# Information overload and environmental degradation: learning from H.A. Simon and W. Wenders

Tommaso Luzzati*† Ilaria Tucci^ Pietro Guarnieri*

*Department of Economics and Management, University of Pisa, Italy
^TAPRI, University of Tampere, Finland
†*Corresponding author*: tommaso.luzzati@unipi.it

**ABSTRACT**

This paper discusses the relevance of information overload for explaining environmental degradation, insofar it can reduce individuals' awareness of the unsustainable side-effects of their choices. This "myopia" is reinforced by the increased distance from nature in everyday life brought about by the abundance of exosomatic energy. The departure point of the paper is to show that two outstanding intellectuals, engaged in very different fields, have set forth very similar reflections on the effects of information overload, namely the film director Wim Wenders and the social scientist, really a polymath, Herbert Simon, whose relevance to ecological economics has been recognised. The presentation of their ideas is then complemented by a presentation of the state of the art on information overload, which allows moving to our core argument about environmental degradation.

Keywords: information overload; knowledge; awareness; individual decision-making; environmental concern; H.A. Simon; W. Wenders; film.

HIGHLIGHTS:

- Information overload (IO) is a key notion both in Simon's and Wenders' works
- IO and distance from nature lower awareness of environmental side effects of choice
- Low awareness helps explaining environmental degradation

## 1 Introduction

Mainstream economics attributes environmental degradation to wrong economic incentives. Since the seminal contribution by Pigou (1920), the notion of "externalities" has become a key conceptual tool, and the remedy is taxation to internalise them. The Chicago school approach to the issue, started by Coase (1960), has shifted the focus to the lack of well-defined property rights. This, however, has not changed the narrative (Klink 1994): economists argue that the economy "consumes" too much "environment" because its price is zero (Pearce et al. 1989).

Unfortunately, the role of other factors remained rather unexplored within economics, at least until the recent acceptance of behavioural insights. We do not deny that wrong incentives at the individual level are important; at the same time a necessary premise for rational decision making is the actors to be aware of the consequences of their choices. In this paper, we highlight that such awareness can be hindered by information overload and artificialization of contemporary life, which can become useful analytical categories to explain environmental degradation.

Concern for information overload, which was so central for Herbert Simon, who dedicated his life to the study of decision-making, also shaped the (early) works of the film director Wim Wenders. With its transdisciplinary focus, Ecological Economics can benefit also from insights coming from outside academia, including cinema (Mayumi et al., 2005, is an interesting example). Analysing the similarity between Simon and Wenders shows not only how close intellectuals working in different fields can be, but also how fruitful their ideas can be applied to another field - sustainability studies in this case. After elaborating on their contributions (sections 2 and 3), we briefly discuss the concept of information overload and the main findings of the several disciplines that have been dealing with it, including behavioural environmental studies (section 4). The implications of information overload and energy abundance for environmental degradation are then drawn; we show how those implications can also be modelled within a standard consumer's choice problem (section 5). Finally, we draw some general conclusions (section 6).

## 2 Herbert Simon

As is well-known, Herbert A. Simon (Milwaukee, 1916 – Pittsburgh, 2001) was one of the most influential social scientists of the twentieth century, an eclectic scholar who gave seminal contributions to different disciplines, namely information technology, artificial intelligence, cognitive psychology, and economics. Because of his achievements, he got many important awards, among which, in 1975 (with A. Newell), the most prestigious recognition in computer science, the Turing Award, and in 1978 the Nobel Memorial Prize in Economic Sciences. This section on Simon serves not only the purpose of allowing a comparison with Wim Wenders, but also to emphasise that the concept of "bounded rationality" has neither to be confused with a form of imperfect rationality nor interpreted as constrained maximisation. This is crucial to our arguments.

The common thread running through Simon's almost one thousand publications is the desire to understand decision-making processes, "I am a monomaniac. What I am a monomaniac about is decision-making" he confessed to one of his students (Feigenbaum, 2001: 2107). Interested in

knowing how human beings face and solve problems, he spent his academic life to understand the principles that the human mind follows in processing and using information.

In many of his writings, and also in the Nobel Prize lecture (Simon, 1978b), he criticised the notion of rationality used in economics for not considering the limits of the human mind. He pointed out many failures and epistemological weaknesses of the neoclassical economic theory, which is grounded on a narrow notion of rationality that does not help explaining empirical observations better than the common sense of rationality. He highlighted that many deductions of neoclassical models do not require the hypothesis of perfect rationality; for instance - as admitted also by a champion of mainstream economics, the Nobel laureate G. Becker - utility maximisation is not necessary for obtaining decreasing demand function (Simon, 1978b: 347-9). By bringing numerous examples, Simon showed (e.g. Simon, 1986: S213-215; Simon, 1978a: 4-5) how the deductions of neoclassical theory are grounded more on auxiliary hypotheses (e.g. particular specifications of the model), rather than on an "omniscient" rationality, a term already used in 1959 (Simon, 1959: 265). Incidentally, it has to be recalled that also the Nobel laureate K.J. Arrow, a scholar who greatly contributed to neoclassical theory, expressed similar concerns. Arrow admitted not only that rationality is often a non- necessary hypothesis (Arrow, 1990: 26), but also that rationality

> "[...] is most plausible under very ideal conditions. When these conditions cease to hold, the rationality assumptions become strained and possibly even self–contradictory. They certainly imply an ability at information processing and calculation that is far beyond the feasible and that cannot well be justified as the result of learning and adaptation." (Arrow, 1990: 25)

The core of Simon´s thesis was the need of attributing a "procedural" meaning to rationality. The mainstream "substantive rationality" is focused only on the results, "[b]ehaviour is substantively rational when it is appropriate to the achievement of given goals within the limits imposed by given conditions and constraints" (Simon, 1976: 66). Neoclassical economics, differently from other social sciences, is not interested in "the nature and origins of values and their changes with time and experience" as well in describing and explaining "the ways in which non rational processes (e.g., motivations, emotions, and sensory stimuli) influence the focus of attention and the definition of the situation that set the factual givens for the rational processes" (Simon, 1986: S210). In contrast, for example, when "psychologists use the term 'rational', it is usually procedural rationality they have in mind", and a "behaviour is procedurally rational when it is the outcome of appropriate deliberation" (Simon, 1976: 67).

Once the focus has moved from outcome to process, the nature of the problem to be faced

becomes crucial for defining rationality; a substantive approach is appropriate for simple problems, while it is irrational if the decisional context is difficult. For instance, substantive rationality would require playing chess by writing down the entire game tree made by all the possible moves. The reason why nobody, not even computer programs, plays by writing the whole game tree is time (and probably also physical limits!):

> "Normally, when a chess player is trying to select his next move, he is faced with an exponential explosion of alternatives. For example, suppose he considers only ten moves for the current position; each of these moves in turn breeds ten new moves, and so on. Searching to a depth of six plies (three moves by White and three by Black) will already have generated a search space with a million paths" (Simon and Chase, 1973: 394).

A player who would try to play chess by writing the game's tree could not be considered as rational. Rather, a rational person can adapt the decisional procedure to the difficulties of the task in relation to his/her own computational capacities. The study of the cognitive processes has shown how in real-life situations, the "difficult" problems are solved by selectively reducing the number of possible paths. In a similar way, operational research tackles the integer programming problems (Simon, 1978a: 11). Humans, who are not abstractly omniscient beings with infinite computational capabilities, explore only a little part of the possible alternatives, addressing only the most promising ones; they follow "rules of thumb" or "heuristics rules" that derive from the identification of patterns and/or trials and errors that come from past experiences (Simon, 1978b: 362).

To restrict the choice domain requires giving up the idea of looking for maximizing solutions but aiming at satisficing solutions, as human beings do in their real lives. Procedurally rational individuals look for "satisficing models that provide good enough decisions with reasonable costs of computation. By giving up optimization, a richer set of properties of the real world can be retained in the models." (Simon, 1978b: 350). At the same time, Simon admitted that, in some instances a maximising solution of a simple model can be "satisficing" in the real world (Simon, 1978b: 350). In any case, 'selective search' and 'satisficing' is a binomial, which defines truly rational behaviour in real decisional contexts, namely procedural rationality (e.g. Simon, 1978b: 356).

