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Abstract

Behavioural scientists have begun to research "sludge", excessive frictions that make it harder for people to do what they want to do. Friction is also an important concept in transaction-cost economics. Nevertheless, sludge has been discussed without explicit referral to transaction costs. Several questions arise from this observation. Is the analogy to friction used differently in both literatures? If so, what are the key differences? If not, should we develop the concept of sludge when the well-established literature on transaction costs already exists? This paper shows that sludge and transaction costs are related, but distinct concepts, and that the literature on sludge can benefit from incorporating elements from transaction-cost research. For example, we suggest defining sludge as aspects of the choice architecture that lead to the experience of excessive or unjustified costs, organise sludges using a typology inspired by the transaction-cost literature and show that sludge audits can be conducted using methods developed in the transaction-cost literature.

Keywords: Sludge, Transaction costs, Behavioural Economics, New Institutional Economics, Frictions.

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1 Introduction

Behavioural insights can be used to help people achieve their long-term goals without limiting their freedom of choice. Thaler and Sunstein (2008) call this nudging. But behavioural insights can also be used to make it more difficult for people to achieve their long-term goals. The phrase for this "dark cousin" of nudging has recently been termed as "sludge" (Sunstein, 2019b, Thaler, 2018). Early definitions of sludge view it as nudging for evil (Thaler, 2018),[1] or as excessive or unjustified friction that makes it harder for people to do what they wish (Sunstein, 2020). Sludge impedes decision making by making it more difficult for people to navigate through their everyday lives (Sunstein, 2019a).[2] Examples of sludge in the private and the public sector include unnecessarily complicated and cumbersome paperwork and form-filling requirements, long and confusing fine print, unfavourable default settings, inconvenient cashback and refund conditions, messages that induce psychological costs in the form of negative emotions, subscription traps and bureaucratic red tape (Soman et al., 2019, Akerlof and Shiller, 2015, Sunstein, 2020). As a result of sludge, take-up of government programmes can be low, profits of firms high at the expense of consumer welfare, people can become frustrated, stressed and sometimes humiliated and exercising some basic human rights can be more difficult (Soman et al., 2019, Sunstein, 2019b, Thaler, 2018). Sludge can influence everybody's decisions, but it is particularly powerful when humans are present-biased, overoptimistic or show other deviations from rationality identified in the behavioural sciences.

While examples of sludge are abundant in the emerging discussions on the dark side of behavioural science, the conceptional work on sludge is in its nascent stage.[3] To make progress, we need to define what sludge is and what it is not. We

[1] We can differentiate sludge from dark nudging. The former makes good decisions more difficult (mainly by increasing friction) and the latter makes bad decisions easier to enact (for example, by reducing frictions) (Thaler, 2018; Sunstein 2020; Soman et al., 2019). Sludging can also be related to ethically unacceptable goals (Lades and Delaney, 2020).

[2] The words "excessive" and "unjustified" are important. There are many valid reasons for friction, including programme integrity, self-control problems, privacy, security issues, the acquisition of useful data (Sunstein, 2019b) and the creation of decision points (Soman et al., 2010). But these frictions are not sludge under this definition, as they are essential or beneficial and not excessive and harmful. Following the definition of sludge as excessive friction, a sludge reduction always promotes welfare for the end-user.

[3] For example, Sunstein (2020) defines sludge as excessive friction and Sunstein and Gosset (2020) investigate the optimal level of sludge. But if sludge is excessive (by definition), optimal sludge

also need to identify different types of sludge and to establish the main factors that determine whether a process is "sludgy" or not. Having established such details will allow us to conduct more systematic "sludge audits" (Sunstein, 2020) in which different types of sludge can be identified in private and public institutions. In this paper, we suggest advancing the conceptual literature on sludge by integrating the literature on sludge (mainly discussed in the behavioural science literature) with the literature on "transaction costs" (mainly discussed in the new institutional economics literature).

Transaction costs are typically defined as all costs involved in a transaction, other than the costs of physical production (Nilsson and Sundqvist, 2007, Webster and Lai, 2003).[4] More substantially, transaction costs are the sum of the direct and indirect costs of making economic transactions on a market. They describe all costs that make a transaction happen but that do not create value (Shahab et al., 2018a, Coggan et al., 2015). They include the costs of finding appropriate opportunities for market transactions, exchanging and trading in the market and the costs of creating and enforcing property rights (Allen, 1999). Williamson (1985) uses the analogy between mechanical frictions and transaction costs. He argues that if engineers look for frictions in mechanical systems, economists need to take account of transaction costs. Three types of transaction costs are often distinguished: search and information costs, bargaining costs and policing/enforcement costs. Additionally, transactions costs are often linked to the creation and enforcement of property rights (Dahlman, 1979, Allen, 1999).[5]

Both the literature on sludge and the literature on transaction costs rely on the analogy to friction in mechanical systems.[6] However, the concept of sludge has

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should be zero. In this paper, we understand sludge as excessive so that the optimal level of sludge for the end-user is, by definition, zero. In an overall welfare assessment, the optimal amount of sludge might be positive.

[4] The concept of "transaction costs" was conceptually introduced by Coase (1937) to explain why firms exist. The concept was then further developed mainly by new institutional economics scholars (Williamson 1985, North 1992, Cheung, 1987).

[5] It is worth noting that while term "transaction costs" suggests that it only applies to costs arising from a transaction, it is sometimes used more broadly (Buitelaar, 2004; Wang, 2003) to also include actions, as opposed to "trans-actions" (Commons, 1931).

