpening a stick, they do not seem to be able to build second-order technologies in any significant way.

The engine, understood as any technology that provides energy to other technologies, is probably the most important, second-order technology. Watermills and windmills converted energy into useful motion for centuries, but it is only when the engine becomes a 'portable' energy-provider, which can be placed between users and

other technologies wherever it is needed, that the industrial revolution becomes a widespread reality. Much of modernity—prompted by science's increasing knowledge about, and control over, materials and energy—gets its mechanical aftertaste from the preponderance of this second-order in-betweeness. It is a world of gears, clocks, and powered mechanisms, characterised not just by the humanity–technology–nature relation but, more significantly, by the humanity–technology–technology relation. Modernity soon became a world of networked dependencies as well as lock-in connections: no trains without railroads and coal, no automobiles without petrol stations and oil, and so forth, in a mutually reinforcing cycle that is both robust and constraining.

As the history of the floppy disc shows, at some stage it is easier to replace the whole system—change paradigm, to put it more dramatically—than to keep improving one part of it. There is no point in having super-powerful floppy discs if the millions of drives already in place are not up to the task of reading them. This explains one of the advantages of any technological leapfrogging: a later adopter does not have to deal with the legacy of any incumbent technological package (coupled first- and second-order technology), and is free to take advantage of the most recent and innovative solution. Yet, this is less simple than it looks, precisely because of the coupled nature of second-order technologies. Of course, it would be easier to introduce electric or hybrid vehicles (assuming that this is what we want to do) if there were only roads but no internal combustion engine vehicles, the trouble is that roads are there because of the latter in the first place. Thus, the task of legislation that deals with technological innovation is also that of easing the transition from old to new technologies by decoupling, sometimes through incentives and disincentives, what needs to be kept (e.g. roads) from what needs to be changed (e.g. internal combustion engine vehicles).

Most of the comfortable appliances we enjoy in our houses today are modern, in terms of conception: the refrigerator, the dishwasher, the washing machine, the clothes dryer, the TV with its remote control, the telephone, the vacuum cleaner, the electric iron, the sound system … these are all either first- or second-order technologies, working between human users and the relevant affordances. They represent a world that is ripe for a third-order, revolutionary leap. For technology starts developing exponentially once its in-betweeness relates technologies-as-users to other technologies-as-affordances, in a technology–technology–technology scheme, and we, who were the users, are no longer in the loop, but at most on the loop, or not significantly present at all, that is, out of the loop, and enjoy or simply rely on such technologies as (possibly unaware) beneficiaries or consumers.

Technologies as users interacting with other technologies as affordances, through other in-between technologies: this is another way of describing 'hyperhistory' as the stage of human development when third-order technological relations become the necessary condition for development, innovation and welfare. It is also a way of providing further evidence that we have entered into such hyperhistorical stage of our development. The very expression 'machine-readable data' betrays the presence of such a generation of third-order technologies. To put it simply, barcodes are not for our eyes and, in high-frequency trading (three quarters of all equity trading volume in the US is HFT), the buying and selling of stocks happens at such an extremely high speed that only fast computers and algorithms can cope with it, scanning many

marketplaces simultaneously, executing millions of orders a second, and adapting strategies in milliseconds. The same holds true in any time-sensitive application, whether civilian or military. Further examples include autonomous vehicles, like driverless cars, or 'domotic appliances', the technologies that are transforming the house in a smart environment, for instance by monitoring, regulating, and adapting to our habits the central heating and the supply of hot water.

The ultimate third-order technology is provided by ICTs (information and communication technologies). The very use of 'engine' in computational contexts (as in 'search engine') reminds us of the equation second-order technology: engine = third-order technology: computer. ICTs can process data autonomously, and hence be in charge of their own behaviours. Once this feature is fully exploited, the human user may be considered as redundant. You could not imagine a modern world of mechanical engines that keeps working once the last human has left earth. History, and in particular mechanical modernity, is still human-dependent. However, we can already conceive a fully automated, computational system that may not need human interactions at all in order to exist and grow. Projects to build self-assembling 3D printers that could exploit lunar resources to build an artificial colony on the Moon may still sound futuristic, but they illustrate well what the future looks like. Hyperhistory can in principle be human-independent. Autonomous agents no longer need to be human.

To summarise, technologies can be analysed depending on their first- second- or third-order nature. Once again, the point could be refined, but without much conceptual gain. Is a clock a first- (between you and your time), a second- (between you and your pressure cooker), or a third-order technology (between your computer and some scheduled task)? Is a pair of scissors a first- (between you and the stem of a rose), a second- (between you and a piece of paper), or a third- (between a robot and a piece of cloth in a factory) order technology? Is a computer a first- (between you and the level of water in a reservoir), a second- (between you and another computer) or a third-order (between two other computers) technology? Evidently each answer depends on the context and how we understand it, but then again, the lack of a decontextualized answer does not make the distinction any less cogent, it only proves that we need to be careful when using it. What is important to stress here is that the distinction is both sound and complete: there is no fourth-order technology. Not because the chain of technologies interacting with other technologies cannot be extended as much as one wishes, which of course is trivially possible, but because such a chain can always be reduced to a series of triples, each of which will be either of first-, of second-, or of third-order.

The evolution of technologies, from first- to second- and finally to third-order, poses many questions. One seems worth exploring in this context. If technology is always in-between, then what are the new relata when ICTs work as third-order technologies? To be more precise, for the first time in our life on this planet, we have technologies that can regularly and normally act as autonomous users of other technologies, yet what is ICTs' in-between relationship to us, not as users but as potential beneficiaries who are out of the loop? Precisely because ICTs finally close the loop, and let technology interact with technology through itself, one may object that the very question becomes pointless: with the appearance of third-order technologies all the in-betweeness becomes internal, no longer ours but technologies'

business. Such a process of 'internalisation' is a source of concern about ICTs ending up controlling human life. Hyperhistory may be the time when we are depending on our technologies and our technologies are independent of us. At the same time, one may still argue that ICTs, as third-order technologies that close the loop, internalise the technological in-betweeness but generate a new externality, for they create a new space outside the loop (think for example of cyberspace), a space made possible by the loop, that relies on the loop to continue to exist and to flourish, but that is not to be confused with the space inside the loop. Occurrences of such spaces are not socially unprecedented: at different times and in different places, buildings' areas have been designed to be used and inhabited only by slaves or servants for the proper, invisible functioning of the whole house-system, from the kitchen and the canteen to separate stairs and corridors. What is unprecedented is the immense scale and pace at which the whole of human society is now migrating to such an out-of-the loop space, whenever possible. We are increasingly living onlife, on Google earth. We should be thinking more carefully about what we are doing.