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IZA DP No. 11454

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ABSTRACT

Nudging in Education*

Can we nudge children, adolescents and their parents to make better decisions on education? And can we nudge teachers to support and encourage better decision making? Education decisions are taken at young ages and involve immediate costs and potential, future benefits. In such settings behavioural barriers (e.g. lack of self-control, limited attention and social norms) likely influence choices and this may motivate the use of low cost 'nudges' to gently push behaviour in the desired direction. Our review of nudging interventions shows that while nudging often has positive effects, the greatest effects often arise for individuals affected most by the behavioural barrier targeted by the intervention. Hence understating underlying behavioural mechanisms is crucial. Negative effects may arise in situations where nudges potentially crowd-out intrinsic motivation, if nudges pressurise individuals, or in situations where the choice architect has an insufficient understanding of behavioural mechanisms.

JEL Classification: D03, D04, I20

Keywords: behavioural bias, boost policies, human capital investment

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* An earlier version of this paper entitled 'The use of nudges and other behavioural approaches in education' has been circulated as EENEE Analytical Report No 29. We thank the editor Daniel Rees, two anonymous referees, two anonymous EENEE reviewers, Fabian Kosse, Hannah Schildberg-Hörisch and Felix Weinhardt for comments.

[P]eople will need nudges for decisions that are difficult and rare, for which they do not get prompt feedback, and when they have trouble translating aspects of the situation into terms that they can easily understand.
— Richard H. Thaler and Cass R. Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness*

1. Introduction

Globalisation and rapid technological progress have increased the focus on educational attainment and efficient investment in high-quality skills. In many countries there is a political desire to reduce student dropout, and underperformance on PISA tests is an area of concern (e.g. European Commission, 2016). Another issue on the political agenda is the assumed underinvestment in non-cognitive (or socio-emotional) skills from early life throughout the educational career (e.g. Kautz et al., 2014). These issues highlight the relevance of policies that gently push children and youths in the desired direction of further skill attainment and better decision-making when it comes to their educational pathways.

At the same time, the past 10–20 years have seen a steady increase in the use of behavioural economics to inform intervention design across a wide range of research and policy areas. Academics are increasingly adopting *nudging* policies aimed at "*alter[ing] people's behaviors in a predictable way without forbidding any options or significantly changing their economic incentives*" (Thaler & Sunstein, 2008), and the 2017 Nobel Prize Laureate in Economics, Richard Thaler, coined nudge theory which has proven imperative for understanding individual decision making. Pioneered by the Behavioural Insights Team in the UK, international organisations and governments around the world have established "Nudge units" which have the specific aim to use behavioural tools in policy making. The popularity of nudging interventions among policy makers is partly due to the potential for high benefit–cost ratios, and partly due to early studies documenting large desired effects of nudging (e.g. Madrian & Shea, 2001; Thaler & Benartzi, 2004).

In education policy the use of nudging has risen sharply in the last few years. This is exemplified by the MineduLAB in Peru which was established in 2016 as a special "Nudge unit" within the Ministry of Education. More generally the growing importance of nudging is evident by the papers included in this review. We identified a total of 122 studies of nudging interventions in the education sector, 57 of which were published as working papers or in academic journals since January 2016.

It is not surprising that nudging is receiving increased attention in education research. The economics of education has traditionally relied heavily on the human capital model, which emphasises the long-term investment aspects of schooling decisions. Accounting for the fact that many education-related decisions are difficult, rare and taken at young ages before the brain is fully developed, there is scope for numerous behavioural biases, and the field lends itself to approaches from behavioural economics (as synthesised in Jabbar, 2011; Koch, Nafziger & Nielsen, 2015). Understanding these behavioural biases can motivate interventions that mitigate their detrimental effects by de-biasing and/or nudging.

The contribution of this paper is to distil research, which employs field interventions that work through *nudging*. Our goal is to provide an overview of studied nudging interventions and their effectiveness in terms of effects on student outcomes in the education sector from pre-school through higher education;[1] that is, when

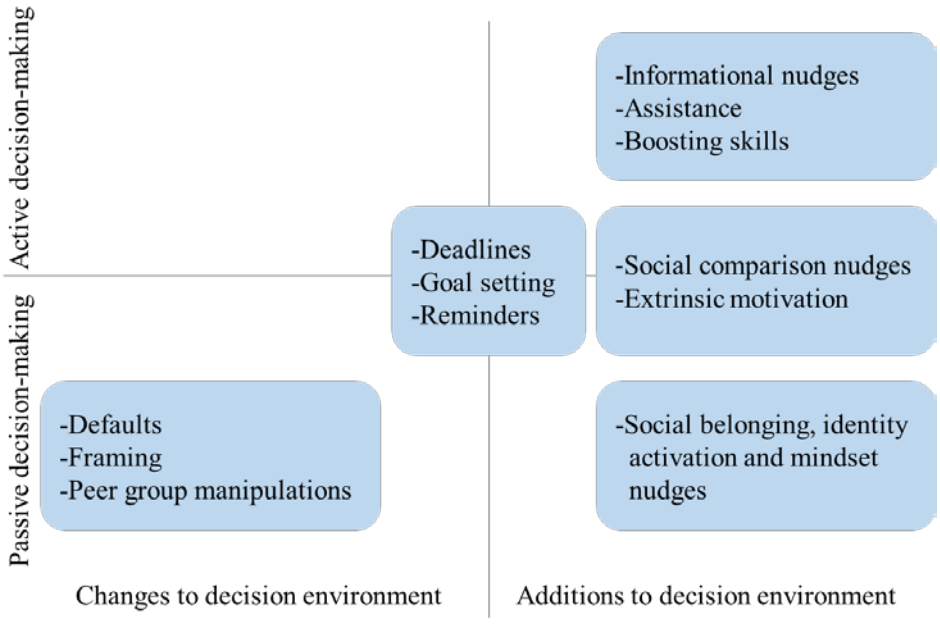
[1] List et al. (forthcoming) discuss behavioural economics in the context of early childhood interventions, which is beyond the scope of this paper.

and under what conditions can the education decisions of children, adolescents, parents and teachers be nudged?

Other recent review papers have considered related topics. Jabbar (2011) and Koch, Nafziger & Nielsen (2015) discuss behavioural and psychological factors influencing education decisions and do not focus on field or nudging interventions. Lavecchia et al. (2016) synthesise evidence from field interventions addressing a set of specific behavioural challenges and do not solely focus on nudging nor do they draw conclusions on what works for different types of interventions or for whom. French & Oreopoulos (2017) review empirical evidence for simplifying the transition to higher education; their scope is, thus, more limited than ours. Escueta et al. (2017) review interventions using new education technology and while there is some overlap with our review, their review only includes interventions if they involve the use of information technology whereas we only consider interventions that involve nudging or related behavioural policy tools.

Recent empirical work suggests that nudges sometimes backfire from a social welfare perspective (see e.g. Carroll et al., 2009; Handel, 2013; Damgaard & Gravert, 2018). It is therefore critical to synthesise the circumstances under which nudging may and may not be successful. Empirical studies have also revealed that nudges may have very heterogeneous effects (see e.g. Allcott, 2011) and as a result it may be desirable to use targeted rather than universal nudges. Furthermore, as argued by Mullainathan and Shafir (2013) behavioural interventions may be particularly relevant and effective when individuals face economic or social scarcity because it occupies attention and potentially impedes good decision making. We study the empirical support for this conjecture by discussing differential effects of interventions for students and parents with high and low socio-economic status (SES). We also discuss differential effects at different stages in the education sector (e.g. primary school, secondary school, university). Our hope is that the review will be valuable to both academics and policy makers by advancing the common understanding of how, when and why nudging can be used to improve education outcomes. This knowledge can hopefully inform future education policies and interventions.

Figure 1: Typology of nudging interventions considered in the review



Note: Passive decision-making is sub-conscious, whereas active decision-making is conscious decision making.

As a consequence of our delimitation to studying nudging, we do not fully represent the vast literature on interventions that explicitly aim to offset immediate costs with immediate benefits, nor do we include interventions that impose mandatory requirements or in other ways restrict the choice sets. However, the definition of nudging provided by Thaler & Sunstein (2008) still gives some leeway for interpretation.