Clearly, the attention to the real decisional processes opens the doors to other radical changes in the representation of the individual and implies the need to include contributions from cognitive psychology. For example, Simon notes that the level of "aspiration" for which the individual ends his/her own valuation process and considers him/herself satisfied changes

depending on how much the surrounding environment is favourable or not (Simon, 1978b: 356). Moreover, individuals usually do not have given ends, which are rather adapted to the available means, this implying that, individual values change over time and with experience. Finally, individuals are affected by emotions and sensorial stimuli (Simon, 1986: S210).

Unfortunately, the acknowledgement of the complex and dynamic nature of rationality led to a common misunderstanding in behavioural economics, namely overlooking the distinction between procedural rationality and "irrationality". Probably, this confusion has been also nurtured by the fact that Simon has coined and used the expression "bounded rationality". This expression, if decontextualized from Simon's thought, is ambiguous and allows two different misinterpretations. On the one hand, Simon's perspective can be reduced to mainstream rational choice, by viewing it as a maximization of given ends under constraints and limits that have not been considered before. Even within the information overload literature (see below), the focus is sometimes on outcomes, that is, on "the decision maker's ability to optimally determine the best possible decision" (Roetzel, 2018: 6). On the other hand, "bounded rationality" can be interpreted as a partially flawed rationality, a mix of rationality and biases, a direction that has been successfully pursued by behavioural economics. Indeed, in many of his writings, Simon pointed out that individuals deviate from the standard assumption of neoclassical economics, also by showing irrationalities and biases. Nonetheless, Simon's bounded rationality was neither constrained optimization, nor imperfect rationality; for him, what is bounded is not rationality but individual computational capacities as compared to the requirements of many real-life choices; as a consequence, the "procedural" one is the highest form of rationality.

Simon's ideas are relevant within ecological economics both via procedural rationality and hierarchical complexity (Foxon, 2006). Procedural rationality has greatly influenced environmental behavioural economics (see below) and counts as an epistemological foundation for social multicriteria evaluation (Munda 2004), but is also related to the notion of Post-Normal Science (PNS) (e.g. Funtowicz and Ravetz, 1994), which is a constituent of Ecological Economics (see e.g. Castro e Silva and Teixeira, 2011). Consistently with Simon's approach, PNS shows that, when complexity of the decisional context gives rise to high uncertainty and ignorance, science cannot go for truth, but must go for quality.

## 3 Wim Wenders

We have seen that the relationship between mental capabilities and the decisional environment is at the basis of Simon's contribution. To acknowledge that minds have limits in comparison to the

decisional environment implies the need of focusing on how humans actually process information for choosing. Simon overturned the mainstream economics concern for scarcity of information, pointing out that the truly scarce resource is the time that an individual is able and willing to spend on processing information, that is, mental attention. In a rather well-known paper, he stated:

> "In an information-rich world, the wealth of information means a dearth of something else: a scarcity of whatever it is that information consumes. What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention and a need to allocate attention efficiently among the overabundance of information sources that might consume it." (Simon, 1971: 40-41)

A surprisingly similar perspective is expressed by the film director, playwright, author, photographer, and producer Wim Wenders (Düsseldorf, 1945) in several of his writings and interviews. For instance, he wrote that

> "If there is too much to see, that is, if an image is too full, or if there are too many images, the effect is: you don't see anything anymore. 'Too much' turns quickly into 'nothing'. You all know that. You also know the other effect: if an image is empty, or almost empty, and sparse, it can reveal so much that it completely fills you, and the emptiness becomes 'everything'. […] (Wenders, 1992: 98-99, original emphasis)

Wenders based his cinema on the awareness that the mind reacts very differently, depending on whether the information contained in the visual experience is scarce or abundant. He emphasised that stimulating the eyes of spectators at high rates generates an excess of information that hampers the ability to think, understand, and know.

Briefly recalling a few of the founding elements of his cinema, particularly his early one (1970-1984), will help to show both the closeness and the complementarity between Wenders' and Simon's ideas on information overload and their model of agency. After a short experience as a student, first in medicine and then in philosophy, in 1966 Wenders started studying painting in France and working as engraver. Soon he got fascinated by the *Cinématheque* and began to write articles and critics for cinema magazines. Back to Germany in 1967, he attended the "Hochschule für Fernsehen und Film München" (University of Television and Film Munich) and made his first short films, in collaboration with other German artists. Wenders' painting experience strongly influenced his early style and poetics in making movies since he considers films as a sequence of images, pictures playing a central role in the composition of the work. Vast images, resembling landscapes' pictures, and slow tracking shots go along the characters through their adventures. Long times, with vague frames and slow dialogues, along with a balanced and wide rhythm in the editing phase have not only aesthetic reasons, they allow the spectator to participate in dramaturgy

construction. For him, films having a soul are born out of a dream, or from an intuition to be developed also with the contribution of spectators (Wenders, 1997: 18 and ff.). In his ethical conception of art, spectators should be actors to whom the movie offers personal cognitive experiences. This is well explained by what Wenders himself wrote, referring to his films *Summer in the City* and *The Goalkeeper's Fear of the Penalty*:

> "There are films where you can't discover anything, where there's nothing to be discovered, because everything in them is completely unambiguous and obvious. Everything is presented exactly the way it's supposed to be understood. And then there are other films, where you're continually noticing little details, films that leave the room for all kinds of possibilities. Those are mostly films where the images don't come complete with their interpretations." (Wenders 1991:3)

Slowing down the pace of the images is the technique used to allow the eyes of the spectator to effortlessly move on the screen. Wenders offers images that are "visible" in all their parts[1].

> Some films are like closed walls: there is not a single gap between its images that would allow you to see anything else than what this movie shows you. Your eyes and your mind are not allowed to wander. You cannot *add* anything from yourself to that particular film, no feelings, no experience. You stumble out empty afterwards, like you have been abused. Only those films with gaps in between their imagery are telling stories, that is my conviction. A story only exists and comes to life in the mind of the viewer or listener." (Wenders, 1992: 98-99, original emphasis)

This leads us to a key element, which is also central to our argument on environmental degradation, namely the "act of seeing", which is also the title of a book by Wenders (1997). The process of seeing is everything but simple, because of those escaping impressions we can perceive with our peripheral eyes, namely those impressions that are under our eyes, but that we do not embrace and decode completely. Those impressions/sensations peripherally perceived with the corner of the eyes make the film a sort of research experience allowing the spectators to think, to freely imagine while watching, connecting the elements of dramaturgy. For Wenders, the peripheral vision not only allows spectators to feel themselves co-authors of the artistic work, but also provides a refreshing and regenerating sensation in their minds due to the imaginative and creative process in which they are involved.

In the ancient Greek culture, thinking and seeing are intrinsically and tightly related. The two terms *ειδοσ* and *ιδεα*, the generic translation of which is "idea", were already in use in the pre-platonic language to indicate *the visible form of things*, what is physically seen, perceived by the

[1] For the same reason, Wenders has criticized most of television productions, characterized by crowded images, pressed and quick editing, that do not allow breathing and thinking freely.

eyes. Later, in his *Dialogs*, Plato uses *ειδοσ* and *ιδεα* with a different understanding; they pertain to the inner form of things, they are the specific objects of the thinking, the true absolute being (Reale, 1988:74). What we can see with the eyes of our bodies are physical things, while what we can see with the eyes of our mind are the non-physical things; the eye of intelligence can see intelligible forms, which are pure essences. It is not by chance that Plato coined the expressions "the mind eye" and "the soul eye" (Reale, 1988:77). Thus, "*idea"* is not only the essence of the observed things, but also the relation between the object of observation and the observer, something that can be seen by the eyes and the mind. The connection between the act of seeing and the thinking, linguistically and conceptually lies in the ancient root *ιδ,* from which also derives the verbal form of *οιδα,* which literally means "I know because I saw". The etymological Greek intuition that seeing and thinking are strictly related is actually not too far from the effective functioning of the physio-psychological system of vision (see, for example, Le Doux, 2003). Eye and mind work together, and they influence each other: the first offers materials to the mind and activates the information storage, the other stimulates the reception abilities/skills of the eye until the fine grade of vision that we normally know/use in our daily life. Therefore, the quality of perception of the external reality – also from the other sensorial channels – can influence our mental processes and consequently our choices.