[6] Friction, in the mechanical context, is the force resisting the relative motion of surfaces and material elements sliding against each other (Atkins and Escudier, 2013). Soman (2020) makes the analogy to friction very explicit when he introduces sludge by describing a metaphorical city in which some houses do not receive water from the water grid due to (actual) sludge that leads to blocked pipes.

been introduced without reference to transaction costs. Several questions arise from this observation: Do transaction costs and sludge theories analyse and explain the effects of friction on economic or policy outcomes in the same way? If yes, is there any need for developing a new concept such as sludge? If no, what are the key differences in their approaches or rationales and how can the sludge literature learn from over 50 years of transaction-cost research? This paper aims to answer these questions.

We start by bringing together and synthesising the literature on transaction costs and the literature on sludge with two main objectives: (i) to identify similarities and differences across both areas; and (ii) to show whether/how the work on sludge can benefit from insights generated in transaction-cost economics. To this end, the next section shows that there is considerable overlap in the concepts and their approaches, but also highlights some key differences. We then describe how the literature on sludge can benefit from insights gained in transaction-cost research, first suggesting to define sludge as *aspects of the choice architecture that lead to the experience of excessive or unjustified costs* and discussing this definition. Second, we borrow from transaction-cost typologies to develop a typology of sludge that differentiates between different choice architectures that lead to search costs, evaluation costs, implementation costs and psychological costs. Third, we discuss the extent to which the main determinants of transaction costs (specificity, uncertainty and frequency) are also determinants of sludge. Finally, we show how approaches to measuring transaction costs as well as the other insights gained from the transaction-cost literature can inform "sludge audits". We conclude the paper by suggesting avenues for future research as well as thoughts on sludge reduction in private and public contexts.

2 Sludge and transaction costs: Similarities and differences

This section compares the concepts of sludge and transaction costs as defined above in the introduction, highlighting some similarities and differences across both concepts. A complete description of all similarities and difference is beyond the scope of this paper. Instead, we hope to provide a useful synthesis to spark some discussion across the two literatures. We focus on those similarities and differences where we have identified potential for transaction-cost research to inform the discussions of sludge, as described in the following section on *Informing discussions on sludge with insights from transaction-cost economics.*

2.1 Bounded rationality

A key similarity across the literatures on transaction costs and sludge is that both literatures share the view that human behaviour is not always best described by the rational agents that maximise their utility under constraints as depicted in many economics textbooks. Transaction-cost economists often cite the influence of Herbert Simon's research on satisficing and highlight that people are "intendedly rational, but only limitedly so" (Simon, 1997, p.xxiv). They argue that bounded rationality can contribute to increased transaction costs; if people were fully rational, less time and effort would need to be spent to allow transactions to happen.[7] The behavioural economic literature goes a step further and argues that people are not only boundedly rational, but also that these deviations from rational behaviour can be predicted in directional hypotheses (Thaler, 2015). Predictable deviations from rationality are called biases, and behavioural economists have identified many of these biases over the last 3 decades (including inertia, present bias, optimism bias, overconfidence, biased expectations, loss aversion and inattention to name just a few) (Dhami, 2016). It is helpful to have this view of human behaviour in mind when discussing the origins and consequences of transaction costs and sludge in the next sub-sections.

2.2 Origins: Institutions and choice architecture

The concept of transaction costs originates from the literature on institutions. Institutions are sometimes described as the "rules of the game" (North, 1990) and can lead to more or less frictions in economically relevant transactions. On the macro level, institutional environments are composed of political, social and legal ground rules and these rules can slow down or speed up economic activities depending on their design. On the micro level, institutional arrangements can lead to frictions when cooperation or competition between different economic actors is hindered by, for example, complicated rules (Williamson, 1993).

The term sludge originates from a literature in behavioural science that highlights the importance of the choice architecture as a main determinant of human

[7] However, the transaction-cost literature does not view bounded rationality as a sufficient condition for the existence of transaction costs. For example, if all the agents involved in a transaction were fully trustworthy, bounded rationality would not necessarily lead to higher transaction costs (Williamson. 1993).

behaviour. Choice architecture describes the contexts in which individuals make decisions (Thaler and Sunstein, 2008). These contexts can make it easy for people to make welfare-promoting decisions, for example when information is described in simple terms. Thaler and Sunstein (2008) call modifications of the choice architecture that facilitate welfare-promoting choices "nudging". But choice architecture can also complicate decisions, for example when the completion of unnecessary forms is required or when prices of consumer products are hidden and communicated without much transparency. In these situations, the choice architecture can be called "sludgy" as it creates unnecessary frictions that make it more difficult for people to make decisions that increase their welfare. Nudges that rely on changes of the choice architecture do not restrict people's freedom to make decisions or change incentives significantly. Instead, these changes use psychological levers to make it more likely that one option is chosen over another. The importance of choice architecture has been overlooked in traditional economic thinking where supposedly minor situational factors have been deemed irrelevant for the behaviour of the rational agents in economics textbooks and hence for economic analysis. But findings from behavioural economics and psychology about bounded rationality and predictable biases suggest that these "supposedly irrelevant factors" do matter a lot (Thaler, 2015).