In figure 1 we provide an overview of the types of interventions considered in this review classified by two dimensions: 1) whether the interventions are likely to induce active or passive decision-making and 2) whether they involve changes or additions to the decision environment. We include so-called 'pure' or 'non-educational' nudges (e.g. defaults, framing and peer group manipulations) that target systematic biases in behaviour through (small) changes to the decision environment that potentially work sub-consciously without promoting active decision-making. We also include deadline, goal setting and reminder interventions that induce people to utilise these behavioural tools in a specific situation where they may otherwise fail to use them sufficiently to self-regulate their own behaviour. Deadline, goal setting and reminder interventions therefore alter the decision environment by exogenously imposing use of already available tools and as a result may change behaviour through better active or passive decision-making. In addition, we include more 'educational' nudges (e.g. informational nudges and assistance) that probably lead to better active decision-making by adding new information or basic assistance to the decision environment. However, like 'pure' nudges, these 'educational' nudges may also influence behaviour subconsciously, e.g. by making certain information more salient. We also include so-called 'boost' interventions deliberately aimed at improving active decision-making capabilities by teaching individuals about behavioural barriers and skills to tackle these barriers (Grüne-Yanoff & Hertwig, 2016)[2]. Moreover, we include social comparison nudges and nudges using extrinsic motivation. These nudges add information or rewards that consciously or sub-consciously motivate individuals to change their behaviour. The added motivation may or may not lead to more active decision-making. Finally, we include brief psychological interventions that target students' mindsets and beliefs (e.g. social belonging, identity activation and mindset nudges) with the aim of creating a self-reinforcing but sub-conscious improvement in motivation and achievement (Yeager & Walton, 2011; Walton, 2014). Both brief psychological interventions and boost interventions are similar to many informational and social comparison nudges in the sense that they aim to de-bias behaviour by adding specific and brief information to the decision environment. Furthermore, as the psychological interventions are brief there is a relatively short interaction with the target population and implementation costs (even at scale) are typically low as for 'pure' nudging interventions. However, unlike 'pure' nudges the goal of boost and brief psychological interventions is to influence behaviour not only in the specific decision environment in which the information is provided but also in other contexts and long into the future.

By synthesising and comparing findings across studies undertaken in different environments and populations, our review contributes with empirical evidence to the discussion of whether and to what extent the effects of experimental interventions is generalisable beyond the original research context (Bracht & Glass, 1968). For policy design it is crucial to understand whether results from one intervention are externally valid (Camerer, 2015) and under what circumstances interventions are scalable. When possible, we address these issues in our discussion but we note that scalability inevitably depends on how interventions are delivered and that it may only arise if interventions are properly adapted to local contexts (Yeager & Walton, 2011). Furthermore, we include both interventions designed from a policy view in which case the studies aim to be generalisable and

[2] Boost interventions are also sometimes referred to as 'educate' interventions (Katsikopoulos, 2014)

studies designed from a research view in which case generalisability is not per se a goal but instead the studies may aim to provide information about principles and mechanisms driving human behaviour (Camerer, 2015).

Some overarching conclusions emerge from our review. It clearly shows that few interventions produce positive effects for everyone and some nudges even have negative effects. In general, beneficial effects are more likely for specific groups constrained by a behavioural barrier. Our review therefore points to a general need to carefully consider underlying behavioural mechanisms and formulate a theory of change. This should enable policy makers and researchers to target interventions and better predict intervention effects.

Remembering that effects are generally heterogeneous and that untargeted interventions are rarely effective, more specific conclusions also emerge for each type of intervention. First, interventions involving passive decision-making often have broad and long term effects on overall student outcomes. However, if behaviour is in fact caused by active decision-making (e.g. peer group manipulations) or if interventions are not significant enough to produce effects then they are likely ineffective. Second, interventions that add information, assistance or skills to the decision environment often have positive effects suggesting that students and parents are motivated to make better education choices but are unable to do so. Third, nudges that rely on possibly underutilised self-regulatory tools (deadlines, goal-setting and reminders) often have positive effects, in particular if people are highly motivated, if the intervention involves specific tasks that may otherwise be procrastinated and if sufficient time is provided allowing people to change their behaviour. Fourth, the motivational nudges (social comparison nudges and nudges using extrinsic motivation) have heterogeneous - and in some cases negative effects. However, if people perform below the norm or attach a high value to receiving a reward (e.g. young children) then performance and motivation tends to improve as a consequence of the intervention.

The remainder of the paper is organised as follows: Section 2 provides a brief introduction to the behavioural economics of education. Section 3 is the core of the paper and presents the review of nudging interventions organized according to the typology in Figure 1. Section 4 concludes.

2. Behavioural barriers to educational attainment

The traditional view on educational attainment comes from the early studies of Mincer (1958), Schultz (1961), Becker (1964) and Ben-Porath (1967), among others, who regard education as a core component of the human capital stock. According to this line of thinking, agents invest time, effort and money in education, which provides knowledge and characteristics enhancing productivity and, thus, lifetime earnings. Teachers and parents provide key inputs into the education production function and empirical studies have found positive effects of parent involvement (Andersen & Nielsen, 2016) as well as both short and long run effects of teachers (Jackson et al., 2014; Chetty et al., 2014) on student outcomes. Empirical evidence also suggests that the return to education may be sizable. For example, Heckman et al. (2006) report large internal rates of return for schooling under rather flexible assumptions and find that the returns are particularly large for secondary school completion in the US. A more recent study, Bhuller et al. (2017), finds that even in a country like Norway, with its progressive tax and pension systems, the internal rate of return from schooling is around 10%. Education also has non-productive benefits on crime, health and good citizenship (Lochner, 2011).

At each stage in the education cycle, the agent should in principle weigh the costs and benefits of education and decide whether to pursue further education. Considering the high estimated financial and non-financial returns, it remains puzzling why individuals drop out or perform poorly in education. Insights from behavioural

economics may provide some of the answer. This section briefly discusses key concepts from behavioural economics, highlighting their relevance for education decisions.[3] We note that students, parents and teachers are all potentially affected by behavioural barriers.

2.1 Self-control

Decisions on education and other investment decisions have long-term consequences. Investing time and effort in studying or attending classes involves a trade-off between immediate costs (effort costs and foregone earnings) and future benefits (higher future income). When making these intertemporal trade-offs, students and their parents may be influenced by present-biased preferences (see e.g. Laibson, 1997). This may cause self-control problems where students do not properly regulate their own behaviour to achieve long-term goals. For example, while students who start secondary school may clearly prefer graduating over dropping out, they might fail on an everyday basis to resist the temptation to do something more enjoyable than studying or attending class. This could lead to declining class participation. Evans et al. (2016) show empirically how student participation may be declining over time. Students with self-control problems also tend to put off important decisions, such as what university to apply to. Moreover, students with self-control problems may lack non-cognitive skills, such as grit and perseverance.

In the context of education decisions, it is worth noting that children and adolescents are particularly likely to be influenced by self-control problems (Green, et al. 1994; Bettinger & Slonim, 2007), because their brains and in particular their executive functions are less developed.[4] There is also evidence indicating that boys are more impatient than girls (Duckworth & Seligman, 2006) and therefore more likely to have self-control problems. Empirical evidence suggests that individuals who are impatient are more likely to drop out of school despite having higher expected returns, and they are more likely to express regret at middle age and earn significantly less on average than their patient counterparts (Cadena & Keys, 2015). Parents, who are an important influence on early-life education decisions, could potentially compensate for their children's poor self-control. However, self-control problems are correlated with low-SES (Mischel, et al., 1989; Golsteyn, et al., 2014), meaning that both low-SES children and parents tend to lack self-control and parents may thus be unable to compensate for their children's lack of self-control.