The connection between seeing and thinking/understanding is also at the core of Wittgenstein's reflection on "aspect seeing" or "seeing as" (Wittgenstein, 1953, 1982), i.e., the peculiar cognitive mode that let us grasp the duck or the rabbit in the famous picture popularized by *Gestalt psychology*. Wittgenstein underlines that seeing one (or the other) aspect of such ambiguous images is *per se* (that is, without the mediation of concepts) understanding the meaning of the image and that this understanding consists in a reorganization of the perception such that new relations among the features of the object emerge (Johnston, 2002). These two characteristics of aspect seeing - its immediacy and its relational nature – bridges Simon and Wenders. Both believe that human action should be guided by knowledge, which in turn involves an agency theory based on perceiving and thinking rather than on automata with given ends responding to external constraints and/or stimuli.

Of course, the above-mentioned arguments require keeping distinct information and knowledge, differently from what is assumed by the homo oeconomicus model, but consistently with the wide discussion in cognition sciences, philosophy of science and cybernetics. A useful framework is the *data-information-knowledge-wisdom* theory (DKIW)[2], the first formulation of

[2] For an historical introduction see Wallace (2007). For a critical discussion of the developments of the theory see

which is attributed to Kenneth Boulding who distinguished "signals, messages, information, and knowledge" in his 1955 article "Notes on the Information Concept" (Boulding, 1955). The notions included in this theory are the object of ongoing re-discussion and clarification (for an overview of the debate see Zins, 2007) and got a robust systematization by Russell Ackoff (1989)[3] - an American systems theorist and professor of organizational change - that is well presented by Ahsan & Shah (2007), whose article also provides a very useful quotations to conclude this section:

> "when information is given meaning by interpreting it, information becomes knowledge. At this point, facts exist within a mental structure that consciousness can process, for example, to predict future consequences, or to make inferences".

## 4 Information overload

Before moving to the core of our argument, it is useful to briefly review the state of the art on the concept of information overload and its application to environmental studies. The idea that information can be excessive and overburden people is an old one (e.g., Edmunds and Morris, 2000: 19-20, Blair, 2011: 1-2). It is even indirectly referred already in the Ecclesiastes[4], as Bawden and Robinson (2009: 183) stated. Information overload in its modern sense is often traced back (e.g., Klapp, 1986: 98-99) to the sociologist George Simmel [1903, (1950: 413-414)], who argued that city inhabitants are sensorially overburdened by the urban context that makes them jaded and also incapable to react to new situations. But also, the economist Hotelling, in 1938, warned against the negative effects of the excess demand for attention generated by media and advertisements (see Festre & Garrouste, 2015).

Most probably, the first use of the term "information overload" came from Bertram Gross, who argued that an excess of information available to a person aiming to complete a task or take a decision can negatively influence the process itself and result in a poor (or even no) decision (Gross, 1964:856). During the years, because of its relevance in our contemporary times, this phenomenon has been referred to, studied, and discussed in different contexts and disciplines, such as psychology, information technology, health, mass communication, management related disciplines, etc. Moreover, the phenomenon has been changing over the time (see e.g. Bawden and Robinson, 2009). Consequently, there is not a single definition for it, and different terms are

Rowley (2007).

[3] The discussion of the notions of "understanding" – which Ackoff introduced in the DKIW paradigm – and "wisdom" is out of the scope of this article. For the interested reader, we only report Ackoff's definitions Ackoff refers to understanding as an "appreciation of 'why'", and wisdom as "evaluated understanding".

[4] "of making many books there is no end; and much is study is a weariness of the flesh" Ecclesiastes, Chapter 12, v.6

used to refer to the phenomenon, e.g., 'cognitive load', 'data smog', 'information fatigue', 'document tsunami' (Eppler and Mengis, 2004: 326; Roetzel, 2018: 6-7). However, the widely accepted meaning of the term relates to an individual's efficiency and accuracy in decision making processes. Information overload occurs when the excessive availability of relevant information becomes an obstacle for processing it and making decisions (Bawden and Robinson, 2009: 182-3). As highlighted by Epple and Mangis (2004: 331), "there is wide consensus today that heavy information load can affect the performance of an individual negatively (whether measured in terms of accuracy or speed)".

The seminal contributions about information overload came from psychology and cognitive science, namely the famous Miller's article "The magical number seven plus or minus two" (Miller, 1956), and two books, respectively by Schroder et al. (1967) and Simon and Newell (1971) (see also Simon, 1979). The developments of the studies on information overload have been summarized by several reviews, most of which have a disciplinary focus, while Bawden et al. (1999), Epple and Mangis (2004), Goetzel (2018) encompass several disciplines.

The general reason why information overload occurs is because the processing requirements exceed the processing capacities. Requirements and capacities are both quantitative and qualitative. Time is an example of a quantitative variable. The time required to process information has to be compared with the time available to individuals (or their willingness to spend time). Qualitative facets relate to personal capacities, to information characteristics (ambiguity, uncertainty, intensity/complexity, novelty, consistency, redundancy), and to characteristics of the task/decision. Moreover, there is an interaction between requirements and capacities since too demanding requirements impair the capacity and the motivation of individuals making them stressed, confused, anxious. As found by the academic literature (see e.g., Epple and Mangis, 2004), individuals react by allocating less time to each information input, ignoring a large part of information by filtering it out, and relying on external sources that synthesise it. Also, identifying the relationship between details and the overall perspective becomes more difficult. The individuals end up needing more time to reach a decision, which results in accuracy loss or even in not taking a decision.

Research that has been inquiring the issue of information overload has focused on several different issues. For instance, Goetzel (2018) organised his review by suggesting five categories, namely, the starting situation (e.g. task complexity, environment, personal characteristics), the role of the source of information (e.g., information system, database, social media, …), the information search and information processing (e.g. the information characteristics such as its novelty, and conditions of time pressure/restrictions), the subjective informational stance of the

decision-maker, and behaviour and emotions after decision-making. To the purpose of the present paper, however, the detailed results of the academic literature are not needed; it is sufficient highlighting that a well-established finding has emerged, namely, that the relationship between the amount of available information and the quality of the decision-making process has an inverted-U shaped curve, as suggested by Schroeder et al (1967) more than 50 years ago. When information is low, its increase will improve the decision-making process. However, beyond some thresholds, information becomes not only useless, that is, not included in the process, but also harmful because it will overburden and confuse actors, as highlighted by Simon and Wenders, .

Sometimes, information overload has been applied within the behavioural paradigm in ecological economics and environmental studies, which point out the importance of bounded rationality (Van den Bergh et al., 2000; Venkatachalam, 2008) and study the role of knowledge in pro-environmental decision-making processes (Gkargkavouzi et al., 2019; Dewulf, 2020). Although various aspects of the relationship between information overload and pro-environmental decisions are dealt with in the literature, these are not organised in a unified theoretical framework and not fully investigated either empirically or experimentally. The conception of knowledge as structured and organised information oriented to practical purposes and its relationship with consciousness remains implicit in key notions of the Value-Beliefs-Norms theory (Stern and Dietz 1994, Stern 2000) and of the Theory of Planned Behaviour (Ajzen 1991, 2002) – the two main theoretical frameworks through which pro-environmental behaviours are studied[5]. Specifically, Ackoff's notion of "knowledge" (and not "information" or "understanding") seems suitable to a) interpret the "awareness of consequences" grounding norm activation according to Value-Beliefs-Norms theory and b) accounting for with the epistemic foundation of the "Perceived Behavioral control".