Institutions and choice architecture are not identical concepts. For example, nobody would deem institutions, such as property rights, marriage and religion as (supposedly) irrelevant. Moreover, institutions are often designed centrally, and the choice architecture is typically designed by street level bureaucrats or lower-level workers in organisations. However, the two concepts are related. When institutions are defined as the "rules of the game", we can define the choice architecture as the "design of the game". Consider chess as an example. The rules of the game dictate that the board is organised in 8x8 squares, that the bishop can move diagonally and that the game is over when the king is taken. Within the limits provided by these rules, the game can happen in loud or quite environments, different pieces can look differently, and the material of the board and the pieces can vary. While these design aspects might not influence the game of grandmasters, beginners might very well be affected, and some designs can make it harder to follow the rules than other designs. As such, the design, or the choice architecture, can either make it easier or more difficult to make decisions. Accordingly, both institutions and choice architecture influence our decisions. But while institutions necessarily influence everybody's decisions, including those

decisions of the rational agents from economics textbooks and sometimes limit freedom of choice, changes of the choice architecture have particularly strong effects on boundedly rational individuals and never reduce freedom of choice.

Both institutions and the choice architecture may originate from deliberate decisions. For example, government officials may make it excessively difficult for people to receive welfare benefits and companies may make it difficult to redeem mail-in rebates to gain financial benefits in a somewhat opaque way. Moreover, financial adviser lobbies have an incentive to keep the tax system complicated to guarantee demand for their services. On the other hand, institutions with transaction costs as well as sludgy choice architecture can also result from unintentional processes where paperwork burdens accumulate over time, potentially because the designers of the institutions and the choice architects themselves are boundedly rational and not aware of the frictions they create for end-users. Public officials and industry representatives might not be able to see these frictions emerging as there might be an empathy gap where experts are blind to problems that non-experts might encounter (Soman et al., 2019).

2.3 Consequences: Effectiveness, efficiency and equity

Transaction costs can have many consequences. The transaction-cost literature often distinguishes between consequences related to reduced levels of effectiveness, efficiency and equity (Coggan et al., 2015, Shahab et al., 2019b, Rørstad et al., 2007, Jaraite et al., 2010, Kuperan et al., 2008, Shahab and Viallon, 2019, Mack et al., 2019). Transaction costs influence the effectiveness of market transactions when, for example, contracts are too complicated to be set up so that sales are not agreed upon. Thus, fewer transactions happen than it would be optimal. They can influence the effectiveness of government programmes when take-up rates of welfare benefits are low due to paperwork burdens. Transaction costs reduce efficiency when, for example, they lead to dead weight losses due to too much or too little trade on a market or when citizens need to spend too much time and effort to receive welfare benefits. High levels of transaction costs in a market mean that more resources than necessary are needed to complete transactions. And transaction costs can influence how equitable outcomes of market transactions are when they make it easier or less costly for some than for others to make transactions. For example, the transaction costs of the EU Emissions Trading Scheme are lower for participants with larger allocations than for those with smaller allocations. While the average transaction costs for smaller

firm is around €2.02 per tonne, larger firms pay only about €0.05 per tonne (Jaraite et al., 2010).

The sludge literature has also begun to discuss consequences of sludge and we can organise these consequences according to their effects on effectiveness, efficiency and equity, as well. In terms of effectiveness in the public sector, sludge can reduce the take-up rates of government programmes, reduce acquisitions of permits or licenses (Herd and Moynihan, 2019) and reduce the ability to enjoy individual rights such as the right to vote and the right for free speech (Sunstein, 2020). In the private sector, sludge can reduce the number of rebates that consumers claim (Bar-Gill, 2012) and generally reduce people's freedom understood as the ability to do what they want to do (Sunstein, 2019a). Moreover, when firms compete to design the most deceiving and sludgy choice architecture (rather than competing over price or quality), lower social welfare can be the result (Akerlof and Shiller, 2015). In terms of efficiency, sludge in the public sector can increase the time and money spent to achieve given outcomes, for example when administrative requirements lead to an increased need for administrative capacity and person-time. In the private sector, sludge can reduce efficiency when goods are purchased for more than the market price. Finally, sludge can have uneven effects on different people, and inequality can increase when sludges have stronger effects on some segments in the population, such as the poor, the elderly, the sick or those with young children (Christensen et al., 2020). Those most in need of welfare support might also be those who have most difficulties overcoming sludge to obtain the welfare benefits due to low mental bandwidth and being pre-occupied with financial and other worries (Shafir and Mullainathan, 2013). While also fully rational people are likely to be adversely affected by sludge, behavioural biases make sludge especially harmful and sometimes devastating (Sunstein, 2019b).

2.4 Measurement: Direct and indirect costs

To quantify transaction costs and consequences of sludge (also in terms of effectiveness, efficiency and equity), we need to identify the units in which transaction costs and the consequences of sludge can be measured. The transaction-cost literature quantifies transaction costs by measuring the direct and indirect costs incurred by involved parties to complete transactions (Coggan et al., 2015, Falconer and Saunders, 2002, Fang et al., 2005, Kuperan et al., 2008,

McCann and Easter, 1999, Shahab et al., 2018a).[8] The direct costs refer to all direct financial (or monetary) costs involved in the transactions. These costs include, for example, administration fees, brokerage fees, the costs of hiring consultants and intermediaries, the costs of transportation and accommodation and the costs of conducting surveys. The indirect costs often refer to the costs of time spent on each transaction. To monetise time-related costs, reported time inputs are multiplied by standard hourly rates.[9]

The effects of sludge can also be measured in terms of direct costs (i.e., monetary costs in terms of how much money consumers/citizens lose) and indirect costs (i.e., time-related costs in terms of how much time consumers/citizens lose).[10] Sunstein (2019b) for example suggests that about 9.78 billion hours have been lost in the US in 2015 due to paperwork. Additionally, behavioural scientists highlight hedonic psychological costs (another form of indirect costs) related to sludge (Thunström, 2019). First studies are emerging that quantify these psychological costs of sludge for example using face recognition techniques (e.g., Hattke et al., 2020). While much more attention has been devoted to quantifying transaction costs than to the quantification of sludge, the transaction-cost literature has largely neglected these indirect psychological costs so far.