2.2 Limited attention and cognitive ability

Cognitive and attentional limitations might pose an important barrier to good decision-making for complex choices such as education decisions. Standard economic theory assumes that individuals consider all of the relevant alternatives and all of the available and cost-free information when making decisions. For example, when applying to college, prospective students should – in theory – consider all possible alternative colleges and fields, seek out all information about those alternatives and then make an informed choice about what to study and where. In practice, attention may, however, better be viewed as a scarce resource (DellaVigna, 2009) and as a result some information may (intentionally or unintentionally) be overlooked or forgotten. For example, there is evidence that students lack accurate information about the returns to education (Oreopoulos & Dunn, 2013; McGuigan et al., 2016), even though such information is freely available.

Interventions outside the area of education policy suggest that people faced with complex choice may react adversely to more alternatives and simply fail to choose (Iyengar & Lepper, 2000; Choi, et al., 2004; Bertrand,

[3] For a more detailed introduction to barriers to decision making discussed in behavioural economics and a broad discussion of the available evidence, see e.g. DellaVigna (2009). For discussions in the context of education economics, see Koch et al. (2015) and Lavecchia et al. (2016).

[4] See e.g. Lavecchia et al. (2016) for a review of the literature on brain development.

et al., 2010). In education policy, the complexity of administrative processes such as student aid applications may be a barrier to educational attainment (Dynarski & Scott-Clayton, 2006) and limited attention may make students forget to do tasks such as homework. The evidence also suggests that (as with self-control problems) the effects of limited attention and cognitive ability are greater for low-SES students (Avery & Kane, 2004) and attention problems and hyperactivity are related to reading difficulties and low academic achievement (McGee et al. 2002).

People may adopt a number of heuristics to simplify the complex choice situations (DellaVigna, 2009). For example, people may place excessive weight on the most salient information or option when making decisions (Bordalo et al., 2012). It is likely that, the costs of attending university are more salient than the benefits because tuition costs are paid up-front and featured in university materials. The overemphasis on salient information implies that decisions may be sensitive to informational nudges and framing.

2.3 Loss aversion

Experimental studies have consistently shown that people evaluate outcomes relative to a reference point. As an illustrative example, suppose that a student applies for financial aid and receives a study grant covering half of his tuition fees. If he had expected to get two-thirds of the costs covered, then such a grant will be disappointing. Conversely, if he had only expected to get one third of their costs covered, the same grant would feel like a surprising gain. Experimental evidence suggests that a loss relative to the reference point looms larger than an equal-sized gain. As captured by several referent-dependent theories (Kahneman & Tversky, 1979; Köszegi & Rabin, 2006; Köszegi & Rabin, 2007), this loss aversion leads to a strong aversion to downside risk.

Investing in education involves some uncertainty with respect to the possible gains; consequently, students may underinvest in education to avoid possible losses. Furthermore, parents' education level might serve as a natural reference point for educational attainment (Page, Garboua & Montmarquette, 2007) implying that children from low-SES backgrounds have a lower reference point than those from high-SES backgrounds. Within this line of reasoning, children experience a loss of utility if they do not reach at least the education level of their parents. Hence, loss aversion provides an additional explanation why high-SES children on average attain a higher level of education than low-SES children.

2.4 Default bias

A common empirical finding is that people tend to stick to the default (Kahneman et al., 1991). This is known as the default bias. Default bias relates to several of the concepts mentioned above. First, limited attention means that people do not pay adequate attention to other options, because the default is the most salient option. Second, loss aversion often leads to a default bias because the default serves as a natural reference point. Finally, present bias combined with immediate switching costs could make people stick to the default.

In the context of education, the default bias might help explain why some parents refrain from exploiting the opportunity to choose a primary school for their child. As people with low-SES are more likely to be influenced by present bias and attention limitations, they are also potentially more likely to be influenced by defaults.

2.5 Self- and social-image and social norms

Education choices may have important effects for how people perceive themselves and are perceived by others. Typically, people care about how they are perceived and may go to some length to preserve a favourable social-image and self-image (as demonstrated in the laboratory experiments by Falk & Szech, 2016). This can be captured by social-image and self-image concerns (Benabou & Tirole, 2002; Benabou & Tirole, 2006) and

might explain why some people make so-called self-handicapping choices (i.e. choices in conflict with their own interests). For example, going out drinking the night before an important exam could be motivated by an interest in maintaining a favourable self-image, because it allows the student to attribute poor exam performance to being hungover rather than limited ability.

Social identity is closely related to image concerns. People like having a sense of social belonging, and one means of achieving that is by using one's actions to reveal information to others (Austen-Smith & Fryer, 2005). Hence, actions may be motivated by the reputational effects in terms of shaping one's image and social identity. In turn, this may lead to preferences (Akerlof & Kranton, 2002; Benabou & Tirole, 2006) or social pressure (DellaVigna, 2009) for following the social norms in one's social comparison group. In the context of education, it is worth noting that the prevailing social norm may in some cases be detrimental to education attainment (Akerlof & Kranton, 2002; Austen-Smith & Fryer, 2005). For example, it may be the norm *not* to exert effort, to skip classes or to drop out of secondary school. In other cases, the social norm may be conducive to education attainment, such as a norm to obtain a university degree. Hence, the perspective of the individual, social norms may lead to underinvestment in some circumstances, overinvestment in education in others.

2.6 Biased beliefs

In order to make education choices, individuals are required to form beliefs about, for example, how likely they are to graduate, how easy it will be to find a job, etc. Evidence suggests that beliefs about the probability of events are often biased (Kahneman & Tversky, 1979), that people tend to be overconfident in their own abilities (Benabou & Tirole, 2002), and that people are influenced by projection bias, meaning that they wrongly believe future preferences will be identical to current preferences (DellaVigna, 2009).

Self-confidence in own ability has been shown to be positively correlated with academic performance and female students have been shown to be less confident than males (Tavani & Losh, 2003). However, confidence may be biased. It is not obvious whether overconfidence (with respect to ability) has a negative or a positive causal effect on effort provision (Benabou & Tirole, 2002). If effort and ability are complementary, then overconfidence is predicted to increase effort provision.[5] In other situations, such as in the context of 'pass/fail' exams, effort and ability could be viewed as substitutes, and overconfidence is then predicted to have a negative causal effect on effort provision because students (wrongly) believe that their high ability level can substitute for study effort. Opposite effects are predicted for underconfident students.

Projection bias has potentially different effects. Students influenced by projection bias may not fully recognise that their life situation and needs change over time, regardless of their education choices. Instead they may think that the current situation is a good predictor of the future. Hence, education choices (e.g. whether or not to move to a different part of the country to obtain a certain university degree) may be made given their current life situation and preferences and not taking their future life situation and preferences into account.

3. Applications of nudges in education

The existence of behavioural barriers influencing decision-making may motivate interventions that target these barriers and potentially try to remove them. This section provides an overview of the use of nudging in education. The discussion is organised according to the intervention type. For each type of intervention, we first discuss which behavioural barrier(s) the intervention targets and/or exploits. We then discuss the empirical

[5] Chen and Schildberg-Hörisch (2017) present empirical evidence consistent with this effect of overconfidence.

evidence for its effects on student outcomes. Each subsection includes a summary table listing the interventions included in our review.

3.1 Defaults

One of the most well-known approaches to nudging is to change defaults. Because of default bias, people tend to choose the default option and as a result changing defaults can be a powerful policy tool. Marx & Turner (2017) provide a recent example of nudging with defaults in the education sector. Applicants accepted into a community college in the US were randomly assigned to treatment and control. Students in the treatment group received material with a nonzero loan offer whereas students in the control treatment received a $0 loan offer. The change of default was a 'pure' nudge as it did not influence eligibility for the loan nor did it require students to take the loan. Marx & Turner (2017) find that students who received the non-zero loan offer were more likely to borrow and more likely to borrow the default amount. In addition, there were positive effects on attempted and earned credits and the grade point average. The intervention did not influence enrolment and it is too soon to properly assess the effect on graduation.