At the same time, information overload has been studied in relation to several aspects of consumers' decisions. The literature refers to information overload as a cause of value-attitude gap (McKercher and Prideaux, 2011; Wells et al., 2011; Berthoû, 2013). Indeed, there is evidence that subjects provided with more information feel less personally responsible for, and less concerned about global warming than less informed ones (Kellstedt, Zharan, and Vedlitz, 2008). Information overload may also negatively affect the attention capability of consumers, as is in the case of ecolabels Thøgersen, J. (2000). The capability of elaborating information in proper

[5] Specifically, Ackoff's notion of "knowledge" (and not "information" or "understanding") seems suitable to a) interpret the "awareness of consequences" grounding norm activation according to Value-Beliefs- Norms theory and b) accounting for with the epistemic foundation of the "Perceived Behavioral control" of the. Such applications are not discussed in the present work and left for further research.

knowledge plays a key role in the case of environmental issues whose complex nature makes realising the connection of lifestyles and consumption patterns with, for example, climate change difficult to realise (Anable, Lane, and Kelay, 2006). Bergstrom et al. (1990) link information overload to the issue of the evaluation of environmental commodities (in terms of the impacts of information on consumers' willingness to pay), by distinguishing an hypothesis of strong information overload accounting for the "emergence of confused or dysfunctional consumer behaviour caused by increased information" - and of weak information overload for which "effects of information on preferences diminish at successively higher information levels (see also Grether and Wilde 1983). Van der Werff and Steg (2015) discuss whether general campaigns capable of activating norm-oriented energy-saving behaviour may be better suited to avoid information overload than single-purpose policies targeting specific behaviours. On the same line, Abrahamse et al. (2007) study which information framework is able to convey a reduction in consumers' direct and indirect energy uses.

## 5 Implications for environmental degradation

### 5.1 The general argument

The insights offered by Simon, Wenders, and the information overload literature, prove useful for going beyond the narrow mainstream view that attributes environmental degradation merely to its nature of public bad and the consequent lack of appropriate individual incentives. The ability to process stimuli (images/information) for developing knowledge is the necessary premise for rational choice. By processing what we see, and what others tell (e.g., friends and media), we build consistent pictures of our world and figure out possible outcomes of our choices. On the contrary, if we do not see and/or are hit by excess information, we run the risk of not reflecting enough on the distant (in space and in time) negative side-effects of action. This is particularly relevant for the consequences on the environment, which are less visible and less immediate to grasp. Hence, difficulties to see and information overload add a further myopic bias to the standard individual's preference of the present over the future.

Another factor reducing our ability to see is the progressive artificialization of our daily life starting after WWII. Since then, we are observing the progressive abandonment of rural areas, where life is usually uncomfortable, but also slow paced, strongly driven by traditional knowledge and practices, and very connected with nature, on which the very livelihood depends. This dramatic change in the lifestyles of millions of people has been made possible by the exponential

increase in the use of fossil fuels that started long ago with the industrial revolution and took off in the 1950s with the "Great Acceleration" (McNeill and Engelke, 2014). Unprecedented levels of exosomatic energy made a progressive detachment of humans from nature possible, providing comforts that were unconceivable even in the recent past (Georgescu Roegen, 1971). Because energy is invisible, its role is difficult to be grasped; yet energy made the life of people in rich countries independent from the natural environment, of which they do not have a daily-life observation. People living in artificial environments, like cities, cannot easily see the systemic interconnectedness between them and their environment. Indeed, many people love nature, enjoy its recreational services, and watch beautiful videos on natural areas; however, their perception is mainly indirect because nature (and the struggle for energy procurement) is not part of their daily experience. As emphasised in the literature, they are alienated from nature (Schultz 2002). Several authors have discussed the fact that people perceive themselves "as being separate and distinct from the world around them" (Frantz et al, 2005: 428; see also Kidner, 2000; Kals et al. 1999; Clayton, 2003). This feeling of separation occurs when "the individual no longer feels a sense of 'resonance' or connectedness to the natural world" (Frantz et al, 2005).[6] The best way to grasp nature detachment is what Martinez Alier wrote, "most citizens of the rich urbanised world get their provision from the shops. Hence the proverbial response of urban children to the question of where does the milk or do the eggs come from – the supermarket" (Martinez Alier, 2002, 26).

We can now draw the implications of considering information overload and nature detachment driven by energy abundance. The huge increase in information we had implies an inverted-U time pattern in "awareness", which is increasingly reduced by the progressive detachment from nature. When information is low and connection with nature high, more information is highly beneficial; then, progressive detachedness from nature and "artificialization" of our lives start to off-set the contribution of more information, which eventually ends up being even detrimental to awareness because of its overload. Figure 1 graphically sketches the argument.

Very important caveats to our argument, however, must be emphasised. It does not abandon the standard rational choice model, rather it simply adds something to it. The inverted U-shaped curve describes only the effect of the new elements, their partial effect, while other relevant factors, for instance psychological ones, might determine a different overall shape of the curve. Moreover, our argument remains anchored to methodological individualism, that it, refers to the

[6] Frantz and Mayer (2004) also developed the Connectedness to Nature Scale (CNS) - a scale that measures attitudes about environment protection. They argued that CNS measures the emotional connection to nature, while according to Perrin and Benassi (2009) it measures cognitive beliefs.

individual choice in isolation, while socio-psychological factors come into play scaling up the picture at the macro level. Finally, the hypothesised inverted-U relation refers not to a general concern for the environment but to the awareness of the side-effects of specific choices. Also, of course, an individual might choose actions harming his/her environment despite being aware of that, or, on the contrary, avoiding some actions without being specifically aware of their effect but merely out of a general concern. Hence, to bring empirical macro evidence of the effects of information overload on decision making is very tricky. In what follows of this section, we will present some suggestions that might prove useful.

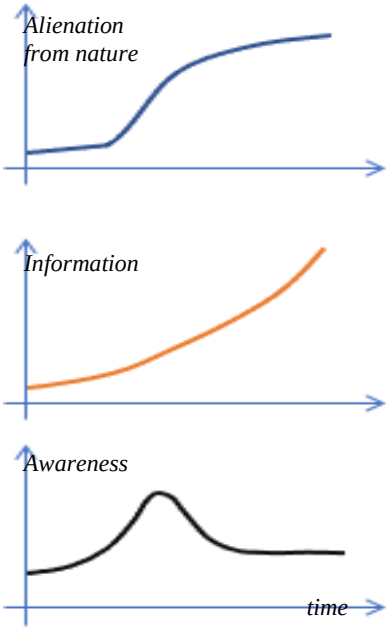


Figure 1. Hypothetical time pattern of awareness as the resultant of trends in information and detachment from nature in daily life.

According to a well-known study by Riley Dunlap (1991), an outstanding sociologist who contributed to the birth of environmental sociology, the rapid public concern[7] in the US for environmental quality that started in the 1960 reached then a peak in 1970 (first earth Day), declined in the 1970s and increased again in the 1980s. The rise and decline were interpreted as part of the natural life cycle of social problems (issue-attention cycle), while the rejuvenation mainly as a reaction to Reagan's administration. Afterwards, environmental attitudes experienced again ups and downs (see Clark and Carlisle, 2020). At the same time, such a variability is partially caused by the several different measures that are used for describing a phenomenon that is, by its

[7] Dunlap and Jones (2002, 484-5) define environmental concern as "the degree to which people are aware of problems regarding the environment and support efforts to solve them and/or indicate a willingness to contribute personally to their solution."

very nature, multifaceted and not subject to easy generalisations (Daniels et al., 2012).

Often, the literature on the environmental attitude uses the polls on the Environment conducted by Gallup, the famous American analytics and advisory company. Indeed, they are very useful also to get an intuitive picture of the issue. When looking at the trends available for longer, a relevant question is "Do you consider yourself an environmentalist, or not?". To this poll, about 75% of the sample answered yes at the beginning of the 1990s, shrinking to less than 50% after a decade and to 41% in 2021. The share of those who do not consider themselves as environmentalists is shown by the series represented with triangles in Figure 2. The other series (in circles) in the same figure shows the proportion of those who "think the U.S. government is doing too much in terms of protecting the environment", which sharply increased during Obama's presidency as compared with previous decades. Figure 3 shows the ratio of those who give priority to economic growth over environmental protection, with values bigger than one meaning that growth is given higher priority.[8] While in the 1990s economic growth was considered 1/3 as important as compared to environmental protection, in 2011 it reached a peak, becoming 50% more important than the environment, and declined thereafter, but for 2021.