2.5 Types: Search, bargaining and enforcement costs

The transaction-cost literature has identified several types of transaction costs (Dahlman, 1979, McCann et al., 2005, McCann and Easter, 1999, Shahab et al., 2019a, Thompson, 1999, Bruce and Fabozzi, 1991). These typologies have helped transaction-cost researchers over the years to think systematically about transaction costs. They have been instrumental particularly in empirical studies

[8] The magnitude of transaction costs varies widely from as low as 1% of the payment (Falconer and Whitby, 1999) to as high as 110% of the payment (Falconer and Saunders, 2002) depending on the context, the way transaction costs are measured and the definition of the baseline payment that defines the 100%.

[9] For example, Shahab et al (2018a) assessed the standard value of time for Maryland farmers as $22.80 per hour. They calculated this rate based on the average net income per farm in 2015, i.e. $40,797 (Maryland State Archives, 2017), divided by the average annual hours actually worked per worker in the US in 2015, i.e. 1790 hours (OECD, 2017).

[10] The "effects of sludge" in this sentence refer to the welfare consequences of changing the choice architecture. Sludges can have economic consequences in form of direct monetary costs just like nudges can make people financially better off. These economic costs can arise although sludges and nudges do not change economic incentives significantly.

that aim to identify and measure such costs in different economic contexts. The literature on sludge has not yet agreed upon a typology.[11] Maybe the most popular typology of transaction costs was suggested by Dahlman (1979). He differentiates between (i) search and information costs, (ii) bargaining and decision costs and (iii) policing and enforcement costs. We briefly summarise this typology here because it has inspired our thoughts on a sludge-typology that is presented in the sub-section *Toward a typology of sludge*.

Dahlman (1979) suggests that people incur search and information costs when searching and collecting information before carrying out transactions. For example, consumers need to spend time and resources to obtain information about potential purchases (e.g., the quality of products and services and the trustworthiness of transaction partners), and companies need to invest time and resources to identify the prices they can sell their products for on the target market. Bargaining costs become relevant once potential transaction partners have been identified. They arise, for example, when interested parties attempt to assess the desire of other agents to participate in the transaction and to obtain information about their willingness to pay or sell. Such bargaining costs can arise in firm-to-firm transactions but are also relevant in transaction within firms and between firms and consumers. Finally, policing and enforcement costs become relevant when parties have come to an agreement and when this agreement needs to be enforced. The parties need to make sure that everybody sticks to the agreements and complies with formal or informal contracts. These costs can include the monitoring of outcomes and the level of compliance with the agreed terms and conditions, as well as the development of monitoring technologies.

2.6 Influencing factors: Specificity, uncertainty and frequency

What are the factors that influence whether transaction costs and sludge are high or low? While the literature on sludge has not yet identified a systematic answer to this question, the transaction-cost literature describes various factors that influence transaction costs (Coggan et al., 2013, Shahab et al., 2018c, McCann, 2013). The literature has mainly focused on three interrelated factors influencing

[11] The first sludge typology we could identify is by Soman et al (2019) who differentiate between process sludge, communication sludge and emotional exclusion sludge. In the literature on administrative burdens, Herd and Monahian (2019) differentiate between learning costs, compliance costs and psychological costs.

transaction costs: specificity, uncertainty and frequency (Williamson, 1985, 1996). Specificity (often referred to as asset specificity) is a "specialised investment that cannot be redeployed to alternative uses or by alternative users without a loss in productive value" (Williamson, 1996, p.377). Specificity, which has various types,[12] concerns the degree to which resources are specific to particular transactions. Some resources can be used in many domains (e.g., money, general computer hardware or math skills) and other resources are not easily re-deployable to other transactions (e.g., specific software and hardware or tacit knowledge about how an organisation works). The more specific resources are, the higher are the transaction costs when these resources need to be employed in another area.

Uncertainty can increase transaction costs when transaction partners have limited and/or asymmetric information about cost structures, prices and potential profits of the transactions. In such cases, contracts are more difficult, expensive and risky to establish (Dixit, 1996, Williamson, 1975, Saussier, 2000). Different aspects of uncertainty can be distinguished, for example in terms of volatility and ambiguity (Carson et al., 2006). Volatility concerns the rate and unpredictability of change in market conditions over time, thereby creating uncertainty over future conditions. Ambiguity, on the other hand, is "the degree of uncertainty inherent in perceptions of [market conditions] irrespective of its change over time" (Carson et al., 2006, p.1059). In other words, volatility concerns uncertain future conditions and ambiguity is about the uncertainty in present and past experiences. Both forms of uncertainty can lead to higher transaction costs.

Finally, frequency is discussed in the transaction-cost literature as an influencing factor of transaction costs. Transaction costs are higher when transactions are infrequent than when they are frequent because agents become more efficient over time through a "learning by doing" effect (Arrow, 1962).[13] Frequent transactions reduce marginal transaction costs due to the ability to re-deploy the collated information and capitalise on standardised processes and contracts. More

[12] There are different types of specificity, such as the site of production, physical and dedicated assets, human capacity (Williamson, 1981), brand name (Williamson, 1985), time of production (Malone et al., 1987) and procedural specificity (Zaheer and Venkatraman, 1995).

[13] There are interrelations between the three factors of specificity, uncertainty and frequency. Frequent transactions can reduce uncertainty over the transaction, whilst creating trust between parties involved. Likewise, asset specificity might impact the frequency of a transaction (Rørstad et al., 2007); a high degree of asset specificity might lead to low frequency.

frequent transactions of the same good or service also enable transactors to capitalise on economies of scale, and individuals' past experiences with an activity can help them to accomplish their tasks in a more efficient way.

