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Every step you take, we'll be watching you: nudging and the ramifications of GPS technology

William Hebblewhite[1] · **Alexander James Gillett**[1]

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Abstract
The increasing use of geographic information systems (GIS) in everyday life is profoundly shaping how humans navigate and interact with their surroundings. Behavioural and ethnographic experimental research indicates that increased usage of GPS devices is having a significant impact on human neurocognitive systems, especially memory and perception (Gramann et al. 2017). Despite this, there has only been a limited investigation of the implications of the spread of GIS technologies. In this paper, we explore how habitual reliance on GPS technology undermines autonomous decision-making through "nudging" (Sunstein and Thaler 2008)—that is, the alteration of psychological behaviour without the explicit forbidding of choice. In particular, we make a novel distinction between what we refer to as "suggestive nudging"—the suggesting of certain routes to take to get to a destination—and "disclosure nudging"—the normalisation of constant tracking and disclosing of our locations to government and corporate actors. We shall argue that although suggestive and disclosure nudging are *in principle* separate, that *in practice* they are intertwined in the design of modern GPS devices. Additionally, since human spatial cognition is highly plastic and susceptible to being sculpted by cultural practices (Hutchins 1995; Levinson 2003), this exacerbates the negative implications of the 'in practice' link of suggestive and disclosure nudging by making the latter harder to avoid and opt-out of. We argue that this state of affairs necessitates re-designing GPS devices.

Keywords GPS devices · Nudging · Autonomy · Geographic information systems · Enculturation · Navigation · Autonomy · Decision-making · Spatial cognition · Wayfinding technology

1 Introduction

Humans live in a remarkable range of habitats. Each presents different spatial navigation challenges. Historically, humans have tackled these challenges using diverse forms of cultural knowledge and wayfinding technologies that have been created and refined overtime. Whilst technology has always played a role in an individual's decision-making processes, widespread use and integration of new wayfinding technologies into our everyday lives raises questions about an individual's autonomy to choose in this domain. In this paper, we will focus on global positioning systems (GPS)—perhaps the most powerful wayfinding technology—and how it has radically altered the way in which people now navigate in the world.[1]

Cass Sunstein has introduced the concept of navigability to discuss the ease by which individuals can obtain their life goals (Sunstein 2015a, b, 2018, 2019). By way of analogy, Sunstein turns to GPS: "A GPS….tells you how you can best get to your preferred destination, but it does not impose any sanction or costs if you refuse to do what it says" (Sunstein 2015c, p. 208). Building on his work with Richard Thaler on the idea of "nudging" (see Thaler and Sunstein 2008),

✉ William Hebblewhite
William.Hebblewhite@mq.edu.au

Alexander James Gillett
Alexander.Gillett@mq.edu.au

[1] Macquarie University, Sydney, Australia

[1] We acknowledge that there are a range of other Geographic Information Systems (GIS)—such as the increasing amount of RFID cards in travel cards, bank cards, passports and ID cards, on shipping containers, etc.—which also raise similar quandaries to those that we raise in this paper about the politics of wayfinding technologies. We focus on GPS devices for several reasons. Firstly, a comprehensive discussion of these other technologies would require too much space for a single article. Secondly, the argument we intend to make here is focused on how GPS devices currently work in smartphone technologies. And lastly, the ubiquity of smartphones in our everyday lives entails that this is the most important point at which to discuss interventions and needs for change in GIS design and choice architecture.

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Sunstein claims that a good nudge, like a GPS, does not undermine an individual's agency in decision-making processes. Rather, nudging ought to increase navigability. A good nudge ought to provide an easier route for an individual agent to achieve their life goals (what we shall term *suggestive nudging*). However, we claim that Sunstein's focus on GPS technology as a form of suggestive nudging underestimates the ways in which GPS technology may undermine an individual's ability to engage freely in the decision-making process.

There is, however, another form of nudging taking place that is overlooked by Sunstein and others. When people use GPS devices and other apps in smartphones, users are nudged towards accepting the normalisation of constant location tracking (what we shall term *disclosure nudging*). Our central claim is as follows: given the enculturating effects of wayfinding technologies, such as GPS, individuals who become reliant on such technologies are constantly nudged towards accepting the normalisation of constant location tracking. It is important to recognise that GPS technologies could *in principle* be designed so that they only involve suggestive nudging without leading to the more problematic issue of disclosure nudging. However, *in practice,* the current design of GPS devices intertwines these forms of nudging. For a user to gain useful information about navigating around in the world (suggestive nudging), they must often agree to disclosing their location to government and corporate actors who then store this information to build profiles for other uses. The more use an individual makes of their device, the higher the probability that they will become normalised into disclosing such information. The more enculturated we become into using GPS, the harder it is to break such a habit. Furthermore, empirical evidence has shown both that purportedly anonymised data can be re-identified fairly easily and used to track the movements of individuals (de Montjoye et al. 2013, 2015; Song et al. 2010) and that data breaches by both governments and corporations have occurred (Gorman 2018; Cadwalladr and Graham-Harrison 2018). These circumstances motivate a closer examination of the precise nature of nudging in GPS devices.

Today, any person who uses a new phone, computer tablet, or car will have direct access to top-of-the-range GPS technologies. As of 2020, it is estimated that there are somewhere between 2.5 and 3.5 billion users of smartphones in the world (O'Dea 2020; Silver 2019). The PEW Research centre released a study in 2012 claiming that three out of four smartphone users in the USA were using location-based services (Zickuhr 2012). The ease with which GPS technology provides individuals with increased navigability can lead to an overreliance whereby they are encouraged into disclosing information to reap the full benefits of the suggestive nudging. There are further complications here because habitual use of GPS devices undermines a range of core spatial navigational skills and faculties—memory, perception, and intellectual autonomy—and as such, renders users who are overly reliant on GPS devices unable to opt-out of suggestive nudging (Gramann et al. 2017; Gillett and Heersmink 2019). Consequently, users are also unable to properly opt-out of disclosure nudging.