Bergman & Rogers (2017) also study a default intervention. The intervention tested the impact of an opt-out vs. an opt-in default for adoption of a text messaging service for parents of middle and high school children in the US. The text messaging service provided information about their child's performance, missed classes and missed assignments. Consistent with findings for opt-in vs. out-out interventions in other domains (Madrian & Shea, 2001; Johnson & Goldstein, 2003), the study found a large difference in the share of parents adopting the technology with 7.8% adopting in the opt-in treatment and 96.5% adopting in the opt-out treatment. That is less than 4% of parents in the opt-out treatment, opted out at any point during the school year despite being given several opportunities to do so. The authors also found that parents who opt in were those who were already engaging more with the school and the parents of already high performing students. Hence, an opt-out default could reach a population of parents who were otherwise harder to reach. The authors also reported positive effects of the opt-out default on grades and the number of courses failed. This suggests that exposure to the messages translated into improved performance at school.

Although the two default interventions target very different behaviour and different target populations, the evidence so far suggests that defaults can positively influence student outcomes such as grades and earned course credits (see Table 1 for an overview). This is consistent with the positive effects of default interventions found in other domains.

Table 1: Studies using Defaults

Paper	Target group	Intervention	Outcome	Effect
Marx & Turner (2017)	US. Community college students.	Default loan amount	Borrowing	Positive
			Grades	Positive
			Attempted and earned course credits	Positive
			Enrollment	No
			Graduation	No
Bergman & Rogers (2017)	US. Parents of children middle and high school children.	Opt in vs. opt out of text messaging service	Adoption of text message service	Positive
			Grades	Positive
			Number of courses failed	Reduced

3.2 Framing

Framing interventions involve small deliberate changes to the choice environment that influence the salience or labelling of different aspects of already available information. Even small changes in the framing of information may change or de-bias behaviour because of cognitive and attentional limitations.

Table 2 provides an overview of recent framing interventions in the education sector. The interventions differed not only in terms of the target population but also in terms of the information altered by the framing manipulation. Some interventions reframed financial information relevant for education decisions. For example, a US intervention randomly allocated incoming university law students to two different financial packages with the same monetary value (Field, 2009). One package involved tuition loans which would be repaid by the university if the student chose a low-paying public interest job after graduation. The other package consisted of tuition waivers issued by the university that had to be repaid after graduation if the student chose a high-paying job not in public interest law. By not framing the aid as a loan, the tuition waiver package attempted to reduce the effects of debt aversion. In addition, by making the waiver conditional on job placement, the intervention could use loss aversion to nudge students towards public interest jobs, because loss-averse students will try to avoid having to repay waivers to which they feel entitled. The different framings led to significant behavioural differences. Students offered tuition waivers were 36–45% more likely to choose a low-paying public interest job after graduating, and if they received the details of the financial package before enrolment, students with tuition waivers were twice as likely to enrol. The behavioural responses were consistent with debt aversion, as students seemed to avoid debt when possible. The response was also consistent with default bias and loss aversion because students behaved to minimise losses relative to the default.

Another example of reframing of financial information is an intervention carried out in Morocco. Parents of school-age children received a modest transfer (Benhassine et al., 2015). The transfer was reframed as a transfer to facilitate education, and enrolment into the programme was administered by schools although eligibility was not contingent on school enrolment or performance. While the programme did not provide new incentives for children to be enrolled in school, it nevertheless led to significant enrolment increases and reduced drop-out rates by 70%, re-entry by previous drop-outs increased by 85%, and the share of never-schooled dropped by 43%. Remarkably, the study found the labelled transfer to be more effective than a transfer that was conditional on enrolment.

A US randomised trial used a gain/loss framing manipulation for incentives offered to students to motivate them to increase effort on a test (Levitt et al., 2016). Randomly selected students were told that improvements in test scores would be rewarded (gain frame). Another group of students was given the reward before the testing began and told that they would have to return it if their scores did not improve (loss frame). To induce a greater sense of loss, students in the latter treatment had to sign a sheet to confirm that they had received the reward and they had to indicate what they planned to do with the reward. Loss aversion would predict that the motivating effect would be greater in the loss framing than in the more typical gain framing. While the results did go in that direction, the differences were not statistically significant. We note that that incentives were provided immediately before the test and students therefore could not respond by increasing study effort. Instead, students could only respond by changing test efforts. In a similar study Fryer, et al. (2012) tested the effect of framing teacher performance incentives as a loss (i.e. teachers are paid in advance and asked to return the money if student test scores do not improve sufficiently) rather than a gain (an end-of-year bonus contingent on student performance). The study found significant improvements in maths test scores only for the loss

framing. In this study, incentives were provided over a longer period and teachers could therefore respond by changing their teaching effort and/or strategy.

Other framing interventions alter the framing of non-monetary incentives. For example, Wagner (2017) implemented an intervention comparing loss and gain frames for (non-monetary) test incentives on a multiple choice test. Elementary school children in Germany were given either a zero endowment of test points with the possibility to earn points by giving correct answers or skipping questions (gain frame) or alternatively they were given a positive endowment of test points from which points were deducted for wrong or omitted answers (loss frame). We note that wrong answers were treated differently than omitted answers but importantly, correct answers, omitted answers and wrong answers had the same "value" in both framings and in both cases students could earn a maximum of 40 point and a minimum of 0 points. Overall there were no effects on the number of points earned. However, high ability children earned *more* test points in the loss framing while low ability children earned *less* points. There is evidence suggesting that this could be explained by more risk taking in the loss frame because children were more likely to attempt questions when they were uncertain about an answer. This strategy seemed to pay off for high ability students who increased the number of correct answers but did not pay off for low ability children who had a lower share or correct answers in the loss framing. However, these findings contrast those of Krawczyk (2011) who found no effect on the number of attempted questions in a similar multiple choice setting with Polish university students.

Apostolova-Mihaylova et al. (2015) studied a similar framing intervention among US university students for grade points earned during a semester and also reported no overall effects on the final grade but heterogenous gender effects with positive effects on grades for males but negative effects for femals. McEvoy (2016) on the other hand reported no gender effects in a similar study also testing a loss framing for grade points earned by US university students. In contrast to Apostolova-Mihaylova et al. (2015), McEvoy (2016) found positive effects on grades and the likelihood of attempting the final exam when controlling for individual specific characteristics. The effect of the loss frame appeared most important for assignments at the end of the semester. The differing results may in part be explained by different control variables included in the analysis and by slight differences in the implementation of the intervention.

Instead of comparing gain and loss framings of feedback information, some interventions have changed the framing of other aspects of feedback information. For example, Wagner (2017) also compared two different framings where children started with a zero or a negative test point endowment of -20. This resulted in positive effects on the number of points earned, the number of correct answers and the share of correct answers, especially for high ability students. Moreover, Martinez (2014b) implemented two different framings of relative performance feedback given to students in a massive open online course (MOOC). In one implementation students were told that "you are doing worse than [X]% of the class" and in the other they were told that "you are doing better than [X]% of the class". Martinez (2014b) reported the largest effects for the former framing but the treatment differences are generally not statistically significant.[6] Kizilcec et al. (2014) also studied a framing intervention involving participants in a MOOC at a US university. The intervention tested the effects of framing reminders to contribute in an online discussion forum either neutrally ("There are a number of lively posts on the discussion board") or more persuasively ("We can all use the discussion board to collectively learn more" or "You can use the discussion board to learn more"). The

[6] The paper only report tests statistics for differences compared to a control condition with no relative performance feedback. Tests for differences between the two framings are not reported but we conjecture that most of the treatment differences would not be statistically significant.

proportion contributing to the discussion forum was unaffected by the intervention and there were no or negative effects on the number of contributions.

Overall framing interventions have provided mixed results. Positive results mostly arise for framing manipulations of monetary incentives provided that individuals are given sufficient time to allow them to meaningfully change behaviour. Framing manipulations of test scores appear to have heterogeneous effects depending on personal characteristics and risk preferences and overall effects may be non-positive. We also note that framing interventions should only be expected to have effects if the framing manipulations are sufficiently different to trigger significantly different thought processes. It is possible that the framing manipulations considered in e.g. Kizilcec et al. (2014) and Martinez (2014b) were simply not significant enough to produce results.