3 Informing discussions on sludge with insights from transaction-cost economics

3.1 A definition of sludge

Viewing sludge through the lens of transaction-cost economics, we suggest the following working definition of sludge: *sludge describes aspects of the choice architecture that lead to the experience of excessive or unjustified costs*.

The *costs* in this definition refer to costs that need to be paid to make an action happen, but that do not create any value; just like transaction costs are the costs that make a transaction happen, but do not create value. Hence, this definition highlights the connection between the literatures on sludge and transaction costs and clarifies how both terms are related, i.e. that sludge can lead to costs, such as transaction costs. The definition refers to the experience of *excessive or unjustified* costs to highlight that sludge, by definition, reduces the welfare for the individuals confronted with the sludge. There are frictions and transaction costs such as decision points and cooling-down periods that are justified for several behavioural and non-behavioural reasons including programme integrity and self-control problems (see Soman, 2010; Sunstein, 2020), but following Sunstein (2020), we consider sludge as welfare-reducing and hence excessive.

The definition also captures that sludge is concerned with specific costs, namely those arising from the *choice architecture*. Other types of (transaction) costs, such as brokerage fees/commissions, legal fees and administrative charges, do not arise due to sludge because they do not directly link to aspects of the choice architecture. Linking sludge to the choice architecture highlights the close connection between sludge and the behavioural science literature which suggests that human behaviour is strongly influenced by the contexts in which we make decisions.

The definition suggests that sludge leads to the *experience* of costs. This is in line with the literature on transaction costs that emphasises the importance of perceived, rather than objective, transaction costs (Mack et al., 2019, Miharia and

Woltier, 2010) and the behavioural public administration literature which defines administrative burden (a sub-set of sludge) as the experience of cost (e.g., Christensen et al. 2020). The focus on subjective experience highlights that the same sludge can lead to different (transaction) costs for different people. For example, requiring some additional paperwork to be completed can lead to the experience of high costs for people who are currently pre-occupied with financial and other worries and thus are low on mental bandwidth (Shafir and Mullainathan, 2013). Other people, who do not perceive these worries, might not experience the same high costs of filling out the same forms.[14] Highlighting that sludge leads to experienced costs also suggests that sludge includes aspects of the choice architecture that create psychological costs such as frustration, anxiety, stigma and humiliation. These psychological and hedonic aspects are often neglected in the literature on transaction costs. Note, however, that in many situations the subjective experience of costs will align with objective costs, for example in terms of time, effort and money spent.

3.2 Toward a typology of sludge

The universe of sludging is large and there are many types of sludges (e.g., unnecessary paperwork, difficulties to opt out of newspaper subscriptions and unnecessary waiting periods). A systematic classification of these types of sludge would be beneficial. For example, it would help to develop scorecards that individuals and institutions can use to identify sludge (Soman et al., 2019).[15] It would also assist in bridging the gap between theoretical and empirical studies on sludge, particularly regarding sludge audits. Hence, we suggest a sludge typology in this sub-section.

Since our definition of sludge connects sludge to the trans\action-cost literature, relying on Dahlman's (1979) typology for transaction costs (described in the sub-

[14] The subjective element of experienced costs in our definition links to the "as judged by themselves" criterion that Thaler and Sunstein (2008) use to determine whether nudges are libertarian paternalistic or not.

[15] Soman et al. (2019) argue that a given choice architecture can be sludgy for some individuals but not for others. They argue that it can be difficult for choice architects (who are experts in their area) to emphasise with non-experts who experience sludge with detrimental outcomes. Experts can easily navigate through even complex choice architectures and thus might have difficulties identifying the effect of sludge on non-experts' behaviour. A typology will help overcome this empathy gap.

section *Types*) is a good starting point to develop a sludge typology. However, Dahlman's typology is most adequate to describe transaction costs that arise in market transactions, and sludge is also present in other situations, for example within organisations and institutions and when citizens interact with the government. Hence, we modify the typology by using broader terms that can describe most examples of sludge currently discussed in the literature. More precisely, and in line with Dahlman's three types of transaction costs, we differentiate between sludge as aspects of the choice architecture that lead to (i) search costs, (ii) evaluation costs and (iii) implementation costs.[16] We also add a fourth type of cost to account for the emotional consequences of sludge: (iv) the experience of excessive psychological costs. Below and in Table 1, we explain this typology and use it to organise some of the emerging behavioural science literature on sludge, also from behavioural industrial organisation (Akerlof and Shiller, 2015, Heidhues and Kőszegi, 2018, Bar-Gill, 2012, Grubb, 2015a). We thus demonstrate that, while there is overlap between the types, many sludges can indeed be organised into one of these four types.