We shall argue that this can be remedied by re-designing GPS devices to instantiate a separation between these two forms of nudging. The current state of affairs has adverse effects on human agency, and an individual's ability to engage autonomously in decision-making processes. This makes a proper understanding of this topic of the utmost importance: particularly in regards to recognising the distinction between suggestive nudging and disclosure nudging; and how they are theoretically separable but in practice intertwined. Our paper also presents a nuanced case study that is of interest to debates in political philosophy about the viability of nudging as an acceptable strategy for the process of autonomous decision-making. Two concerns arise in the case of "autonomous decision-making": freedom of choice and agency. For the purposes of this paper, we accept the definition of autonomy that is prevalent in the literature on nudging (Vugts et al. 2020). In short, autonomy refers to the ability of an agent to deliberate and decide what to choose without interference. This we believe covers the ability of individuals to choose freely, insofar as all choices are available to them and treats individuals as agents whereby the individual has the ability to choose and decide what option they believe is best for them. We recognise that there are nuances in the autonomy literature (see Vugts et al. 2020). However, we believe the nuances are not inimical to the central claims of the paper.

The paper is structured as follows: in the next section (§2) discusses the extent to which human spatial cognition is shaped by culture. Section 3 outlines the recent literature on nudging (§3.1), introduces a novel distinction between *suggestive nudging* and *disclosure nudging* (§3.2), and shows how enculturation complicates the relationship between them (§3.3). Section 4 defends our position against objections that our concerns are alarmist and proposes re-designing GPS devices to separate the two forms of nudging.

2 Human spatial cognition: enculturation and wayfinding technologies

2.1 The western navigational Niche

There are two key abstract epistemic problems in navigation: "where am I?" and "if I am at point A how do I get to point B?" (Hutchins 1995). All subsequent issues can be distilled into these two major questions. Importantly, for humans,

it is notable that these epistemic concerns are mediated by cultural knowledge and wayfinding technologies. So, rather than these abstract questions, the epistemic issue is often "given that I have cultural knowledge X/wayfinding tool Y, how do I tackle the navigational problem?". For instance, one can use a paper map to navigate one's way around in a city. As Richard Menary and Alexander Gillett (2017) point out, using mediational epistemic tools in this manner alters the cognitive task (also see Hutchins 1995). In the context of spatial navigation, altering the cognitive task involves different strategies and frames of reference that humans can use. Researchers have distinguished between two major strategies by which humans can tackle a navigational problem: route knowledge and survey knowledge (e.g. Ishikawa and Montello 2006). The former involves remembering a series of headings along a specific route (e.g. "to get to the shops you go down a specific road and take the third left followed by the second right"). In contrast, survey knowledge is more reflexive and involves building up a detailed cognitive map so that the agent can solve a range of navigational tasks and deviate from a specific route in an informed manner. This involves remembering the location of landmarks, path segments, and gaining an understanding of how they relate to one another.

A wide range of literature in various fields indicates that this basic framework is significantly shaped by cultural practices that are acquired through development and habituation into certain cultural contexts or niches; Richard Menary (2015) refers to this as "enculturated cognition"—the extent to which the acquisition of cultural practices partially shapes a cognitive domain (also see Fabry 2017; Menary and Gillett 2017). Numerous examples show that habituation into what we call a 'navigational niche' (e.g. certain sets of wayfinding strategies and wayfinding tools, spatial vocabulary and terminology, and other forms of relevant cultural knowledge) has significant impacts on various aspects of human spatial cognition: how agents think and feel about space; sculpting how an agent tackles basic spatial reasoning tasks; and what kinds of different orientational methods are used (Aporta and Higgs 2005; Chao 2017; Hutchins 1995; Levinson 2003). A range of psychological reports indicate that emotional states can also affect how one relates to space and feels at home, suggesting that this is crucial to our sense of personal identity and agency (Allen 2015; Ingold 2000; Lengen and Kisteman 2012). Leila Scannell and Robert Gifford (2010) articulate a tripartite model of place attachment based around three dimensions: the individual; the various processes (affective and cognitive); and the place itself. This relationship can become pathological, as indicated by some cases of anxiety (see Lengen and Kisteman 2012 for an overview). In general, our relationship to space is fundamental to much of how we relate to the world (Ishikawa 2016), and this is not just about information processing. As Hubert Dreyfus (1995, pp. 41-43) has observed, we aren't just 'in' the world like a toy in the box, we are in the world as being *involved* and embedded in a rich social environment—e.g. being in love, being in business, etc. Impacts on spatial cognition have ramifications for our general well-being. Therefore, issues of nudging and navigability regarding GPS devices need to be viewed in this broader sense.

Within this broader discussion of enculturated spatial cognition, our particular focus is on the 'Western Navigational Niche'. A set of traditions which have accumulated cultural knowledge in regards to wayfinding technology: discrete mathematical measurement systems and increasingly sophisticated forms of measurement of certain variables used in navigation (Aporta and Higgs 2005; Hutchins 1995; Wood 2010).[2] Central to this approach is the creation of the physical map. This enables the vast body of geospatial information accumulated over centuries by thousands of individuals to be condensed into a format that is highly portable, and allows for the high fidelity transmission of knowledge across a population. It also enables certain actors to gain more precise control over certain regions (Woods 2010). Maps designate space into specific configurations of social meaning with boundaries and regions: territories, pathways, districts, zones, and so on. For a long time, usage of these maps was limited for certain tasks due to the immense computational load required in altering them. This changed with the advent of modern computers which allowed the quick and easy collection of geospatial information in databases that could then be transposed onto digital maps with much greater ease (Bray 2014). Starting in the 1960s, governments and other agencies began to collect geospatial information – information about the location and certain other variables (e.g. disease, population size and composition, crime rates, etc.)—at an increasing rate.

Perhaps the peak of combining modern computing and mapping technologies is the Geospatial Positioning Systems (GPS). GPS utilises at least four satellites to triangulate the position of any device anywhere on the globe (Kumar and Moore 2002). Invented in the 1980s, they were primarily for use by the US military. But after the end of selective availability—the intentional degrading of public signals in GPS devices—and with improved user friendly designs, GPS devices were successfully marketed from 1990s onwards to many forms of commercial and private travel (Aporta and

[2] It is notable that this way of thinking about measuring and interacting with space is often seen as the default due to a Western-centric focus in psychology (Henrich et al. 2010). But there are numerous examples of alternative frames of references and wayfinding orientational methods that do not have discrete metrics of temporal duration nor spatial distance: e.g. see Hutchins (1995) discussion of Polynesian nautical navigation; and Chao's (2017) account of wayfinding in Western Papua.