Table 2: Studies using framing

Paper	Target group	Intervention	Outcome	Effect
Field (2009)	US. University students.	Tuition waiver (vs. loan) framing	Enrolment	Positive
			Public interest job choice	Positive
Benhassine et al. (2015)	Morocco. Parents of school-age children.	Education (vs. unlabeled) transfer	Enrolment	Positive
			Drop-out	Reduced
Levitt et al. (2016)	US. Primary, middle and secondary school students.	Monetary test incentives framed as losses (vs. gains)	Test scores	No
Fryer et al. (2012)	US. Teachers at primary/middle school.	Pay incentives with loss (vs. gain) framing	Maths test scores	Positive
Wagner (2017)	Germany. Elementary school children (age 8-10)	Test scores framed as losses (vs. gains)	Test scores	No (negative if low ability, positive if high ability)
			Attempted questions	Positive
			Correct answers on test	Positive (driven by high ability children)
			Share correct answers	Negative (for low ability children)
		Negative (vs. zero) test score endowment	Test scores	Positive (for high ability children)
			Attempted questions	No
			Correct answers on test	Positive (driven by hgih ability children)
			Share correct answers	Positive
Krawczyk (2011)	Poland. University students.	Test scores framed as losses (vs. gains)	Attempted questions	No
Apostolova-Mihaylova et al. (2015)	US. University students.	Course grade points framed as losses (vs. gains)	Grades	No (negative if female, positive if male)
McEvoy (2016)	US. University students.	Course grade points framed as losses (vs. gains)	Grades	Positive
			Final exam attempted	Positive
Martinez (2014b)	US. Active students in a MOOC.	Relative performance framed as worse (vs. better) than other students	Grades	No
			Course engegement	No
Kizilcec et al. (2014) Study 1	US. Students in a MOOC.	Persuasive (vs. neutral) reminders of an online forum	Proportion contributing	No
			Number of contrinutions	No or negative

3.3 Peer group manipulations

Like framing interventions, peer group manipulations represent exogenous changes to the decision environment. Peer group manipulations involve a restructuring of the choice environment to facilitate peer interaction which may help improve the sense of social belonging, enforce or create social norms of effort provision or improve skill transfer through study partnerships.

A US intervention assigned half of the freshmen at the United States Air Force Academy into carefully designed peer groups (Carrell, et al., 2013). Low-ability students were placed with high-ability students and medium-performing students were placed together in more homogenous groups. Students in the control group were randomly allocated. The study found negative and significant effects on the grades of the low-ability students, even though this was precisely the group the intervention was intended to help. The performance of high-ability students was unchanged, and medium-ability students performed significantly better. The high- and low-ability students who were supposed to interact instead appeared to form subgroups and avoid each other. The fact that medium-ability students performed better suggests that they may have been better able to create a sense of group belonging. The results highlight that it can be very difficult to create a sense of group belonging exogenously and that social comparisons may lead to discouragement if the performance level of peers seems unattainable (Lockwood & Kunda, 1997). Similarly, Rogers & Feller (2016) studied a natural experiment where students in a MOOC randomly were exposed to the work of high performing peers. They found negative effects on course completion and grades.[7]

In contrast, Papay et al. (2016) studied an intervention facilitating greater interaction between high and low performing teachers. In treatment schools low performing teachers were paired with a high performing teacher and the teacher pairs were instructed to work together to improve their skills. The study reported positive and marginally significant effects on student test scores that persisted into the year after the intervention. This is in line with the positive effects of Carrell et al. (2009) who studied a natural experiment where students were required to interact with the students in the peer group they had been assigned to.

Overall, peer group manipulations have not been particularly effective unless combined with instructions or requirements to interact. Non-interventional studies of peer effects in student housing have also found mixed effects on academic performance (Carrell, et al., 2009). The reviewed studies highlight that it can be difficult to exogenously influence group identity, but there is a scarcity of studies in the area.

[7] Coaching, mentoring and tutoring interventions also facilitate peer group interaction and have rather consistently given positive effects on student outcomes for primary school children (Falk et al., 2017), secondary school students (Bos, et al., 2012; Acker & Rowen, 2013; Avery, 2013; Cook, et al., 2014; Carrell & Sacerdote, 2017), university students (Castleman et al., 2012; Castleman et al., 2014) and teacher coaching (Kraft et al., forthcoming). We note that coaching interventions often include various other components in addition to peer interaction e.g. coverage of application fees, application assistance, information provision, and economic incentives and while the interventions target behavioural issues they are far more comprehensive than nudging interventions and therefore not covered in-debt in this paper.

Table 3: Studies using peer group manipulations

Paper	Target group	Intervention	Outcome	Effect
Carrell et al. (2013)	US. Air Force Academy students.	Interaction between high and low-ability students	Grades	Negative effects for low-ability students. Small positive effects for medium-ability students, no effects for high-ability students
Rogers & Feller (2016) Study 1	US. Student in a MOOC.	Peer assesment with random exposure to high quality peers	Grades	Negative
			Course completion	Negative
Papay et al. (2016)	US. Primary school teachers.	Interaction between high and low performing teachers.	Student test scores	Positive

3.4 Deadlines

Students with self-control problems may repeatedly procrastinate doing tasks such as homework, written assignments and exam preparation. Interim deadlines may serve as a commitment device for students to study sooner rather than later (O'Donoghue & Rabin, 1999a). Models with present-biased preferences (Laibson, 1997; O'Donoghue & Rabin, 1999b) predict that students benefit from such commitment devices and that sophisticates (who are aware of their self-control problems) will actively choose to use deadlines as a commitment device when given the choice.

The empirical evidence on the effectiveness of deadlines focuses on the impact on university students and is generally positive for grades but not when it comes to completion rates (see Table 4 for on overview).[8] An early and very influential paper documenting a deadline effect is Ariely & Wertenbroch (2002). They tested the effect in a setting with ninety-nine excecutive students at the Massachussettes Institute of Technology who had to write three term papers for a course. They were assigned to one of two deadline treatments. In the first treatment, participants were given evenly spread deadlines, whereas the students set their own deadlines in the second one. In both treatments, there was a 1% grade penalty for each day of delay beyond the deadline. Ariely & Wertenbroch (2002) found that students exposed to evenly spread deadlines achieved better grades than those without such intermediate deadlines. They also found that, when given the choice, more than two-thirds of the students did set intermediate deadlines. Grades were lower with self-imposed deadlines than externally imposed deadlines, however, suggesting that students did not set deadlines optimally. Notably, there was no effect on the completion rate, as all of the students completed all the three papers regardless of the treatment.

While these results indicate a postive effect of deadlines, they were obtained for a very specific sample of highly motivated students with strong incentives to complete the course (non-refundable fees). This might explain why task completion was not an issue. In contrast, Burger et al. (2011) studied a field intervention where motivation was manipulated. University students were paid $95 for 75 hours of monitored studying over a five-week period. Students were randomly assigned to one of two treatments. In the first, they were free to

[8] Studies of non-field interventions with students also produce diverging results. While the studies consistently show a demand for self-imposed deadlines as a commitment device, Ariely & Wertenbroch (2002) find that completion and performance on a non-study related task are better with deadlines than without, but Bisin & Hyndman (2014) find the opposite effect. Other (non-educational) field contexts have found limited support for deadline effects (Bertrand et al., 2010; Damgaard & Gravert, 2017).

plan their study time as they wished over the five weeks; in the second, they were given intermediate deadlines and required to study 12 hours per week or no payment was made. Burger et al. (2011) found lower completion rates in the treatment with intermediate deadlines, suggesting that deadlines are not always beneficial. Another US interventions aimed to increase motivation to meet deadlines by combining interim deadlines with a time incentive. Using an online exam environment with more than 1,000 students, students were given interim deadlines to complete an exam that, if met, meant students would have more time to work on the exam (Levy & Ramim, 2013). The study found that this intervention had no effect on grades but reduced procrastination (more people completed the exam earlier).[9]

In the education context, tests and exams may be regarded as natural deadlines. There is some indication that increased test (and hence deadline) frequency affects performance positively. De Paola & Scoppa (2011) study a randomised control trial where university students in the control group had one exam at the end of the semester covering the full material of the course, whereas the treatment group students had a mid-term exam covering half of the material and a final exam at the end of the semester covering the other half. The final grade was determined by the average grade on the two exams. The students in the treatment group achieved higher grades and were more likely to pass the course. High-ability students appeared to benefit more from frequent exams than low-ability students, and there was no negative (nor positive) spillover on exams in subjects not included in the intervention.[10] As procrastination would be expected to be negatively correlated secondary school grades, this finding appears to suggest that low procrastinators (high ability students with good secondary school grades) benefitted most from the interim exam. In contrast, Tuckman (1998) provide evidence from another intervention that heavy procrastinators benefitted most from frequent testing. The differential effects may be due to the fact that the control group students in Tuckman (1998) were given additional homework instead of additional tests. This was not the case in De Paola & Scoppa (2011). If high-ability students indeed have higher self-control, then they might benefit more from the homework assignements, which may explain the smaller treatment effects for low procrastinators in Tuckman (1998).