3.2.1 Search costs

Sludge can increase search costs when aspects of the choice architecture make it more difficult for people to find the relevant information needed for good decision making. For example, presenting too much information can decrease the motivation to choose or the satisfaction with the finally chosen option (Grubb, 2015b, Scheibehenne et al., 2010). The order in which information is presented can also increase search costs, for example when initially low prices increase throughout the purchasing process (Gabaix et al., 2006). A product might be listed at a very low price but additional shipping and handling costs or essential "extras"

[16] Sludge is particularly relevant when individuals interact with non-human systems such as websites, booking systems and generally in online environments (Costa and Halpern, 2019). Since the term bargaining does not capture all these transactions as it implies active participation of both bargaining partners, we use the term *evaluation costs* to describe costs arising from choice architecture that makes it more difficult for people to evaluate the costs and benefits of an action. Evaluation costs include bargaining costs (or the evaluation of the willingness of the potential transaction partners to pay or sell products), but evaluation costs are not limited to bargaining costs. Similarly, *implementation costs*, as we use the term, are broader than policing and enforcement costs. They include the implementation of agreements between different parties, but also include the costs of sticking to plans people have made before and when people attempt to behave according to their intentions.

can increase this price above that of competitors, a characteristic sometimes referred to as "shrouded attributes" (Ellison and Ellison, 2009, Gabaix and Laibson, 2006). Generally, the choice architecture can determine whether prices and other product attributes are immediately visible and salient or hidden from sight, which influences how easy or difficult it is to find the relevant information. Moreover, the choice architecture can orient people's attention to one area of the product over another potentially more important dimension (Bar-Gill, 2019, Ubel et al., 2015). In the context of interactions between the government and citizens, sludge can lead to search costs when websites are so complicated that it is difficult for citizens to become aware of their eligibility for welfare benefits, tax reductions or other government benefits (Herd and Moynihan, 2019).

3.2.2 Evaluation costs

Sludge can increase evaluation costs when the choice architecture makes it more difficult to evaluate advantages and disadvantages of different options. In many cases, this creates deviations from *perceived* attributes from *actual* attributes of options. For example, the way firms communicate product features, contract terms and prices can make consumers overestimate benefits and underestimate prices of products such as credit cards, mobile phone contracts and mortgages (Bar-Gill, 2012). Moreover, predicting how consumers will use products in the future is inherently difficult, and firms can make use of this by hiding overdraft fees and credit limits in the fine print. For example, mobile phone and credit card contracts are often designed to make the evaluation of their actual prices difficult: Salient up-front costs are reduced and the less salient, hidden costs such as overdraft fees, are increased.[17] Shrouded attributes do not only increase search costs as described in the previous sub-section, they can also make it more difficult to evaluate the costs and benefits of different options.

[17] Note that the design of contracts that exploit consumer biases as described in Bar-Gill (2012) is not necessarily sludge. When companies decide to reduce salient prices and increase hidden prices, they do not change the choice architecture but rather change incentives. However, sludge can be present when companies change the choice architecture to highlight or hide certain product attributes.

3.2.3 Implementation costs

Sludge can lead to higher implementation costs when the choice architecture makes it more difficult for people to get what they want and avoid what they do not want. For example, after people have evaluated the costs and benefits of receiving a monthly service and decided to cancel the service, they must implement that decision. Sludge can make this implementation very difficult when the cancellation process is made complicated and long. Similarly, excessive paperwork and form filing requirements can make it more difficult for people to participate in government programs, for example when information needs to be provided multiple times, when one's status needs to be certified although the government is the certifying institution, when submissions are required to be sent by postal mail rather than digitally or when people are required to actively renew their participation in welfare programmes (Herd and Moynihan, 2019). As many researchers will know, applying for third-party funding can be easy or difficult depending on the administrative requirements in one's institution and these differences can be described as implementation costs.

3.2.4 Psychological costs

A main gap in the transaction-cost literature is the acknowledgment of psychological costs of frictions. The literature on sludge, on the other hand, frequently refers to psychological costs (Sunstein, 2020).[18] For example, Hattke et al. (2020) show in a laboratory experiment that bureaucratic red tape creates negative emotional responses as measured using facial recognition technology. Other examples of psychological costs of sludge include the stress in dealing with unnecessary frictions with the underlying worry of the risk of losing important benefits, embarrassment that might arise when people need to apply for welfare benefits, self-image concerns related to the requirement to tell others how miserable one is to get welfare benefits, the stigma of participating in programmes, loss of personal autonomy, a sense of unfairness and animosity among public servants who administer programs (Herd and Moynihan, 2019). For choice architects it can be difficult to anticipate these psychological effects of

[18] Here (and in other instances) the literature on sludge cites insights from the administrative burden literature which places emphasis on citizen experiences with welfare administration (Herd and Moynihan, 2018).

sludge because the designers of the choice architecture may not have experienced these emotions first-hand. Hence, the empathy gap between the choice architect and the end user is likely strongest when it comes to psychological costs (Soman et al., 2019).

Table 1 A typology of four different types of sludges leading to different costs

Type of cost	Definition	Examples
Search costs	Choice architecture that makes it more difficult to acquire relevant information about different options.	Offering too many options; Confusopolies; Ordering of search results by profit margins rather than price.
Evaluation costs	Choice architecture that makes it more difficult to evaluate advantages and disadvantages of different options.	Hiding add-on costs and extra fees; Untrue discount claims and moon pricing; Long and confusing fine print.
Implementation costs	Choice architecture that makes it more difficult to get what you want and avoid what you do not want.	Hidden subscriptions; Automatically renewing subscription; Unnecessarily complex paperwork; Difficult return policies; Complicated tax filing.
Psychological costs	Choice architecture that creates negative experiences such as stress, stigma, disempowerment and loss of autonomy.	Misleading messages that put psychological pressure on buyers to purchase; Misleadingly highlighting the popularity of a product; False scarcity messages; Pressure selling.

3.3 Factors influencing sludge

As summarised in section *Influencing factors*, the transaction-cost literature suggests that, *inter alia*, specificity, uncertainty and frequency influence how low or high transaction costs are. These three factors are also important determinants

of whether a choice architecture is sludgy or not. First, a highly specific choice architecture can make a change of setting more costly. For example, people may have developed the skills to navigate through the choice architecture of a specific software in their organisation. This skill is of limited use in other organisations where people need to navigate through a different choice architecture that can be complex to navigate in at the start. If that is the case, specificity of the choice architecture can be a form of sludge as it creates implementation costs related to the move from one organisation to another.