Higgs 2005; Frazier and Easton 2013; Kumar and Moore 2002). Arguably, they are now the primary means by which many people tackle the two fundamental goals of navigation we identified at the beginning of the section: "where am I?" and "If I am at point A how do I get to point B?". GPS devices mediate these epistemic goals and, to a certain extent, "outsource" (Menary 2012) the cognitive load associated with tackling these problems. The agent no longer has to engage in the standard practices by which they combine internal memory, external resources, and salient features of their environment to ascertain their location and develop survey knowledge (Gillett and Heersmink 2019; Ishikawa 2016; Li et al. 2013). Instead, as Aporta and Higgs remark: GPS devices have freed us from the cognitive "burden" associated with this task. Indeed, we do not need to engage with local features of an environment to know where we are (2005, p. 741). We just need to look at the indicator on the device asserting "YOU ARE HERE". As such, agents who rely on GPS devices become passive rather than active in tackling spatial navigation tasks of route knowledge (Li et al. 2013).

With the widespread uptake of GPS devices by the general public, it is now relatively easy to collect and analyse massive amounts of geospatial information. We have huge numbers of individuals whose operation of these devices provides this data constantly to governments and corporations. For instance, the IBM analyst Jeff Jonas (2016) has claimed that mobile phones generate 600B transactions per day just in the USA—this is a huge amount of geo-locational data. To forestall claims that our views on this topic are overly negative, one-sided, or alarmist: we accept that there are numerous positive uses to the collection of geospatial data from smartphones—especially in regards to health, social planning, and scientific work in general (Bengtsson et al. 2011; Boulos 2011; Deville et al. 2017; Eagle et al. 2009; Finger et al. 2016; Ratti et al. 2006; Song et al. 2010). For instance, some scientists have compared the availability of large behavioural datasets collected from smartphones as akin to the invention of the microscope—insofar that we can now observe phenomena that were previously occluded due to the limitations in our ability to track the movement of people (de Montejoye et al. 2015). Previous methods of investigating and measuring the movement of people were extremely limited in two regards: the unreliability of surveys; and the large delay in the collection of the data in comparison to the dynamic nature of human movement (Deville et al. 2017). Given that, for example, the ongoing dynamics of human movement is a crucial factor in understanding the spread of disease (Finger et al. 2016), the ability to collect real-time data—what Ratti et al. (2006) refer to as "mobile geographies"—has enabled a better and more accurate response to natural disasters, epidemics, and improved transport networks (Bengtsson et al. 2011; Boulos 2011; Finger et al. 2016). Additionally, geospatial data are not necessarily corporate or government controlled. Crowdsourced ventures such as Ushahidi have enabled better responses of aid in some countries in Africa where official census reports are unreliable and subject to fraud and corruption (Boulos 2011; also see Bray 2014).

But whilst we acknowledge these undeniably positive uses for the mass collection of geospatial data from smartphones and other GPS devices, serious concerns about who has access to this information and how easily supposedly anonymised data can be re-identified. Empirical investigations indicate that knowing an individual's daily movements for just three months is sufficient to predict their future movements with 93% accuracy (Song et al. 2010). Other studies show that individuals can be re-identified from supposedly anonymised data with relative ease—even when that data are quite coarse-grained in regards to spatiotemporal points—with an accuracy of 95% (de Montejoye et al. 2013, 2015). Researchers have even been able to discern an anonymous agent's friendship network with 95% accuracy from a few months of geospatial data (Eagle et al. 2009). As such, geospatial data have been labelled an "informational superfood" (Jonas cited in Bray 2014) because of how much information it provides about particular individuals and groups—hence the need to be cautious in how easily it is collected, how it is stored, and who has access to (Bray 2014; Jonas 2016; de Montjoye et al. 2013, 2015; Song et al. 2010). Companies and organisations with access to geospatial information can know an extraordinary amount about an individual. These are important points we need to bear in mind in the context of nudging and issues of privacy.

2.2 The impact of GPS devices on human spatial cognition

Habitual use of GPS devices is associated with a marked decline of an individual agent's spatial memory, and perception, and intellectual autonomy. This is shown by a diverse range of empirical evidence: ethnographic studies and behavioural experiments in both the real-world and virtual environments in the laboratory. These studies demonstrate that GPS devices are having a significant impact on how we think and feel about space. The relevance here is that these cognitive deficits and deskillment influence how we should think about the way in which GPS devices operate as nudges.[3] We now briefly review this evidence.

[3] In regards to the notion of deskillment it has been argued by Brown and Laurier (2012) that learning to use a GPS device to navigate does not entail total deskillment since one learns new sets of skills in the proper use of the device. They further point out that the evolution and invention of new technologies always entails the general loss of skills associated with abandoned and replaced technologies; and the emergence of new skills associated with the new technologies. As Gillett and Heersmink (2019) note, this is indeed a core and distinctive feature of human cultural evolution—the streamlining of previous cognitive work to ease the cognitive load of the following generations.

Firstly, an ethnographic study by Gilly Leshed et al. (2008) of drivers who use GPS devices in a habitual manner found that they are less engaged with certain aspects of their local environment, such as natural and constructed landmarks, and instead had their *perception* channelled by attention to aspects of the environment indicated by the GPS device. An ecologically salient field study of drivers using GPS devices found that drivers often focus more on the screen of the device than other sources of information in the environment (Jensen et al. 2010). A recent lab-based experiment in which agents navigated a virtual city showed that participants attend to their environment much less, and did poorly in attempting to identify salient landmarks (Gramann et al. 2017). Using a GPS device can also impact on the perception of people moving around on foot. Matthews Timmis et al. (2017) conducted several studies in which participants wore eye-trackers as they moved whilst using a smartphone. Significant differences were observed in both the gait and visual search behaviour of people using smartphones versus non-users. Smartphone users had increasingly cautious stepping strategies whilst not attending to where they were in the environment.