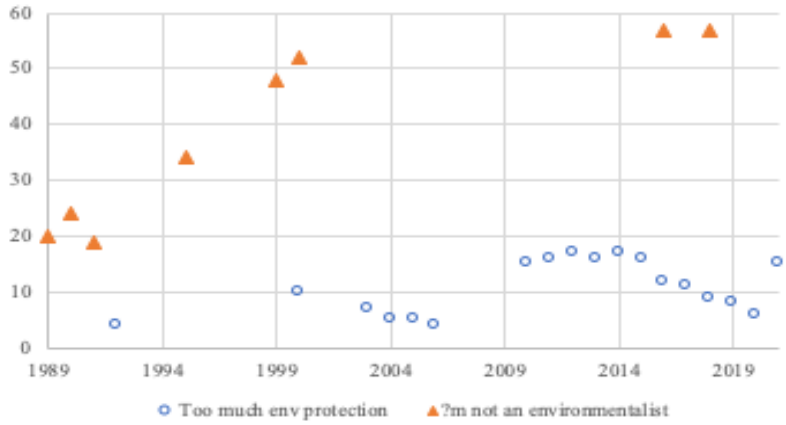


Figure 2. Trends of the shares of those who A) do not consider themselves as environmentalists (triangles) and B) "think the U.S. government is doing too much in terms of protecting the environment" (circles), over the period 1989-2021. Data: Gallup polls, https://news.gallup.com/poll/1615/Environment.aspx

[8] The exact question is "With which one of these statements about the environment and the economy do you most agree -- protection of the environment should be given priority, even at the risk of curbing economic growth (or) economic growth should be given priority, even if the environment suffers to some extent?"

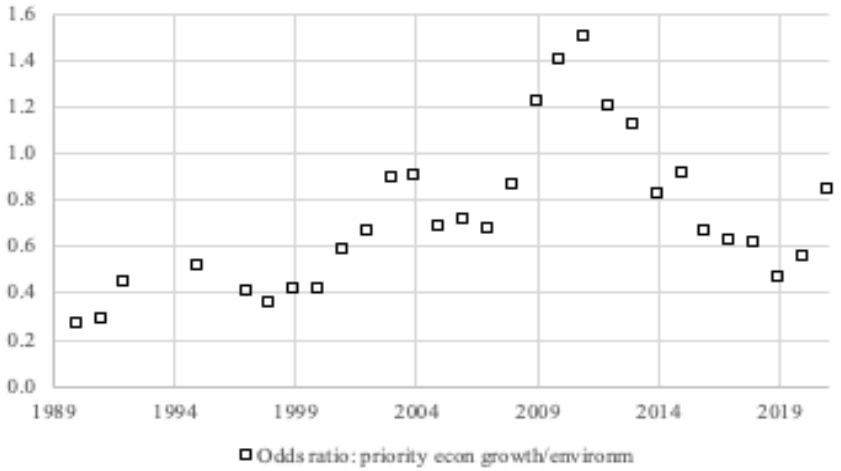


Figure 3. Trends of the ratio of those who give priority to economic growth over environmental protection, values bigger than one mean that growth is given higher priority. Data: Gallup polls, https://news.gallup.com/poll/1615/Environment.aspx

Finally, the opinions concerning the environmental policies in the US are also very suggestive. Figure 4 reports the opposition to four policy options, namely, stronger enforcement of federal environmental regulations, higher emissions and pollution standards for business and industry, mandatory controls on CO2 emissions and other GHGs, higher emissions standards for automobiles. As data shows the percentages of opposers to the listed options in the last decade are higher than those of the previous decade, with the strongest opposition being against tighter car emissions standards.

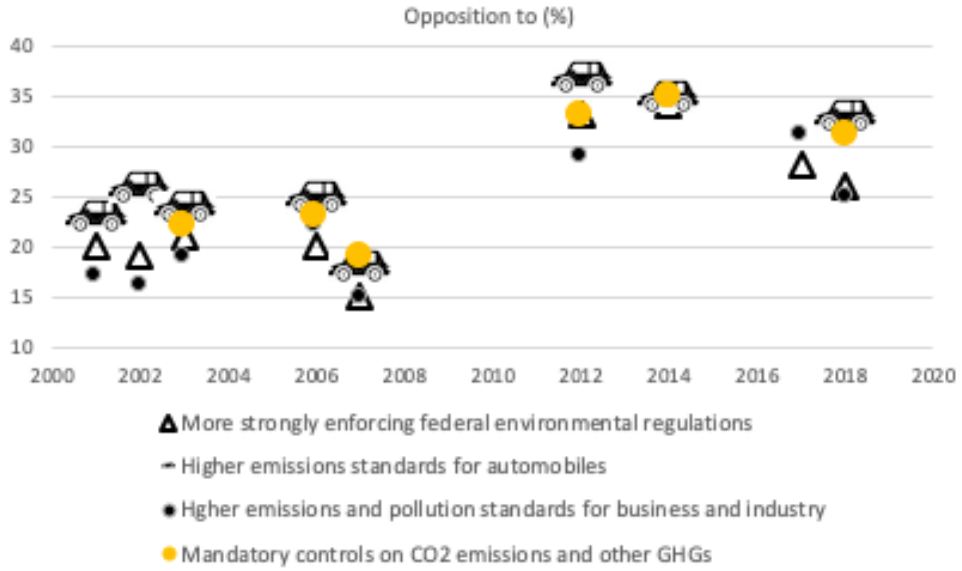


Figure 4. Trends of the percentage of opponents to federal environmental regulations protection, emissions standards for cars, emissions and pollution standards for business and industry, mandatory controls on CO2 emissions and other GHGs. Data: Gallup polls, https://news.gallup.com/poll/1615/Environment.aspx

Of course, one can object that the USA are peculiar. However, also for Europe, whose institutions are more environmentally concerned, several studies highlighted not only several ups and downs (and marked regional differences) but also a decline in concern after the peak in the late 1960s, and the one in the late 1980s, which was boosted by the discovery of the ozone layer hole over Antarctica in 1985 and the nuclear accident in Chernobyl the year after. Only recently, also because of the grassroots efforts of Greta Thunberg and the Fridays for Future movement, with their mass media coverage, environmental concern gained momentum again (Kenny 2021).

Finally, it is worth highlighting that despite the concern for climate change has increased everywhere, the literature highlights that, "the awareness of the contribution of various human activities to the phenomenon, such as energy use, animal farming, food miles and waste, does not appear to have risen much over time" (Baiardi and Morana, 2021). This is very consistent with trends in actual behaviours. A rather stunning one is the impressive growth in the sales of SUVs that the automotive market is experiencing, both in absolute and relative terms. In the USA the continuous rise in SUVs since the 1980s made the share of produced sedan/wagon vehicles to decline from a value well above 75% in the 1970s to about 30% in 2020 (Hula et al. 2021, p. 16). Such trends are occurring globally, with a share of new registered SUVs going from 16.5% in 2010 to 45.9% in 2021 (IEA, 2021). The high environmental impact of those vehicles is well-known also by non-experts, yet we observe such a strong preference for buying SUVs. Can this be attributed only to over-exploitation of the public good "environment" by selfish individuals or a kind of myopia is playing a role, too? Can difficulties in "seeing" explain the widely studied attitude-action gap?

### 5.2 A mainstream formalisation

This sub-section shows how the core argument discussed above can be modelled even within the standard consumer's choice between leisure and consumption, as is taught to undergraduate students. The purpose of such an exercise is illustrating that no reasons would impede mainstream economics to abandon its narrow view about the causes of environmental degradation.

Following the standard approach, environmental degradation arises because pollution is a public bad and externalities do not enter the individual choice problem. When considering the choice between leisure time and consumption[9] in the presence of negative externality, preferences

[9] We are aware that in many economic models some variables are included without much attention to the units of measure, as in this case the aggregated bundle of consumption and pollution. Since the purpose of this subsection is to show a possible translation of our argument into mainstream language, we do not think important to discuss the issue here.

of a generic individual *j* can be represented by the following utility function[10]

$$U^j = f(C^j;\ L^j;\ P(C^j + C^{-j}))$$

where *C* is the bundle of consumption goods, *L* is leisure, and *P* is pollution.