Overall, the initial positive effects on grades found by Ariely & Wertenbroch (2002) seem consistent with the positive grade effects of increasing exam frequency in De Paola & Scoppa (2011) and Tuckman (1998). Notably, a common feature of these environments is that the deadlines/exams involve (real) high stakes that motivate students to study. In addition, there is sufficient time to allow students to increase study effort and hence impact grades. In contrast, there seems to be little scope to increase study effort in Levy & Ramim (2013) due to the short time scale and the way deadline incentives are constructed. As evidented by Burger et al. (2011) it may be difficult to exogenously induce motivation to meet deadlines but vairation in the level of motivation may be key to understanding the differential extensive margin results (i.e. task completion and pass rate results). There is some evidence that positive extensive margin effects only arise if motivation is high but not so high that there is no room for improvement.

[9] Another study rewarded students for meeting interim deadlines by providing them with (earlier) access to study material relevant for an upcoming test (Perrin, et al., 2011). While the study had a very small sample (only 10 students), the results suggest that such incentives to meet interim deadlines could work. However, the authors found no evidence that students had a demand for this kind of commitment device.

[10] Moreover, De Paola & Scoppa (2011) provided evidence suggesting that the positive effect of frequent examinations was not driven by additional feedback but instead by a workload division or commitment effect, as treatment differences were of similar magnitude for the exam questions relating only to the first half of the course for which feedback effects could be excluded for both groups.

Table 4: Studies varying deadline and exam frequency

Paper	Target group	Intervention	Outcome	Effect
Ariely & Wertenbroch (2002)	US. Executive students.	Interim deadlines (external)	Grades	Positive
			Completion	No
		Self-imposed	Grades	Small
			Completion	No
Burger et al. (2011)	US. University students.	Interim deadlines (external)	Completion	Negative
De Paola & Scoppa (2011)	Italy. University students.	Frequent exams	Grades	Positive (especially for high-ability students)
			Passing	
Tuckman (1998)	US. University students.	Frequent testing	Grades	Positive (for high procrastinators)
Levy & Ramim (2013)	US. Students at unknown academic institution.	Interim deadline	Grades	No
			Procrastination	Positive (less procrastination)

3.5 Goal setting

A number of recent studies have investigated another type of commitment device: goal setting. Theoretically, present-biased agents who invest too little effort in their education can benefit from self-set goals as internal commitment devices. Once set, goals become salient reference points that students (and parents) will be motivated to reach in order to avoid psychological costs (due to loss aversion) of not reaching the goals (Jain, 2009; Koch & Nafziger, 2011; Clark et al., 2017). Therefore, asking students, parents and teachers to set a *specific* goal for task completion or task performance may help alleviate self-control problems by subconsciously nudging individuals towards behaviour that enables them to meet the goal.

Table 5 summarises the effects of goal-setting interventions that involve *specific* goals. In Section 3.9, we discuss boost interventions that improve *general* goal-setting skills. Clark et al. (2017) tested the effect of self-set, task and performance goals for US university students. They found that task-based goals led students to engage more with the task and, ultimately, perform better on exams. In contrast, performance goals for exams and the overall course grade had little effect. The authors argue that task-based goals involve less risk, making the outcome more controllable for students. At the same time, performance goals are more long-term and procrastination might therefore reduce the effectiveness. However, in contrast van Lent & Souverijn (2017) found positive effects on grades of a performance-based goal where Dutch university students set a target grade for a course. The effects were strongest for students who initially performed poorly, and there were no negative spillover effects to other courses. Interestingly, van Lent & Souverijn (2017) found negative effects of suggestions by others to raise the goal, meaning that such suggestions may reduce commitment to the goal or render it seemingly unattainable. Moreover, Karlsen & Varhaug (2016) consider a very subtle task-based goal-setting intervention in Norway and find no effects. Applicants at teacher colleges were asked to send a text message stating their intent to enrol or not if accepted to college. Simply stating the intent to enrol could provide a goal-setting mechanism and at the same time serves as a way to make a promise to enrol which applicants might feel uncomfortable breaking (Charness and Dufwenberg, 2006; Vanberg, 2008). However, Karlsen & Varhaug (2016) find no effect on enrolment. Survey evidence suggests that the choices not to enrol were due to careful consideration and that ultimately other factors than procrastination were more important for the decision not to enrol.

Other goal-setting interventions have combined goal setting with other policy components making it hard to isolate the effect of introducing a goal. For example, Patterson (2015) considered the effect of combing a goal with a commitment device. Students in a MOOC were provided access to a commitment tool that reminded

them of a previously stated goal to limit time spent on disctracting webseites. The students were asked on a daily basis whether they wanted to change the goal but mostly did not make use of this opportunity. Once they exceeded the limit, the commitment device would automatically block distracting websites but students could un-block them on a site-by-site basis. The intervention led to positive effects on course effort, homework competion, grades and course comletion, especially for the most motivated students.

Another goal-setting intervention targeted parents and combined goal setting with information provision and extrinsic motivation (Mayer, et al., 2015). Every week, the treatment group parents were asked to set goals for the amount of time they would spend reading to their child in the coming week. They were then reminded via text messages to read to reach the goal, and they would receive a congratulatory text message as a non-monetary reward upon reaching it. The treatment group parents were also provided with information about the importance and benefits of parental involvement. In combination, the treatment components resulted in more than a doubling of parental reading time. The effect of the treatment was particularly strong for parents who were classified as impatient and, hence, more likely to suffer from self-control problems. Without the intervention, low-patience parents read on average less to their children than high-patience parents. With the intervention, this order was reversed. This suggests that the reminder intervention reduced self-control problems. There is also indication that the effect was not driven by the informational content because the beliefs about the effects of parental involvement were found to be similar ex post in the treatment and control groups.

Overall, the evidence on the effects of setting *specific* goals is somewhat mixed and it remains unclear whether task-based goals or performance-based goals are generally better at nudging behaviour. There is some evidence to suggest that goals *can* have positive effects on effort provision and student performance for tasks and individuals likely influenced by procrastination. For example, goals are not effective if behaviour is due to careful consideration and goals are more effective for impatient parents and low performing students who are likely to also be high procrastinators. However, the evidence also suggests that care must be taken not to pressure individuals to set too high goals as suggestions of higher goals may have adverse effects.

Table 5: Studies using goal setting

Paper	Target group	Intervention	Outcome	Effect
Clark et al. (2017)	US. University students.	Task goals	Study effort	Positive (driven by males)
			Grades	Positive (driven by males)
		Performance goals	Grades	No
van Lent & Souverijn (2017)	The Netherlands. University students.	Performance goals	Grades	Positive (especially for low-performing students)
		Suggestions to raise the goal	Grades	Negative
Karlsen & Varhaug (2016)	Norway. Teacher college applicants.	Task goals	Enrolment	No
Patterson (2015)	US. Students in a MOOC.	Goals limiting undesireable behaviour + commitment device	Study effort	Positive
			Homework completed	Positive
			Grades	Positive
			Completion	Positive
Mayer et al. (2015)	US. Parents of pre-school children.	Task goals (+ non-monetary incentives)	Parental reading time	Positive (especially for 'impatient' parents)

3.6 Reminders

Due to attention limitations, there is a risk that people forget to make decisions they intended to make and fail to take action they planned to take. Reminders target such problems by refocusing attention to the decision problem or task (see e.g. Karlan et al., 2016). Moreover, reminders may have informational value, reminding people of already known information or providing easy access to new information. In addition, reminders may emphasise deadlines and tasks or the benefits of meeting deadlines and completing tasks. As a result they may mitigate self-control problems. In this section we focus on reminders that provide minimal new information and hence allow identification of a reminder effect (see overview in Tables 6 and 7). We discuss interventions targeting students, parents and teachers in turn.