Secondly, numerous field experiments examining both on-foot and in-car navigation around real-world environments have repeatedly shown that agents using GPS devices have worse *memories* in comparison with agents using other forms of wayfinding technology (Burnett and Lee 2005; Ishikawa et al. 2008; Munzer et al. 2006). Agents who use GPS devices perform poorly in a range of measures assessing memories: e.g. post-trial sketches of an environment; and renavigating the same environment without the aid of a wayfinding tool. Stefan Munzer et al. hypothesise that GPS users engage in much less *active* learning when in a new environment—i.e. there is less emphasis on coordinating internal spatial memory with external resources and salient features of the local environment (also see Gillett and Heersmink 2019; Ishikawa 2016; Li et al. 2013). These findings are supported by lab-based experiments in which participants navigate a virtual city using a GPS device (Gramann et al. 2017) and by ethnographic and longitudinal surveys of people living in major cities, which reveal that individuals who used GPS devices the most—and were thus the most *passive*—had the least survey knowledge of their own local environment even if they had lived there for a long time (Minaei 2014).

Lastly, Alexander Gillett and Richard Heersmink (2019) argue that this passivity undermines a range of epistemic virtues: intellectual autonomy and intellectual carefulness.[4] Declines in perceptual attention to spatial phenomena and abilities in spatial memory can have incredibly dramatic effects—especially when correlated to instances where agents are not checking the relevant information because they lack the sufficient skills and abilities associated with intellectual autonomy and intellectual carefulness. Greg Milner (2016) has documented multiple instances in which overreliance on GPS devices combined with a disengagement to other salient environmental cues has led to major and fatal accidents. Several people have died in Europe and America through following erroneous information or ending up on unsuitable roads in which their car gets stuck. People have driven hundreds of kilometres in the wrong direction despite navigating in their local area. Others have even driven into the sea, lakes, and off of cliffs. These admittedly extreme cases are indicative of a general pattern by which agent's lack the ability to properly assess information, and are not being sufficiently diligent in checking the information (Gillett and Heersmink 2019; Menary 2012).

This state of affairs shows that GPS devices are having a profound impact on human spatial cognitive abilities. Enculturation has knock-on effects for autonomy and privacy given the ubiquity with which people are dependent on GPS devices.

3 GPS and nudging: a closer examination

3.1 Nudging and navigability

In his recent book *On Freedom* (2019), Sunstein returns to the issue of navigability. His claim is simple: Freedom denotes an ability to navigate through one's life. An inability to navigate suggests people are less free than they might think. When we lack resources to be able to make informed decisions, we may feel trapped and forced into making decisions we might not otherwise have made. Consider being in a large unfamiliar airport. It is a perplexing feeling. Without proper guidance to lead us to where we want to go, we

Footnote 3 (continued)

But, in the case of GPS devices, the loss of skills here demands our attention because it is linked to undermining certain intellectual virtues, such as autonomy. See Gillett and Heersmink (2019) for further discussion.

[4] Epistemic virtues are defined as knowledge generating capacities that enable reliable and truth-conducive behaviour and thinking. The epistemological literature divides epistemic virtues into faculty based features (e.g. perception, memory, etc.), and character based traits (e.g. open mindedness, intellectual autonomy, etc.). Intellectual autonomy does not entail a sole reliance on oneself. Virtue approaches are based on Aristotelian philosophy and see virtues as balances between extremes. For example, open mindedness is a balance or mean between close minded dogmatism and credulity. As such, a virtuous epistemic agent with intellectual autonomy is one who can rely on their own judgement to assess the testimony of others and various epistemic tools. See Gillett and Heersmink (2019) for more details.

might miss our flight. Nudges—a term introduced by Thaler and Sunstein (2008)—provide guidance without limiting the choices available to the individual making the decision; nudges preserve individual autonomy when navigating through life's choices. Sunstein uses GPS devices, amongst other forms of choice architecture, to show how nudging may provide increased navigability to users. However, as helpful as GPS technologies are, there are concerns that they overemphasise the liberty-preserving conditions GPS may provide us, and underestimate ways in which overreliance on GPS technology erodes our privacy and autonomy. Sunstein overlooks the enculturating effects of GPS use and as such underestimates an individual's relation to their environment. Before we address how people can become over-reliant on GPS technology, it is important to detail the fundamental aspects of nudging and choice architecture which Thaler and Sunstein claim can be used to improve our everyday decision-making.

Based on evidence from a range of cognitive science experiments, human beings are not particularly rational when it comes to making decisions (e.g. Kahneman 2011). Thaler and Sunstein are concerned with how one could improve the decision-making of others without impairing their right to choose. They conceive of ways to nudge people towards making the "correct" decision (for instance related to health) without coercively denying any particular choice from being made.

Thaler and Sunstein propose a conception of Libertarian paternalism which encourages better decision-making without denying the agent any one particular choice that they could make. An idea they designate as "liberty-preservation" (Thaler and Sunstein 2003; Thaler and Sunstein 2008; Sunstein 2015a, b). Consider, for instance, a supermarket which has signage throughout the premises expressing the benefit of eating healthy foods. These signs also alert customers to the area of the store where such products are on display. The supermarket is encouraging you to choose fresh fruit and vegetables over ready-made meals or candy without denying you the choice of buying these products. Libertarian paternalism does not actively discourage the decision-making agent from making any choice but uses choice architecture to encourage a particular choice to be made.

Nudging is a "liberty-preserving" device which encourages agents to make particular choices. Nudging is built upon a dual systems approach to cognitive processing: system 1 is automatic, quick, and dirty, and system 2 is slower and more deliberative (Kahneman 2011). Thaler and Sunstein argue that nudges ought to be developed in a way that conditions the automatic processes to make decisions that improve the well-being of the individual. As Sunstein puts it "nudges are interventions that steer people in particular directions but that also allow them to go their own way" (2015a, p. 511; cf. Thaler and Sunstein 2008; Sunstein 2015b). The cognitive processes of the automatic system are fallible, prone to biases, and easily steerable. Functioning effectively in the world in an expedient manner requires that agents utilise heuristics to quickly handle the multitude of decisions that they face each day when long deliberation is not possible. Furthermore, given our "natural" abilities to develop these heuristics are subject to a range of specific biases (Kahneman 2011), nudging, according to Sunstein and Thaler amongst others, can help us re-conceive our heuristics and "rules of thumb" to encourage decisions that will be better for us in the long term.