Second, a choice architecture that creates uncertainty can be considered sludgy. For example, sludge is present when companies present their products in a way that shrouds product attributes (Gabaix et al., 2006) or when information about the most likely future product use patterns is limited (Bar-Gill, 2012). In these cases, the choice architecture makes it more difficult for people to find the optimal products and/or evaluate all present and future costs and benefits of the products correctly (thus increasing search and evaluation costs). To the contrary, when the choice architecture reduces uncertainty, decisions are easier to make as less costs are present. A choice architecture characterised by high uncertainty may also lead to psychological costs due to perceptions of lower autonomy, agency or locus of control when trying to make good decisions in such complex environments.

Finally, the extent of sludge in a choice architecture can also be influenced by the frequency of navigation in this choice architecture. When people first encounter a new choice architecture, they often experience high costs. However, once people have learned to navigate in this choice architecture, it becomes less sludgy for them as they experience less search, evaluation, implementation and psychological costs over time. A choice architecture can be particularly sludgy when people encounter the choice architecture only infrequently (for example, once a year for the tax returns). Such infrequent requirements to navigate through a largely unchanging choice architecture provide business opportunities for third parties to become experts in these choice architectures by re-using collected information and re-deploying resources again and again. This allows them to become helpful guides in choice architectures that appear complex and alien to most people.

3.4 Sludge audits

Arguably the main reasons to better understand sludge are to be able to identify it, to conjecture about its welfare consequences and to develop ways to reduce sludge if deemed necessary (Soman et al., 2019, Sunstein, 2019b). To identify sludge as a first step in this process, Sunstein (2020) suggests using "sludge audits." He argues that private and public organisations can engage in annual sludge audits to identify where and when sludge exists and whether it needs to be reduced. Periodic lookbacks at existing sludge can be conducted to identify the current stock of unnecessary requirements posed to employees and civil servants as well as customers and citizens. To measure sludge, he differentiates between time-related costs, financial costs and psychological costs (see also sub-section *Measurement: Direct and indirect costs*). When conducting sludge audits, Sunstein argues, cost-effectiveness and cost-benefit analyses should be considered,[19] and a mix of quantitative and qualitative approaches should be used to look at sludge on a case-by-case basis (Sunstein, 2020).

The insights from the transaction-cost literature, some of them presented in the previous sections of this paper, may provide additional guidance on how to design sludge audits. Transaction-cost economics has developed a large body of literature that addresses questions on how to measure transaction costs in theoretical, empirical and methodological contributions (Shahab et al., 2018a, McCann and Easter, 1999, Coggan et al., 2015, McCann et al., 2005, Jaraite et al., 2010). Referring to this literature and the previous insights presented in this paper, in what follows we present five crucial aspects to be considered when conducting sludge audits: (i) breaking up the processes into required actions, (ii) choosing the appropriate methods, (iii) recruiting the relevant participants, (iv) asking the right questions and (v) communicating the benefits of sludge audits.

3.4.1 Breaking up the processes into required actions

Most sludge audits will proceed in two steps. The first step is to break up more complicated processes into smaller sub-processes. This is essential to keep the

[19] Cost benefit analyses may often be impossible in the context of the quantification of sludge. Sunstein (2020) suggests that an alternative to the cost benefit analysis is to make assessments of proportionality, asking whether there are significant costs from the sludge and whether these serve significant purposes.

audit manageable and to identify the specific interventions that can reduce sludge in certain situations. A potential problem arises in this process as, theoretically, each sub-process could be further divided into more and more sub-sub-processes (Shahab et al., 2018b, Tan et al., 2012). To avoid endless divisions into smaller processes, a basic unit of analysis needs to be identified. In the transaction-cost literature, the basic unit of analysis is the transaction (Williamson, 1998), defined as the transfer of property rights regarding goods, services, information, knowledge or ideas (Williamson, 1996). For sludge audits, we suggest using the "required action" as the basic unit of analysis. The required action would be defined as each step that has to be taken in a decision-making process to achieve one's goal. The concept of the required action is somewhat broader than the concept of the "trans-action", because sludge can also be present when only a single individual makes a decision and no other people are involved who could be the receiver of a transaction. Practically, sludge auditors can ask relevant interview/survey participants to describe the process of, for example, applying for a visa, filing a tax return or completing a form by breaking down the process into the different actions required. In the second step, a sludge auditor would then analyse each required action using methods/questions as presented in the next sub-sections.

3.4.2 Choosing the appropriate method

The transaction-cost literature uses various approaches to measure transaction costs. For example, McCann et al. (2005) identify five different sources of information for measuring transaction costs: (i) interviews or surveys of people and parties involved in transactions, (ii) secondary data from other studies, (iii) government reports, (iv) financial reports and (v) proposed budgets. However, the most common way to collect data about the size of transaction costs is to use surveys and/or interviews (see for example Falconer and Saunders, 2002, Shahab et al., 2018a, Fang et al., 2005, Kuperan et al., 2008, Ofei-Mensah and Bennett, 2013). The main reason for the use of interviews and surveys is that other methods and data sources are not always available to obtain information regarding both *ex-ante* and *ex-post* transaction costs (McCann et al., 2005). As such, the most common methods to conduct sludge audits will likely be interviews and surveys as well. Moreover, to start the sludge audit, it is advisable for auditors to go through the process themselves, if possible, attempting to gain a first-hand experience. To bridge the "empathy gap" (Soman et al., 2019), auditors can alternatively ask a

non-expert to go through the process. Additional methods, such as face recognition experiments to measure psychological costs (Hattke et al., 2020), are likely to become more common over time.