However, since the side effect of pollution is not immediately observable by the individual and difficult to assess, one can add a term standing for the degree of information accuracy about pollution (which can be interpreted also as awareness) that the individual has in estimating the negative effects that consumption provokes via pollution. By indicating accuracy/awareness with *a*( ), the utility function becomes

$$U^j = g\left(C^j;\ L^j;\ a(\,)P\left(C^j + C^{-j}\right)\right)$$

The individual allocates her/his time considering the opportunity cost of leisure time, that is, wage. Normalizing the price of consumption to 1, and assuming that income comes only from labour (*w* is the hourly wage rate), the standard budget constraint will hold, namely,

$$C^j = w(24 - L^j)$$

Because pollution affects utility, the self-concerned maximising consumption (given the level of pollution generated by the others) will be lower than that in the absence of externalities, but still higher than the efficient bundle, namely the one for which the Samuelson's conditions in the presence of public goods hold (and negative externalities are considered by each individual). Figure 1 traces the three bundles of goods along the budget line, while indifference curves are omitted for a better visualisation. The highest bundle is the maximising one in the absence of awareness, which formally coincides with the case of no externalities. The lower the parameter *a*( ), the lower is leisure and higher are consumption and working time. The intermediate bundle is the maximising bundle that considers externalities[11], while the lowest is the efficient bundle (the Lindhal's solution for public goods), which, as well-known is inconsistent with individual maximisation.

[10] For the sake of simplicity only total consumption (and not leisure) is assumed to generate pollution, namely, the sum individual *j*'s and the other individuals' consumption.

[11] Consumption in the "self-concerned" bundle might be lower than in the "efficient" bundle only if the contribution to reduce pollution by the others is very low. This situation, however, cannot be a Nash equilibrium, which involves pollution higher than the Lindahl solution ("efficient" bundle).

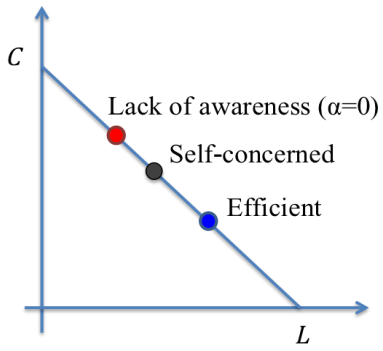


Figure 5. Optimal choices under different hypothesis concerning individual awareness and others' behaviour, showing that consumption decreases the higher the awareness, while efficiency cannot be reached as an equilibrium solution.

Since the optimal (self-concerned) consumption is determined by the size of the parameter $a(\ )$, that is, by awareness/accuracy, it is interesting to also model its determinants. The discussion so far suggests that both information, $I$, and available exosomatic energy, $E$, are relevant. As emphasised by Wenders and Simon, and confirmed by the literature on information overload, the relationship between degree of accuracy and information can be thought as inverted-U shaped. Concerning the partial effect of exosomatic energy on availability generated by an artificialization of daily-life, one can think of it as reducing $a(\ )$, at least until a high level of detachment from nature has been reached.

Hence, we can write accuracy/awareness as $a(I,E)$ [12]

with $\frac{\partial a}{\partial E} < 0$; and $\frac{\partial a}{\partial I} > 0 \ \forall I < I°, \frac{\partial a}{\partial I} = 0 \ \ if \ \ I = I°, \frac{\partial a}{\partial I} < 0 \ \forall I > I°; \ \ \frac{\partial^2 a}{\partial I^2} < 0$

Finally, also the process that converts information into knowledge might be modelled within the traditional model. Since time is needed to generate knowledge from information[13], the choice between consumption and leisure time should also include the (leisure) time spent in processing information[14], $L_K$, while the "pure" leisure time can be indicated as $L_L$. In general, one can assume that "knowledge" contributes to the individual utility by improving the awareness of the choice consequences, as written in the following utility function,

$U^j = g(C^j;\ {L_L}^j;\ a(K(I;\ L_K),E)\ P(C^j + C^{-j}))$ , subject to the following budget constraint,

$C^j = w(24 - {L_L}^j - {L_K}^j)$

[12] Only for illustrative purposes, consider the following simple specification:

$a = \frac{I(1-I)}{ln\,(1+E)\,+1/4}$, which reaches its maximum ($a$=1) for $I$=1/2 and $E$=0.

[13] The knowledge production function can be thought of as having decreasing marginal returns in time and be subject to information overload, for example, $K=I(1-I){L_K}^b$, with b<1.

[14] Of course, time is also needed for consumption, as in Steedman, 2001.

## 6 Conclusion

The purpose of this paper was to show that lack of time and attention offers important hints for understanding environmental degradation. One of the departure tenets of Ecological Economics is that the economy is embedded within society, taking materials from and returning to the physical environment (e.g. Ropke 2004). As the German institutional economist KW Kapp emphasised well before the birth of the discipline, in the beginning of 1970s (e.g. Luzzati 2009), the implications of the open system nature of the economy are not easy to be fully grasped. One of the reasons is that contributions from many different disciplines must be put together, which implies attempting to reconcile very different perspectives and/or methodologies. At the same time, surprisingly closeness often appears. This is the case for the emphasis that the polymath Herbert Simon and the film director Wim Wenders put on the difficulties coming from information overload, implying lack of attention that hampers reasoning.

In the first two sections of this paper, we showed that their close viewpoints complement each other. Simon, who already attracted interests from ecological economists, is central to our argument for his concept of procedural rationality. Differently from what is often believed, this term captures much better than the fuzzy "bounded rationality" Simon's idea that the decision context is what suggest how to rationally behave (including using rules of thumbs), thereby emphasising the importance of quality in decision making. In a very effective way Simon (1978a, p. 13) expressed the importance of the decision context as follows:

> "In a world where information is relatively scarce, and where problems for decision are few and simple, information is almost always a positive good. In a world where attention is a major scarce resource, information may be an expensive luxury, for it may turn our attention from what is important to what is unimportant."

The concern for information overload by the German film director was related to the visual/perceptive issues in watching, which emerges not only from his movies but is made explicit also in his writings that argue against crowded and quick scenes resulting in information overload that the spectator is unable to process (e.g. Wenders 1986, 1991, and 1997). Unaffordable stimuli lower the capacity of self-reflection and self-elaboration, implying lower autonomy in the capacity of thinking and deciding, and the risk of manipulation. According to Wenders, for instance

> "American television exploits and stimulates perceptive capacities to the full, thus ending up subjugating them to the schemes of social convention and economic convenience. In this context, "seeing" is no longer an active form of selection and perception: in front of the TV screen there is no longer physical and psychological space and time to develop one's own interior image, one's own position, one's own point of view.. […] Under conditions of effort, pressure, constriction or even violence, the eyes and the mind work poorly, sight is blurred, the conscience becomes manipulable. By

> contrast, under conditions of relaxation and mobility one can see and think in a natural, personal and clear fashion." (Russo 1997, 51 and 62, our translation)

Wenders ideas are very useful to our argument because they stress the role of visual experiences in self-reflection and understanding. As we briefly illustrated, the link between seeing and thinking is deeply rooted in ancient Greek culture and philosophy and discussed by modern philosophy too.

To sum up, the lesson drawn from juxtaposing Simon and Wenders is about the importance of information overload in seeing, thinking, and hence decision making, but also about the need to keep information and knowledge as separate notions. After showing that information overload is not a mere intuition but has been subject of study by several disciplines, getting a (moderate) interest also from environmental behavioural studies, we draw the overall implications for environmental degradation. Our argument goes that in the current fast-paced life, people lack the attention (and willingness) to reflect about their complex environment and particularly on the distant (in time and space) side-effects of action. This is reinforced by another element which is founding ecological economics, namely the role of exosomatic energy. Its abundance moved masses of people to cities, alienating them from nature and the procurement of their subsistence; for citizens, nature stopped to be a daily experiential object, hence they cannot see anymore - Wenders would say.

The empirical prediction of our arguments is that awareness of the (un)sustainability of the chosen actions follows an inverted-U trend in time. This prediction is only about the effect on a rational decision maker when exposed to information overload, particularly if living detached from the natural environment. Of course, other psychological factors, including emotional ones, are in play at the individual level. Moreover, scaling up to a macro picture needs also social-psychology and sociology, so that the overall trend of awareness need not to have an inverted U-shape.