In being characterised as "encouragements", "influences", or "steering"; nudges are presented as a low-cost, easy 'opt-in/opt-out' position for the individual agent. Furthermore, Thaler (2015) argues that "good nudges" are categorised by an easy identification of the choice architect of the nudges, and as such the choice architect can be held accountable for "bad nudges". Such steering mechanisms are already in place in public and private institutions. Recent studies have shown that replacing unhealthy foods with healthy varieties at the kiosk increases the likelihood of healthy choices being made (Kroese et al. 2016). Other examples include a particularly humorous use of an image of a fly on the public urinals of airport bathrooms in Amsterdam. Given the purported notoriety of the ineffective aim of male users of the bathrooms, the airport etched images of flies into the bowls of urinals. The experiment saw a significant decrease in "spillage" (Thaler and Sunstein 2008).

However, nudges have been criticised for manipulating an agent's ability to freely choose. Marjolein Lanzing (2018) argues that it is manipulative to shape choices to make it seem as if only one is available. Manipulation of an individual's ability to choose would undercut the idea that agents retain their autonomy to choose any choice (Weimer 2014; Susser et al. 2019). Such concerns focus on the potential of agent's to be manoeuvred into making a particular choice without realising that other choices are available to them (Wilkinson 2013).

In the next section we turn to Sunstein's consideration of GPS technologies. We think that not enough focus has been paid to the different forms of manipulative nudging that relies on gaining access to the geo-location of an individual.

3.2 A novel distinction: suggestive nudging and disclosure nudging

Sunstein, throughout his work on nudging and navigability, consistently draws a direct line between GPS and "good nudges": "It respects your freedom; you can ignore its advice if you like […] the device is there to help you to get to your preferred destination. It increases navigability" (2019, p. 14; also see Sunstein 2015b). A GPS performs what we call a *suggestive nudge*. Suggestive nudging is what most people

will recognise in their everyday use of GPS devices. The calculation that the device makes to generate a suggested route based on a set of data input by the user: their current location and the location they want to arrive at (i.e. the two main epistemic questions); as well as other details: e.g. "avoid toll roads", "avoid freeways", "avoid traffic", "quickest route possible" (Golledge and Garling 2008). As we observed in Sect. 2.1, such everyday considerations show that our relationship to space is not purely analytical but also driven by social projects and emotional concerns. Based on these constraints, GPS devices calculate the optimal choice *for the individual* in getting to their destination. Prima facie, these suggestions appear to be low-cost and provide an easy opt-out. Sunstein (2015b, 2019) uses this form of nudging, and the example of the GPS, as an explanans for nudging in general.

However, there is another kind of nudging, which is overlooked by Sunstein and others. This form of nudging encourages agents to share their current location and geospatial information. We refer to this as *disclosure nudging*. Importantly, disclosure nudging is arguably not always in the best interests of the agent, but is instead in the interests of other parties—namely, governments and corporations. It is not clear whether this type of nudging improves navigability, as Sunstein suggests of GPS technology. By focusing more on the occurrence of disclosure nudging, and how individuals are willing to share data to limit the cognitive workload required in decision-making processes, we can show the implications this has for our autonomy and privacy.

It is important to recognise that *constant* disclosure nudging is not a necessary feature—as suggestive nudging is—of GPS technology. Instead, it is an effect of both the agent's overreliance and the device's current design. GPS devices are developed with the ability to make a seemingly low-risk exchange of information to satisfy immediate preferences. We have a starting point and destination in mind (the primary epistemic goals). We input that information into the GPS device. It shows us optimal routes for travelling to that destination within a specific timeframe, and if all goes well, we arrive at that destination. As noted above in Sect. 2.1, this is done through mere passive route knowledge—i.e. there is no reflexive need to actively engage with the wider environment beyond this immediate short-term goal (and thus no long-term development of survey knowledge). By operating on automatic cognitive processes, suggestive nudging is often outside of our attention or awareness. It is only in cases where a malfunction occurs—such as an obvious non-optimal route choice—that suggestive nudging comes into conscious awareness. This makes GPS technology an incredibly reliable technology for improving our ability to reach our destination in a preferred amount of time whilst also helping to minimise cognitive load—i.e. through cognitive offloading or cognitive outsourcing (Menary 2012).

The issue is the extent to which individuals are nudged into *constantly* sharing personal data through disclosure nudging operating in tandem with suggestive nudging. For a GPS device or a phone application utilising GIS technology to work optimally, it requires an accurate understanding of an individual's geo-location. The use of phone applications—e.g. food delivery, ride-share applications and maps—often require such information in real-time. Such applications can be expected to use geo-location tracking to work optimally. As Binfeng Li et al. (2013) argue, there is an expectation that geo-location tracking applications will use my location to improve navigability of a particular space or, put in another way, improve preference-satisfaction. However, other applications such as news services, mobile gaming, and social media applications also use geo-tracking. It is often difficult for users to assess the reasons why such data are needed for the application to work optimally. A report in 2015 showed that 9 out of 10 smartphone users in the USA left location tracking services on at all time (Kaplan 2016). Whilst there is a general concern regarding privacy, the particular concern we have in this paper considers the habitual use of GPS and geo-location tracking services, and the way in which we are enculturated into allowing geo-tracking to take place—even in circumstances where it is not needed. As Yves-Alexandre de Montejoye et al. succinctly put it: "… it is estimated that a third of the 25B copies of applications available on Apple's App Store^{SM} access a user's geographic location, and that the geo-location of, ~ 50% of all iOS and Android traffic is available to ad networks" (2013, p. 1). We speculate that many of these involve unnecessary disclosure nudging.

To determine your precise location, GPS devices or phone applications will often provide push notifications asking for access to your current location. Such notifications are coupled with disclosure nudging—implying that granting access will improve an individual's preference-satisfaction. Whilst a precise determination of your location is not entirely necessary for map applications, and is even less necessary for playing mobile games, phone applications may insist this lack of information results in imprecise measurements regarding distance travelled and length of time to destination (or other variables). As such, if you have the setting for location tracking switched off on your phone, the application may persist in reminding you to turn it on for more accurate results. Now, imagine that every time you use your map application, or another other application, it is *constantly* nudging you to turn on location tracking—implying that this will improve the overall results of your input. Eventually, you may be in a position wherein turning on location tracking provides you with optimal information regarding your travel. Push notifications such as these exhibit all the aspects of nudging. It is an easy opt-in category which potentially improves the navigability of an

individual's preference-satisfaction. However, by accepting such push notifications we permit our geospatial location to be tracked—even at times when we are not using the GPS device or phone application.