3.4.3 Recruiting the relevant participants

If sludge auditors decide to use interviews and/or surveys to collect data regarding each of the required actions, the next step will be to recruit the relevant participants. Some studies in the transaction-cost literature separate this process into three steps (Shahab et al., 2018a): (i) defining the population of interest, (ii) deciding on a sample size and (iii) selecting a sampling strategy. The population of interest would be a set of all people who are eligible to be interviewed/surveyed in a sludge audit. To define the population of interest, either inclusion (i.e., everyone who has a specific characteristic such as the population who uses a particular product or service) or exclusion (i.e., everyone who does not have the specific characteristic) criteria can be used. Deciding on the size of the sample of participants depends on the chosen method. In quantitative surveys, the sample size needs to allow for statistical generalisability and power analyses can be helpful. In qualitative interviews, the aim is to reach data saturation, which describes the point at which no new additional data or no further insights are generated from data collection (Guest et al., 2006). Finally, regarding the sampling strategy, the auditors can choose between different types of purposive and/or random sampling strategies, depending on the main objectives of the audit and the chosen method.

3.4.4 Asking the right questions

The second step in most sludge audits will aim to identify sludge related to each of the required actions. To identify valid topics to discuss and questions to ask, it can be helpful to refer to the definition of sludge, the sludge typology and the influencing factors that we have described above. For example, a good start is to ask participants to indicate whether they experienced costs in the process of enacting the required action. It is worth noting that these costs can be financial (direct costs) or related to lost time or psychological burden (indirect costs). Follow-up questions can then ask whether participants experienced specific types of costs (i.e., search costs, evaluation costs, implementation costs and psychological costs). For example, questions about what made it difficult for

participants to acquire relevant information, to evaluate advantages and disadvantages of options and to get what they wanted and avoid what they did not want can be asked. Similarly, sludge auditors can directly ask about negative experiences such as stress, stigma, disempowerment and loss of autonomy.

Once these different costs have been identified, sludge auditors can ask participants to reflect on the sources of these costs, highlighting supposedly irrelevant factors related to the choice architecture. In particularly, sludge auditors can invite participants to reflect on the specificity, uncertainty and frequency of the choice situation. It may be helpful, for example, to ask participants whether they are able to transfer knowledge from one experience to the next, whether they knew how to complete the required action or whether they perceived uncertainty and whether the process would get less costly each time they go repeat it.

3.4.5 Communicating the benefits of sludge audits

For sludge audits to happen, it is essential to get some buy-in from the relevant actors in industry or policy. To obtain this buy-in, it is important to clearly demonstrate the relevance of thinking about the choice architecture and design aspects, rather than thinking only about institutional rules. It can be helpful to communicate some key insights from the behavioural sciences about predictable decision-making biases and the related importance of context effects to highlight why it is important to also consider the choice architecture. Moreover, potential auditors might be experts in the choice architecture that might benefit from a sludge audit. This can lead to an empathy gap, making it difficult for the experts to "see sludge" (Soman et al., 2019). Hence it is important to highlight the subjective nature of sludge; that what is sludge for one person is not sludge for another person. Finally, it might be better to avoid using negative language. Both the words "sludge" and "audit" may be perceived as threatening and public officials as well as industry representative may be more open to "behavioural process reviews", "tests for regulatory load" or "transaction costs measurement" than for "sludge audits".

4 Summary and Conclusion

This paper shows that sludge and transaction costs are related, but distinct concepts. It suggests that the behavioural science literature on sludge can benefit from incorporating concepts and methods developed in the new institutional

economics literature on transaction costs. First, it suggests defining sludge as aspects of the choice architecture that lead to experienced excessive and unjustified (transaction) costs. Second, it presents a new typology of sludge that differentiates between aspects of the choice architecture that lead to the experience of (i) search costs, (ii) evaluation costs, (iii) implementation costs and (iv) psychological costs. Third, the paper shows that specificity, uncertainty and frequency are factors that influence transaction costs as well as how sludgy a choice architecture is. Finally, building on the discussed contributions, the paper presents some pragmatic considerations for conducting sludge audits.

Once sludge audits have been conducted, the next step is to reduce the previously identified sludge where adequate. While "sludge reduction" is beyond the scope of the current paper (see Sunstein 2019, Sludge and ordeals, for a discussion on sludge-reduction), we do provide an outlook on future work on this topic. First, our definition of sludge suggests that sludge reduction refers to changes in the choice architecture that remove those aspects that create experienced search costs, evaluation costs, implementation costs and psychological costs. Sludge reduction policies might well differ depending on the type of sludge. Second, while we have focussed on changing the choice architecture in this paper, our definition of sludge also allows an alternative avenue of sludge reduction: It is possible to educate people to be aware of sludge in its different facets and to help them navigate through the choice architecture efficiently. Such educational strategies could be considered a specific form of "boosting" (e.g., Grüne-Yanoff and Hertwig, 2016). In fact, merely providing a language to describe the hassle related of administrative burdens and other frictions of everyday life might already be enough for self-reflective individuals to experience less costs when navigating through complex choice architecture. Third, sludge is often reduced by private agents when intermediaries (for example, consultants, lawyers and the tax preparation industry) take care of our paperwork for us. Finally, when sludge is intentional, governments may also consider mandating sludge reductions and thus engage in specific forms of "budging", i.e. the governments' uses of behavioural economic findings to inform where and how to regulate the private sector (Oliver, 2013).

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