Nonetheless, reviewing the evidence on environmental concern shows the plausibility of the importance of information overload and alienation from nature. With the caveat that awareness of side-effects of specific actions is different from a general environmental concern, its rise at the end of the 1960s and subsequent fall is consistent with our argument. Later, highly visible events and their media-coverage, raised concern again, including the recent protest led by Greta Thunberg. This too might be interpreted as coming from information overload. Daily-life is so busy and information so abundant that we need 'fast-food' information, attracting our attention and being simple at the same time. A self-reinforcing feedback loop seems to have started, where the simplification we got used further reduced our capability of thinking and processing the

information inputs, which in turn gives rise to new demand for simplicity from the mass- and social media. Many contemporary phenomena, such as fake-news or perhaps populisms, can be attributed to this self-reinforcing process.

To sum up, we argued that the increasing availability of information, reinforced by the artificiality of life in economically advanced countries, makes it difficult seeing, perceiving, and correctly assessing consequences of choices and actions. This difficulty must be considered when interpreting the current environmental degradation, which cannot be solely explained by unpaid externalities. Under this perspective, our argument can pave the way to further theoretical and empirical research on the role of information quality and knowledge processes in fostering pro-environmental decisions.

## References


Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T., 2007. The effect of tailored information, goal setting, and tailored feedback on household energy use, energy-related behaviors, and behavioral antecedents. Journal of environmental psychology, 27(4), 265-276. Ackoff, R. L., 1989. "From data to wisdom." Journal of applied systems analysis, 16(1), 3-9, in Ackoff, R. L., 1999) Ackoff's Best. New York: John Wiley & Sons, pp 170 – 172.

Ahsan, S., & Shah, A., 2006. Data, information, knowledge, wisdom: A doubly linked chain. In the proceedings of the 2006 international conference on information knowledge engineering, pp. 270-278).

Ajzen, I., 1991. "The theory of planned behavior". Organizational behavior and human decision processes, 50(2):179–211.

Ajzen, I., 2002. "Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior". Journal of applied social psychology, 32(4):665–683, 2002

Anable, D.J., Lane, B., & Kelay, T., 2006. A review of public attitudes to climate change and transport behaviour. London: Department for Transport

Baiardi, D., & Morana, C., 2021. Climate change awareness: Empirical evidence for the European Union. Energy Economics, 96, 105163.

Bawden, D., Holtham, C., & Courtney, N., 1999. "Perspectives on information overload". Aslib Proceedings, Vol. 51, No. 8, pp. 249-255. MCB UP Ltd.

Bawden, D., & Robinson, L., 2009. "The dark side of information: overload, anxiety and other paradoxes and pathologies". Journal of information science, 35(2), 180-191.

Bawden, D., & Robinson, L., 2016. "Information and the gaining of understanding". Journal of Information Science, 42(3), 294-299.

Bergstrom, J. C., Stoll, J. R., & Randall, A., 1990. The impact of information on environmental commodity valuation decisions. American Journal of Agricultural Economics, 72(3), 614-621.

669 Berthoû, S. K. G., 2013. The Everyday Challenges of Pro-Environmental Practices. Journal of
670 Transdisciplinary Environmental Studies, 12(1).

671 Boulding, K., 1955. "Notes on the Information Concept". Exploration. Toronto. 6: 103–112. CP
672 IV, pp. 21–32.

673 Blair, A., 2011. "Information overload's 2300-year-old history". Harvard Business Review.
674 Retrieved from http://blogs. hbr. org/cs/2011/03/information_overloads_2300-yea. html.

675 Castro e Silva, M., Teixeira, A.A.C, 2011. A bibliometric account of the evolution of EE in the
676 last two decades: is ecological economics (becoming) a post-normal science? Ecological
677 economics, 70(5), 849-862.

678 Clark, A. K., & Carlisle, J. E., 2020. Pushing a green agenda: explaining shifting public support
679 for environmental spending. Political Research Quarterly, 73(2), 243-260.Dana, J. D.,
680 Kuang, X. J., & Weber, R. A., 2004. "Exploiting Moral Wriggle Room: Behavior
681 Inconsistent with a Preference for Fair Outcomes" (September 24, 2004). Available at
682 SSRN: https://ssrn.com/abstract=400900 or http://dx.doi.org/10.2139/ssrn.400900

683 Clayton, S., 2003. Environmental identity: conceptual and operational definition, in Clayton, S.
684 Opotow S. (Eds.), Identity and the natural environment: The psychological significance of
685 nature, MIT Press, Cambridge: 45-65.

686 Daniels, D. P., Krosnick, J. A., Tichy, M. P., & Tompson, T., 2012. Public opinion on
687 environmental policy in the United States. Handbook of US environmental policy, 461-486.

688 Dewulf, A., Klenk, N., Wyborn, C., & Lemos, M. C., 2020. Usable environmental knowledge
689 from the perspective of decision-making: the logics of consequentiality, appropriateness,
690 and meaningfulness. Current Opinion in Environmental Sustainability, 42, 1-6.

691 Dunlap, R., & Jones, R., 2002. Environmental concern: Conceptual and measurement issues. In
692 Handbook of environmental sociology, ed. R. Dunlap and W. Michelson. London:
693 Greenwood.

694 Edmunds, A., & Morris, A., 2000. "The problem of information overload in business
695 organisations: a review of the literature". International journal of information management,
696 20(1), 17-28.

697 Eppler, M. J., & Mengis, J., 2004. "The concept of information overload: A review of literature
698 from organization science, accounting, marketing, MIS, and related disciplines". The
699 information society, 20(5), 325-344.

700 Festre, A., & Garrouste, P., 2015. The 'Economics of Attention': A history of economic thought
701 perspective. Oeconomia. History, Methodology, Philosophy, (5-1), 3-36.

702 Feigenbaum E.A., 2001. "Herbert A. Simon, 1916-2001, Science, 291(5511), 2107.

703 Frantz, C., Mayer, F.S., Norton, C. and Rock, M., 2005. There is no "I" in nature: The influence
704 of self-awareness on connectedness to nature. Journal of environmental psychology, 25(4):
705 427-436.

706 Foxon, T., 2006. Bounded rationality and hierarchical complexity: Two paths from Simon to
707 ecological and evolutionary economics. Ecological Complexity, 3(4), 361-368.

Funtowicz, S. O., & Ravetz, J. R., 1994. The worth of a songbird: ecological economics as a post-normal science. Ecological economics, 10(3), 197-207.

Gkargkavouzi, A., Halkos, G., & Matsiori, S., 2019. How do motives and knowledge relate to intention to perform environmental behavior? Assessing the mediating role of constraints. Ecological Economics, 165, 106394.

Grether, D. M., & Wilde, L. L., 1983. Consumer choice and information: New experimental evidence. Information Economics and Policy, 1(2), 115-144.

Gross, B. M., 1964. The Managing of Organizations: The Administrative Struggle. New York: Free Press of Glencoe

Hula, A., Maguire, A., Bunker, A., Rojeck, T. and Harrison, S., 2021. The 2021 EPA Automotive Trends Report: Greenhouse Gas Emissions, Fuel Economy, and Technology since 1975 (No. EPA-420-R-21-023).

IEA (2021), Global SUV sales set another record in 2021, setting back efforts to reduce emissions, IEA, Paris https://www.iea.org/commentaries/global-suv-sales-set-another-record-in-2021-setting-back-efforts-to-reduce-emissions

Johnston, P., 2002. Wittgenstein: Rethinking the inner. Routledge.

Kaiser, V. and Leventhal, R. S., 2003. Rewiring the Oedipal Scene: Image and Discursivity in Wim Wenders's Journey Until the End of the World. In Wurzer, W. (Ed.) Panorama: philosophies of the visible. A&C Black.

Kals, E., Schumacher, D. and Montada, L., 1999. Emotional affinity toward nature as a motivational basis to protect nature. Environment and behavior, 31(2): 178-202.

Kellstedt, P.M., Zharan, S., & Vedlitz, A., 2008. Personal efficacy, the information environment, and attitudes toward climate change in the United States. Risk Analysis, 28(1), 113–126

Kenny, J., 2021. The evolution of environmental concern in Europe. In Research Handbook on Environmental Sociology, Franzen A. and Mader S. (eds.), Edward Elgar Publishing.