3.3 Enculturation leads to dependency and habituated agents cannot opt-out of nudges

A reasonable position to begin from is the notion that many people are happy to receive aid that improves navigability. As such, at first glance, the suggestive nudging operating in GPS devices seems benign and useful. Disclosure nudging one might argue seems to be less clearly and singularly motivated for an individual's benefits in regards to navigability. Arguably, disclosure nudging may improve navigability in being provided information about what is in one's local environment (e.g. restaurants, sales, traffic reports, events, etc.). Andy Clark (2003, 2007) and other extended mind proponents have pointed out that this allows our smart computing devices to become more tailored to our preferences; and effectively becomes an alternative way of choosing. I.e. the nudges of the choice architecture are part of our hybrid or distributed decision-making processes (see Levy 2017). But, as we noted in Sect. 2.1, geospatial data are an informational superfood. One which can be exploited to gain a large amount of information about a person. So, the benefits here of *constant* disclosure tracking (as opposed to disclosing when needed) are more obviously in favour of corporate or government actors who collect personal data en masse for various purposes.

There are three issues here which are all interconnected: [1] the normalisation of disclosure nudging; [2] the link between suggestive nudging and disclosure nudging; and [3] how enculturation complicates this matter. *Firstly*, as technology increasingly permeates our everyday lives concerns have been raised about how it may be utilised for nefarious purposes (Susser et al. 2019). Within this broader discussion, our focus here is about how normalisation of constant disclosure nudging poses a threat to individual autonomy and privacy. Hiawatha Bray (2014) notes that constantly knowing both where one is and having others know where one is, is a novel and unprecedented situation. Much has been written on the impact of constant surveillance and how it influences behaviour and agency (e.g. Foucault 1977, 1978; Richards 2013; Zuboff 2019). But our specific concern here is how disclosure nudging operates in the choice architecture of the current design of GPS devices as a constant pressure. As noted above, on the surface it intrudes into one's life as a low-grade, low-cost, and easy opt-out. But it is the constant drip-drip insisting—combined with the genuine benefits to navigability—that normalises agents into new facts of existence: that others—namely corporate and government actors—will always know where you are. Whatever view one takes on modern GIS technologies and privacy, the role of disclosure nudging needs to be examined more carefully.

A second concern is the relation of suggestive and disclosure nudging. As previously stated, these two are not in principle connected. One can see this by the fact that other forms of GIS technologies operate only involving one form of nudge or the other (e.g. RFID cards, which are present in travel cards, bank cards, etc. only involve disclosure nudging[5]). So, in principle the choice architecture of GPS devices could involve a separation of suggestive and disclosure nudging. But in practice these two are interlinked. In order to gain effective suggestive nudges to aid navigability one is pressured into accepting disclosure nudging. One might think that this is nothing to be too concerned with: if one wants accurate directions, surely one can accept revealing one's location in order to get tailored and appropriate information? I.e. one could argue disclosure nudging actually increases and enhances the way suggestive nudging facilitates navigability in the broad sense (for similar points see Clark 2003).

However, this overlooks the third concern: how the enculturated nature of human spatial cognition exacerbates the problem by which suggestive nudging and disclosure nudging are entwined. As noted above, Sunstein and others have primarily focused on suggestive nudging and have overlooked disclosure nudging. But they have also overlooked how enculturated cognitive capacities alter this situation as well. Combined, we argue, these elements entail that nudging is not always beneficial to the agent in the way GPS devices are currently designed. Sunstein and others who are optimistic about nudging's ability to shape better choices for individuals—a "GPS does not undermine human agency; it promotes it" (Sunstein 2015, p. 512)—ignore the wider social context in which they are deployed and the long-term effects of habitual GPS reliance that we outlined in Sect. 2.2.

The issue can be stated briefly as follows: agents habituated into overly relying on GPS devices for spatial navigation tasks are utilising a response strategy; entailing only route knowledge and correspondingly 'thin' cognitive maps. Long-term overreliance on GPS devices not only undermines memory but also impacts on how agents perceive their

[5] Indeed, in relation to the first concern mentioned above about disclosure nudging, several theorists have noted that RFID cards play a large role in normalising and habituating people into being constantly tracked. For instance, in regards to their increasing presence in schools, Bray (2014, p. 225) notes that "Perhaps the most troubling aspect is that constant tracking of students conditions young people to expect similarly intrusive surveillance as adults". Gillom and Monahan point out that "students are 'normalised' to this surveillance—it becomes commonplace, unquestioned, and unremarkable" (cited in ibid).