3.6.1 Reminding students

Several recent North American studies test the effect of targeting reminders at students. Some of the interventions have had the aim to get secondary school students to complete the transition to higher education. For example, Castleman & Page (2015) sent text message reminders to secondary school graduates intending to go to college and their parents. The reminders contained information about upcoming deadlines and tasks required for enrolment in their intended college as well as information about available means of assistance. The results suggest that reminders can increase enrolment to some colleges but only in regions where students have little access to assistance to complete the enrolment process (Castleman & Page, 2015). The effects were largest for students with less clearly formulated college plans and less access to help from other sources. These characteristics are likely to be correlated with lower SES. These results were largely replicated by Castleman & Page (2017) whom also tested the effect of contacting both prospective college students and their parents. There was no additional effect on college enrolment of also nudging parents. In another intervention, Bird et al. (2017) provided reminders of financial aid applications including planning prompts targeted at low-SES students who had registered with Common Application (an organisation through which it is possible to apply to several colleges and universities with one application). The reminders were intended to get students to plan ahead and set reminders for themselves to get tasks done. The authors reported no effects on college applications and college choice but again there were positive effects on college enrolment. Similarly, Page, Castleman & Meyer (2017) reported positive effects on financial aid applications and college enrolment in Texas of personalised reminders of finanical aid applications, the steps involved and feedback on how far in the process the individual student had reached. Page, Castleman & Meyer (2017) also implemented the same text messaging intervention state-wide in Delawere giving students the choice to self-select into the messaging service. This resulted in some positive effects on aid applications.[11]

A related study used text message reminders to remind first-year college students to apply for financial aid for their second year (Castleman & Page, 2016). Again, the reminders contained information about upcoming deadlines and requirements together with information about how to get assistance. The intervention had large effects among students at community colleges, where recipients were about 12–14 percentage points more likely to remain enrolled in the next two semesters. There was little effect among students at four-year institutions, however, possibly because of already high enrolment rates meaning that there was little scope for improvements. This evidence is consistent with the strongest effects arising for students with lower SES. Positive effects of reminders targeting new university students have also been reported by Castleman & Meyer (2016). They found that participation in a text messaging campaign was positively associated with the number of attempted and earned course credits during the first semester, with some evidence of stronger effects for low-SES students. However, these effects did not persist to the second semester and there were no effects on

[11] The effect on college enrolment for the Delaware sample was not studied.

grades. A large scale Canadian intervention also highlighted that positive reminder effects do not necessarily arise (Oreopoulos & Petronijevic, forthcoming). There were no effects on grades and earned course credits of similar reminders targeted at undergraduate students.

Two studies have tested the effects of reminders in MOOCs. Kizilcec et al. (2014) found short-term effects of a reminder intervention reminding students enroled in a MOOC about the possibility to contribute to an online discussion forum. There were no effects of plain reminders on the *proportion of students* contributing but immediately after the intervention the *number* of contributions increased.[12] The effect persisted for about 1-2 weeks and 7 weeks after the intervention the total number of contributions in the treatment group was identical to the total number of contributions in the control group. Kizilcec et al. (2014) also tested the effect of using more persuasive reminders which told the students either that "The more people participate the more we all learn" or that "The more people participate, the more they learn". These persuasive reminders had no effect on contributions in the short term, and in the longer term the effect might even have been negative.

Patterson (2015) also targeted students in a MOOC. In one treatment, Patterson (2015) provided students with reminders to study after each half-hour spent on distracting websites. In particular, the reminders reported the time spent on distracting websites and provided a link to the course website. There were no effects on any of the outcome measures considered. In another treatment, Patterson (2015) reminded students who logged into the course website to focus on studying and gave them the opportunity to block distracting websites for 15, 30 or 60 minutes. Again, there were no effects on any of the outcome variables.

Finally, Unkovic et al. (2016) targeted reminders at graduate students encouraging them to submit a presentation to an academic conference. They found positive effects on the number of presentations submitted and to a lesser extent on the number of presentations submitted. The latter finding is likely due to the fact that the total number of presentations was capped.

At first glance, the results of studies using reminders targeted at students seem to be inconsistent. However, some patterns emerge. The effects of reminders on specific tasks such as completing college enrolment, aid applications, number of contributions posted in an online forum or applying to an academic conference generally are positive with some indication that the largest effects arise among low-SES students. However, the effects mostly seem short-lived and the effect on outcomes which are more long-term and require ongoing effort (e.g. grades and earned course credits) are more mixed. Interestingly, Oreopoulos & Petronijevic (forthcoming) contrasted their reminder treatment with a small-scale one-on-one coaching intervention on a similar study population. For the coaching intervention the authors reported large effects on earned course credits and grades, suggesting that text message reminders are unable to substitute for coaching when it comes to ongoing effort provision at university.

[12] Here we discuss the effect of the reminders in study 2 in Kizilcec et al. (2014) which can be compared to a control group who did not receive any reminders. In study 1, the authors also test the effects of different framing manipulations on a larger scale but with no control group. We discuss these results in Section 3.2.

Table 6: Studies with reminders targeting students

Paper	Target group	Intervention	Outcome	Effect
Castleman & Page (2015)	US. Secondary school students (age 17–18)	Reminders of college enrolment	College enrolment	Positive (in regions with little prior enrolment support.) Largest effects for students with unclear college plans.
Castleman & Page (2017)	US. College-intending secondary school students (age 17–18).	Reminders to students (and parents) of college matriculation tasks	College enrolment	Positive (for low income and first generation students). No additional benefit of contacting parents.
Bird et al. (2017)	US. Low-SES secondary school students registered with Common Application (age 17-18).	Reminders/planning prompts of financial aid applications	College application	No
			College enrolment	Positive
			College choice (characteristics)	No
Page, Castleman & Meyer (2017)	US. Seconday school students (age 17-18).	Personalised reminders of financial aid applications, tasks and available assistance	Aid applications	Positive
			College enrolment	Positive
Castleman & Page (2016)	US. University students	Reminders of financial aid applications	Persistency	Positive (for students at community colleges).
Castleman & Meyer (2016)	US. University students.	Reminders of tasks, access to advising and encouragement	Earned and attempted course credits	Positive (initially, later no effect. Largest for low income students)
			Grades	No
Oreopoulos & Petronijevic (Forthcoming)	Canada. Undergraduate Economics students.	Reminders of tasks, access to advising and encouragement	Earned course credits	No
			Grades	No
Kizilcec et al. (2014) Study 2	US. Students in a MOOC.	Neutral reminder of online forum	Proportion contributing	No
			Number of contributions	Positive (in short term)
		Persuasive reminder of online forum	Proportion contributing	No
			Number of contributions	No or negative
Patterson (2015)	US. Students in a MOOC.	Reminders to study + reminders to focus on studying	Study effort	No
			Homework completed	No
			Grades	No
			Completion	No
Unkovic et al. (2016)	US. Graduate students.	Reminders to submit papers to a conference	Conference applications	Positive
			Conference acceptance	Positive

3.6.2 Reminding parents and teachers

Several US studies have targeted reminders at parents and teachers. For example, parents of pre-school children in San Francisco received three informational text message reminders per week with simple information about key components of early childhood learning and practical tips for initiatives they could implement at home to support their child's learning (York et al., forthcoming). The programme significantly increased home literacy activities and parental involvement as well as some aspects of student learning. In a more recent intervention, Doss et al. (forthcoming) revisited the intervention in York et al. (forthcoming) and adapted it to parents of US

kindergarten children. They supplemented the original sample with additional sample and offered $10 to get parents to stay in the program. Doss et al. (forthcoming) reported positive effects on reading abilities and home literacy activities but only in a treatment with personalised messages. If the text messages were not personalised to include information about the child's performance level, there were no effects on reading or home literacy activities. Hurwitz et al. (2015) studied a similar intervention targeted at low-SES parents of pre-school children and found positive effects on parent-child activities, especially for fathers and parents of boys.