Kidner, D.W., 2000. Fabricating nature: A critique of the social construction of nature. Environmental Ethics, 22(4): 339-357.

Klapp, O. E., 1986. Overload and boredom: Essays on the quality of life in the information society. Connecticut: Greenwood Press.

Klink, F. A., 1994. Pigou and Coase reconsidered. Land Economics, 70(3), 386-391.

Luzzati, T., 2009. Human needs, sustainable development, and public policy: learning from K.W. Kapp (1910–1976). In: Salvadori, N., Opocher, A. (Eds.), Long-run Growth,

Social Institutions and Living Standards. E. Elgar, Cheltenham.

LeDoux, J. E., 2003. Synaptic self: How our brains become who we are. London: Penguin.

Marino, B. 1994. Wim Wenders, Dino Audino Editore, Roma, 1994

Martínez-Alier, J., 2002. The environmentalism of the poor: a study of ecological conflicts and valuation. Cheltenham: Edward Elgar.

Mayer, F.S. & Frantz, C.M., 2004. The connectedness to nature scale: A measure of individuals' feeling in community with nature. Journal of environmental psychology, 24(4): 503-515.

Mayumi K, Solomon BD, Chang J., 2005. The ecological and consumption themes of the films of Hayao Miyazaki. Ecological Economics, 54(1):1-7.

McKercher, B., & Prideaux, B., 2011. Are tourism impacts low on personal environmental agendas? Journal of Sustainable Tourism, 19(3): 325-345.

McNeill, J. R., & Engelke, P., 2014. The Great Acceleration: An Environmental History of the Anthropocene since 1945. Harvard University Press, Cambridge (MA)

Miller, J. A., 1956. "The magical number seven plus or minus two: Some limits on our capacity for processing information". Psychological Review 63:81–97.

Munda G., 2004. Social multi-criteria evaluation: Methodological foundations and operational consequences. European journal of operational research, 158(3):662-77.

Pearce, D., Markandya, A., & Barbier, E. B., 1989. Blueprint for a green economy. Earthscan.

Perrin, J.L. and Benassi, V.A., 2009. The connectedness to nature scale: A measure of emotional connection to nature? Journal of Environmental Psychology, 29(4): 434-440.

Pigou, A.C., 1920. The economics of welfare. London: Macmillan

Reae, G., 1988. Storia della filosofia antica, Vol 2, Milano, Pubblicazioni della Università Cattolica

Roetzel, P. G., 2018. "Information overload in the information age: a review of the literature from business administration, business psychology, and related disciplines with a bibliometric approach and framework development". Business Research, 1-44.

Røpke, I., 2004. The early history of modern ecological economics. Ecological economics, 50(3-4), 293-314.

Rowley J., 2007. "The wisdom hierarchy: representations of the DIKW hierarchy". Journal of Information and Communication Science. 33(2): 163–180.

Russo, M., 1997. Wim Wenders, percezione visiva e conoscenza, Le Mani, Genova.

Schroder, H. M., Driver, M. J., and Streufert, S., 1967. Human information processing—Individuals and groups functioning in complex social situations. New York: Holt, Rinehart, & Winston.

Schultz, P. W., 2002. Inclusion with nature: The psychology of human-nature relations. In Psychology of sustainable development (pp. 61-78). Springer, Boston, MA.

Simmel, G., 1950. "The metropolis and the mental life". In K. H. Wolff, The Sociology of George Simmel, New York: Free Press, 409 - 424 (English translation by Kurt H. Wolff of Die Großstädte und das Geistesleben, Dresden: Petermann, 1903).

Simon, H.A., 1959. "Theories of Decision-Making in Economics and Behavioral Science". The American Economic Review, 49(3), 253-283.

Simon, H.A., 1971. "Designing organizations for an information rich world"., Iin Greenberger,

M. (ed.), Computers, communications, and the public interest, The Johns Hopkins University Press, Baltimore MD, p. 37-52. Reprinted in: Simon, H.A. "Models of bounded rationality", 1982 Vol. 2: Behavioral economics and business organization. The MIT Press, Cambridge, Massachussettes.

Simon, H.A., 1976. "From substantive to procedural rationality". In MA. Kastelein T. J., Kuipers S. K., Nijenhuis W. A., & Wagenaar R. G. (Eds.), 25 years of economic theory: retrospect and prospect. Martinus Nijhoff Social Sciences Division, Leiden. 67-86

Simon, H.A, 1978a. "Rationality as process and as product of thought". The American economic review, 68(2), 1-16.

Simon, H.A., 1978b. "Rational decision-making in business organizations – Prize Lecture". Available at <https://www.nobelprize.org/prizes/economics/1978/simon/lecture/>. Republished in 1979 on The American economic review, 69(4), 493-513.

Simon, H. A., 1979. "Information processing models of cognition". Annual Review of Psychology 30:363–396.

Simon, H.A., 1986. "Rationality in psychology and economics". Journal of Business, S209- S224

Simon, H. A., and Newell, A., 1971. "Human problem solving: The state of the theory in 1970". American Psychologist, 26:145–159.

Stern, P.C., 2000. "New environmental theories: toward a coherent theory of environmentally significant behavior". Journal of social issues, 56(3):407–424.

Stern, P.C. and Dietz T, 1994. "The value basis of environmental concern". Journal of social issues, 50(3):65–84.

Thøgersen, J., 2000. Psychological determinants of paying attention to eco-labels in purchase decisions: Model development and multinational validation. Journal of consumer policy, 23(3), 285-313.

Valli, B., 1990. Lo sguardo empatico: Wenders e il cinema nella tarda modernità. Urbino: Quattro Venti

Van den Bergh, J. C., Ferrer-i-Carbonell, A., & Munda, G., 2000. Alternative models of individual behaviour and implications for environmental policy. Ecological Economics, 32(1), 43-61.

van der Werff, E., & Steg, L., 2015. One model to predict them all: predicting energy behaviours with the norm activation model. Energy Research & Social Science, 6, 8-14.

Venkatachalam, L., 2008. Behavioral economics for environmental policy. Ecological economics, 67(4), 640-645.

VV. AA., 1995. Wim Wenders. Il cinema dello sguardo, Firenze: Loggia de' Lanzi.

Wallace, D.P., 2007. Knowledge Management: Historical and Cross-Disciplinary Themes. Libraries Unlimited. pp. 1–14

Wells, V.K., Ponting, C. A., & Peattie, K., 2011. Behaviour and climate change: Consumer perceptions of responsibility. Journal of Marketing Management, 27(7-8), 808-833.

Wenders, W., 1986. Emotion pictures: Essays und Filmkritiken, 1968-1984. Verlag der Autoren.

Wenders, W., 1991. The Logic of Images: essays and conversations, London: Faber and Faber (English translation by Michael Hofmann of Die Logik der Bilder: Essays und Gespräche. Verlag der Autoren, Frankfurt am Main, 1988)

Wenders, W., 1997. The Act of Seeing: Essays and Conversations, Faber and Faber Limited, London (English translation by Michael Hofman of The Act of Seeing: Texte und Gespräche, Verlag der Autoren, Frankfurt am Main, 1992.

Wittgenstein, L. [1951], 2009. Philosophical investigations. John Wiley & Sons.

Wittgenstein, L., Anscombe, G. E. M., von Wright, G. H., Nyman, H., & Luckhardt, C. G., 1982. Remarks on the Philosophy of Psychology. Volume I.

Zins, C., 2007. Conceptual approaches for defining data, information, and knowledge. Journal of the American society for information science and technology, 58(4): 479-493.

## Acknowledgments

We gratefully acknowledge the valuable comments received by several participants in the ESEE conferences Budapest 2017 and Turku 2019, where preliminary versions of this paper were presented. This piece of research was partially funded by PRA 2017_31 grant of the University of Pisa and Ecoesione, a project of the University of Pisa funded by the Italian Ministry for the Environment. This paper is the outcome of a joint long-term reflection and research of the authors. Nonetheless, authorships can be attributed as follows: sections 1, 2, 5, and 6 to Luzzati, section 3 to Ilaria Tucci, section 4 to Guarnieri.