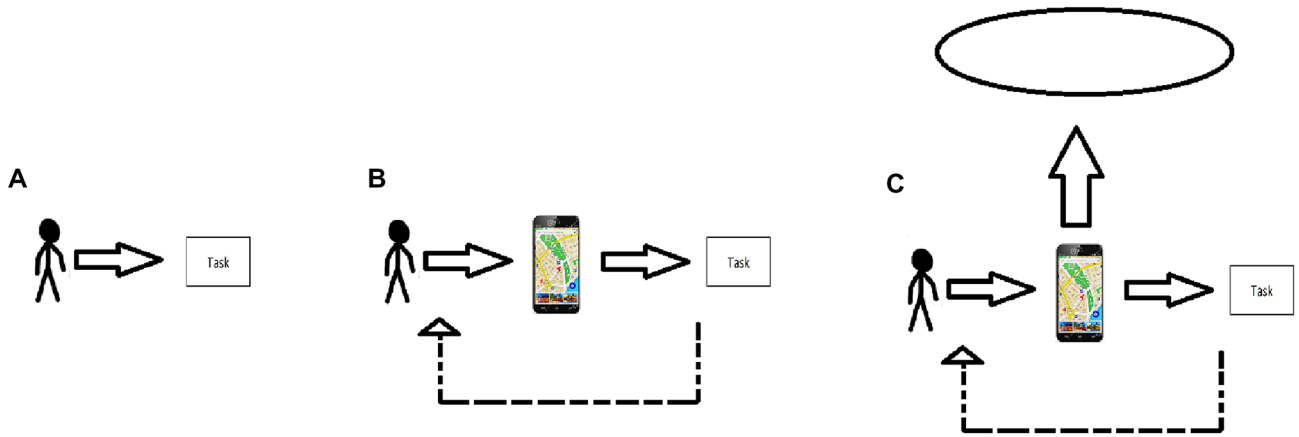

Fig. 1 Schematic depiction of the entanglement of Suggestive Nudging and Disclosure Nudging. All agents face navigational tasks in their everyday lives (**a**). For humans immersed in cultural contexts these are mediated by their available resources. In the Western navigational niche the major mediational epistemic tools are GPS devices (**b**). GPS devices operate by providing users with prospective routes to their destination—suggestive nudging. Although Sunstein characterises these as easy opt-out; through habituation and enculturation, agents become reliant upon suggestive nudging because of deskillment that arises because of the passive role of the agent and its focus on route knowledge (the loss of intellectual autonomy and the undermining of memory and perception in regards to basic spatial navigation tasks). But suggestive nudging is not the only form of nudging at work in the current design of GPS devices. Agents are also nudged towards sharing their location (disclosure nudging) (**c**). Since, agents are unable to opt-out of suggestive nudging they are also unable to opt-out of disclosure nudging. This entails a loss of both autonomy and privacy

environments. Additionally, GPS users are *passive* in regards to how they interact with information produced by the device (i.e. they do not have to be active in triangulating internal representations, external representations, and the environment itself). The general deskillment and types of knowledge structures entail that agents also lack a sufficient degree of intellectual autonomy, and as such agents who overly rely on GPS devices are not properly able to opt-out of suggestive nudging. Since suggestive nudging and disclosure nudging are intertwined in practice, this entails that agents who are unable to properly opt-out of suggestive nudging are also unable to properly opt-out of being constantly tracked. But one must also see this as an ongoing process. As the agent becomes increasingly reliant on GPS devices to solve basic navigational goals, they also become increasingly unable to opt-out of constantly sharing their location with others. The entanglement of suggestive nudging and disclosure nudging is schematised in Fig. 1 below.

By no means do we mean to claim that these circumstances are inescapable for all people. But the empirical evidence surveyed in Sect. 2.2 provides a strong basis to claim that this is an accurate description for a large number of people in the Western navigational niche. Additionally, because of the nature of nudging operating in regards to system 1 processes, this is mostly outside of conscious considerations in our everyday choice architecture.

The current circumstances are undesirable for several reasons: firstly, habituated reliance on GPS devices renders people passive and undermines their capacity to make genuine choices. Thus, GPS devices do not in fact increase navigability (in the broad sense that Sunstein conceives). Secondly, constant and inescapable revealing of one's location undermines one's privacy, and potentially curbs one's autonomy as well. Therefore, this state of affairs impels the re-design of choice architecture of GPS devices to create a disjunction between suggestive and disclosure nudging so they can properly and genuinely support autonomy and navigability.

4 Response to the charge of alarmism; making the case for device re-design

A potential criticism of our position regarding *disclosure nudging* is that it is alarmist and unwarranted given the current stability of western liberal democracies (and the normative legal frameworks that underpin that stability).[6] In particular, currently existing regulatory frameworks—such as the Australian Privacy Act, the General Data Protection Regulation, and the California Consumer Privacy Act—protect individual privacy by making secondary use of personal data illegal unless explicit consent by users is provided.[7]

[6] We thank an anonymous reviewer for raising this issue with us.

[7] *Australian Privacy Act 1988* (Cth). Retrieved from https://www.legislation.gov.au/Details/C2018C00292; *The General Data Protection Regulation* 2016. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0679; The California Consumer Privacy Act 2018. Retrieved from https://iapp.org/resources/article/california-consumer-privacy-act-of-2018/.

Under these privacy acts, personal information collected by the user's device is still owned by the individual. The right to use personal data collected by a device therefore hinges on the consent provided by the individual. The EU's *General Data Protection Regulation* (GDPR) for instance introduces several articles regarding the right of individuals to act on the usage of their personal data. This includes the right to erasure (more commonly known as the right to be forgotten), the right to restriction of processing, and the right to object to usage of personal data for direct marketing purposes. One could claim that these policies protect users from any issues potentially arising from disclosure nudging. We outline a number of issues regarding legal regulation in Western democracies below; demonstrating that our concerns about disclosure nudging are well-founded and not alarmist.

Firstly, whilst it is the case that legal regulations in many western democracies restrict the use of on-selling of user's private data to third-party organisations, we do not believe that such restrictions are likely to be effective against disclosure nudging. As we have made clear throughout this paper, disclosure nudging comes about through the habitual use of GPS devices, and phone applications utilising geo-location tracking. Constant usage of these devices and applications leads us to a position where it becomes too cognitively demanding, to navigate our surroundings without using a GPS device. We become accustomed to the efficiency and effectiveness by which GPS devices and geo-location tracking improve navigability, that our expectations over our privacy are less effective when we are prompted to consent to the use of phone applications and GPS to geo-location tracking. Regulatory frameworks are unable to protect our privacy in cases where individuals have consented to the use of their data. Whilst the option to the right of erasure remains open to the individual, it is questionable how easily this option is available to users. GPS devices and geo-location tracking services inculcate us into an environment in which the efficiency and effectiveness of our preference-satisfaction is undermined by disallowing personal data to be used by these applications.

The second reply to the criticism that Western liberal legal frameworks prevent corporations and governments using disclosure nudging for their benefit (rather than the benefit of the user) can be provided by looking at several recent whistleblower reports on data usage by global surveillance networks, and data analysis firms. In 2013, Edward Snowden revealed the extent to which the NSA and other global surveillance networks have access to an individual's personal data (Greenwald 2014). In the subsequent months after the release of the documents, the extent to which an individual's data could be accessed by these government surveillance networks—which included organisations from the USA, Australia, the United Kingdom, and Canada—came to light.

Most privacy advocates' concerns about the misuse of data usually focus on government intrusion, but are less concerned by the activities of the corporate sector (for notable exceptions, see Mosco 2015; Zuboff 2019). However, the mass collection and exploitation of geospatial data is also carried out by corporations despite the laws against this in liberal Western democracies. A particularly egregious example of this came in the 2018 revelation that the personal data of eighty million users of the social media site FACEBOOK was released to data analytics firm, Cambridge Analytica (Cadwalladr and Graham-Harrison 2018). Information was gathered through the use of a social media app called "This Is Your Digital Life" designed by data analyst Aleksandr Kogan. The app included an informed consent process which users could opt-into. The issue was that Facebook's design allowed data to be collected from not only those who gave informed consent but also those who were connected to the consenter. The information became an international story when it was revealed that Cambridge Analytica had used the data collected from users accounts to help swing the political messaging of candidates during elections in the US, Australia, the UK and a variety of others (Cadwalladr and Graham-Harrison 2018). In these cases, no criminal charges were laid. Rather than being alarmist, these cases show that our concerns are proportional and well-motivated.

The claim that Western liberal democracies are in a unique position to defend against the types of incursion discussed above does not account for how individuals are enculturated into acting in certain environments. As we have shown, human cognitive abilities are highly plastic and shaped by prevailing cultural patterns of the local cultural-cognitive niche (Fabry 2017; Menary 2015; Menary and Gillett 2017). This in turn can lead us to become exceedingly relaxed when faced with the opportunity to release our personal data when presented with a more efficient and effective means of satisfying our preferences. Whilst we have acknowledged that there are some positive uses for GPS devices (especially for responding to disaster events and epidemics), there are a number of concerns with what kinds of information people are normalised into readily giving away in regards to constantly being tracked (disclosure nudging). Geospatial data enable other actors to gain a huge amount of information about an agent: not only where they are, but where they will be, who they will be with, and who they are (Bray 2014; de Montejoye et al. 2013, 2015).

The replies we have offered here are not meant to justify an alarmist attitude towards the general use of GPS technology. We believe the issues discussed above provide a sound basis to advocate the *re-designing* of GPS devices, and privacy policies surrounding those devices. The aim of such a project would be wayfinding technologies that do genuinely facilitate navigability and human flourishing as Sunstein and others envision. As we discussed in Sects. 3.2

and 3.3, suggestive nudging and disclosure nudging are *not in principle* necessarily connected. But the current design of GPS devices is one in which they constantly nudge users into disclosing their location when also receiving suggestive nudges so that they are interconnected *in practice*.

Our call for re-designing GPS devices to keep suggestive nudges but untangle them from disclosure nudging would protect individual privacy more explicitly; and is not an infeasible project. Empirical experiments by Klau Gramann et al. (2017) show that GPS devices can be re-designed to facilitate rather than undermine perception, memory, and intellectual autonomy. The modified devices not only provide instructions for following a path (e.g. "in 2 km turn left) but also provide incidental information about certain decision points (e.g. "In 2 km turn left at the Italian restaurant with a red sign"). The latter set of instructions are not vital to the basic completion of a navigation task—i.e. to tackling the epistemic goal "how do I get from A to B?". But these incidental instructions have been shown, by several experiments of navigating around a virtual city, to be sufficient in getting individuals to pay more attention to their environment, developing more robust cognitive maps (survey knowledge and not just route knowledge), and subsequently having a better grasp of how to make effective decisions when navigating in the absence of the device (intellectual autonomy) (see Gillett and Heersmink 2019 for further discussion).

Arguably, these modified GPS devices have altered the choice architecture presented to the user to nudge them towards being more aware of their environment, and thus scaffolding the development of better spatial memories. Furthermore, re-designing devices in this fashion does not undermine their primary purpose of aiding navigation to certain destinations. Given that re-designing GPS devices can be done to offset their negative effects on our cognitive capacities, it seems eminently reasonable that they can also be designed to enforce a separation of suggestive nudging and disclosure nudging. This could be achieved in a number of ways. Primarily, it could be made much easier for users to opt-out of long-term profiling of use. In response to the reasonable points of Clark (2003) and others who think that building profiles about preferences is beneficial, we can note that modifying GPS devices in the manner described would actually make them more orientated around benefits to the user *rather than* corporate and government actors who benefit from *constant* disclosure nudging. To reiterate: our goal here is not some luddite or romantic fantasy in which people have to find their way around a city by discerning True North based on the position of the stars. Rather, our aim is to make technology viable for truly aiding navigability in the broad sense Sunstein envisages. Our point is not to abandon the use of GPS devices, but is instead to re-design them so that users can properly opt-out of disclosure nudging whilst making use of the evident benefits of suggestive nudging for navigability.

5 Conclusion

The purpose of this paper has been to specify the detrimental effects of an individual's wayfinding ability through the overreliance on GPS devices, and associated technologies. Motivated by what we see as a key misunderstanding regarding the designation of GPS technology as a way of improving navigability, we introduced a distinction between "suggestive nudging" and "disclosure nudging" that clarifies what occurs when individuals use GPS technology. At first appearances, the increasing usage of these wayfinding technologies is freeing us from the burden of a tedious cognitive task ("where am I?" "How do I get to where I want to go?"). GPS devices are easy to use and access information that streamlines cognitive work (Aporta and Higgs 2005). But it also sculpts the way we tackle these problems such that we only build the thinnest of cognitive maps of our environments. The very tools for navigability that are offered to us implicitly limit our ability to make choices by shaping the very way in which we navigate in our environments, potentially making some choices imperceptible. As such, rather than being easy opt-out—as Sunstein claims—ongoing usage of these devices make them more and more heavily entrenched in our decision-making processes.

Our contribution to this debate has been to identify that there is a previously overlooked dimension: empirical evidence from a wide range of fields shows that habitual use of GPS devices has a significant impact on a range of cognitive capacities related to wayfinding (especially perception, memory, and decision-making). We have demonstrated that this issue of enculturation exacerbates and deepens often-overlooked political ramifications of GPS devices. Distinguishing between two forms of nudging, we argued that people are normalised into constantly revealing their location (disclosure nudging), and furthermore, that because they are deskilled through constant reliance on their device (suggestive nudging), they are deskilled in regards to escaping this scenario. Pointing to this problem is not an alarmist exaggeration as demonstrated by evidence in recent years showing that both governments and corporations have been exploiting disclosure nudging for their own interests and against putative legal protections.

To this end, we have suggested ways by which GPS technology could be re-designed to improve suggestive nudging without the threat of constant disclosure nudging. We believe that orientating GPS technology to facilitate, rather than undermine our ability to develop cognitive maps could potentially help in this regard. And that such changes are

necessary if GPS devices are to truly aid navigability as Sunstein claims.

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