There are a few similar interventions among school-age children in the US. Kraft & Monti-Nussbaum (2017) sent parents (who opt in to the program) text message reminders of home literacy activities over the summer holiday with the aim of reducing the summer learning loss. They found large, positive and persistent effects on test scores for 3rd and 4th grade children but no effect for 1st and 2nd grade children. However, the study may be somewhat underpowered and this could explain the insignificant results for younger children. It is also possible that the parents of the younger children would have benefitted more from a different message content e.g. more along the lines of the contents in the pre-school interventions discussed above. Kraft & Monti-Nussbaum (2017) also found positive effects on attendance at parent-teacher conferences suggesting greater parent involvement. Similar reminder effects were obtained in an earlier US study with printed reminders to involve parents in homework (Balli, et al., 1998). The reminders were associated with greater parental involvement, but there were no effects on test scores. However, this earlier study consisted of only three school classes with randomisation at the class level into three different treatment groups. Hence, the effects could be confounded with other class-specific effects.

Bergman (2016b) found positive reminder effects on the grades of high and middle school children. Parents were reminded of the opportunity to access information about their child's performance in school. The intervention led to an immediate increase in the share of parents who accessed the online portal and parents (and children) in the treatment group also engaged more with the portal in subsequent months. Finally, Rogers & Feller (2017) found positive effects on child absenteeism of reminding parents of primary and secondary school childen of the importance of low absenteeism. The target population in the study was childern with a history of absenteeism but at a level below 2 standard deviations above the student average.

Reminders may also be targeted at teachers. Jackson & Makarin (forthcoming) provided teachers with access to online learning material in the form of off-the-shelf lessons in mathematics. Some teachers were then randomly assigned to a treatment condition which involved an introduction to the learning material as well as regular reminders to engage with the material. The study found positive but statistically insignificant effects of the intervention on student test scores in maths.[13]

Overall, studies nudging parents with reminders have almost consistently found positive effects on parental involvement and student skills. Additional studies targeting reminders at teachers are needed before conclusions can be made with respect to the effect of reminders for teachers.

[13] Jackson & Makarin (forthcoming) implement do not present a test for treatment differences between their reminder treatment (Full Treatment) and the non-reminder treatment (the Licence Only Treatment). Instead they test for differences between the two treatments and a control with no access to the online materials. From their table 2 it is, however, clear that the differences between the reminder and non-reminder treatments are insignificant.

Table 7: Studies with reminders targeting parents and teachers

Paper	Target group	Intervention	Outcome	Effect
York et al. (forthcoming)	US. Parents of pre-school children (avg. age 4).	Reminders of home literacy activities	Home literacy activities	Positive
			Early litteracy assesment	Positive (on some measures)
Doss et al. (forthcoming)	US. Parents of kindergarten children (avg. age 5).	Reminders (personalised or not) of home literacy activities	Reading	Positive (for personalised messages)
			Home literacy activities	Positive (on some measures for personalised messages)
			Parent-teacher communication	No
Hurwitz et al. (2015)	US. Low income parents of children at (Early) Head Start Centers (age 0.5-5).	Reminders of home literacy activities and encouragement	Parent-child activities	Positive (especially for fathers and parents of boys)
Kraft & Monti-Nussbaum (2017)	US. Parents of primary school children (age 6-10).	Reminders of home literacy activities over the summer	Test scores	Positive for 3rd and 4th grade students
			Parent involvement	Postive (for parent-teacher conference attendance)
Balli et al. (1998)	US. Parents of middle school children (age 11–12).	Reminders of parental involvement	Parental involvement	Positive
			Test scores	No
Bergman (2016b)	US. Parents of middle and high school children.	Reminders of online portal giving information about academic performance	Parent engagement with portal	Positive
			Child engagement with portal	Positive
			Grades	Positive
Rogers & Feller (2017)	US. Parents of primary and secondary school children with medium-high absenteeism.	Reminders of importance of low absenteeism	Absenteeism	Positive
Jackson & Makarin (forthcoming)	US. Teachers of middle school children.	Reminders to use online teaching material	Test scores	No

3.7 Informational nudges

Attention limitations may also imply that students and parents do not acquire all of the relevant and important information when making decisions – even if the information is publicly available. By providing important information in an easily accessible manner, it may be possible to overcome attention limitations. In addition, choice architects can ensure that some information is more salient than other information. Consequently, informational nudges may target both attention limitations and other behavioural barriers. A large number of studies fall into this category (see Tables 8-11), we structure our discussion around the type of information provided.

3.7.1 Parental information

Some informational nudges target parents and either 1) provide information relevant for education decisions influenced by parents or 2) provide information about child behaviour (see Table 8 for an overview of the interventions). In the former category is an evaluation of a policy providing information about average school

test scores to parents of children enrolled in low-performing schools (Hastings & Weinstein, 2008). The intervention increased the share of parents choosing higher performing schools, especially if there were high performing schools nearby. This result was achieved regardless of whether the information was provided in a simplified manner. Another US intervention provided information to parents about the benefits of taking maths and science classes in high schools (Harackiewicz et al., 2012). The study found that high school children of parents in the treatment group took approximately one additional semester of science and maths during the last two years of high school compared to the control group.

Interventions providing information about child behaviour are numerous. Such interventions may de-bias beliefs about the child's behaviour and alleviate possible negative effects of asymmetric information. Children are better informed about the effort that they exert than their parents. The asymmetric information problem is well-known, even in classical economic theory, and is not per se behavioural. However, some interventions to alleviate the problems are behavioural in the sense that they reduce information barriers by providing parents with easy access to standardised information. For example, a Dutch intervention introduced a smartphone app allowing parents of 7th, 8th and 9th grade students to track their child's use of an online learning tool (Haelermans & Ghysels, 2016). On average, the app had no effect on students' use of the learning tool. However, there were heterogeneous effects with evidence of positive effects on the study efforts of 7th and 8th grade students but negative effects for 9th grade students. The positive results for 7th and 8th grade students were driven by male and low-SES students, whereas the negative results for 9th grade students were driven by high-SES students. The app had no effect on language test scores but a positive effect on maths test scores. Null effects were also found for an intervention providing parents of 3957 high school students in New York City with text message information about their child's absenteeism (Balu et al., 2016). There was no effect of the intervention on child absenteeism. This is in contrast to the results of another US intervention providing parents of primary and secondary school children with relatively high levels of absenteeism with information about their child's absolute level of absenteeism (Rogers & Feller, 2017). The study found a 10% reduction in absenteeism and the informational intervention was shown to be more effective than simply reminding parents of the importance of low absenteeism.

Another intervention provided parents in Los Angeles with frequent and detailed information about their child's missed assignments and grades via email, text messages and phone (Bergman, 2016a). Both student effort and grades improved significantly as a result. A similar intervention providing frequent information updates to parents in West Virginia found large positive effects on classes attended and passed, especially for low achieving students and high school students (Bergman & Chan, 2017). Positive effects were also found for student retention, grades, parent awareness and parent-school communication about the children. There were no effects on parent-child communication about school, test scores, the number of assignments handed-in and the likelihood of being suspended. Bergman et al. (2016) and Kraft & Dougherty (2013) also reported positive effects of providing personalised information about child performance to parents in the US and Miller et al. (2016) reported positive effects on math test scores and attendance in the UK. Bergman et al. (2016) and Miller et al. (2016) provided the information using text messages whereas Kraft & Dougherty (2013) combined text message information with phone calls.

Kraft & Rogers (2015) also obtained positive effects of a similar intervention providing parents of secondary school students in the US with weekly, one-sentence messages about their child's performance. Messages emphasising areas for improvement appear to have been more effective than messages emphasising good performance. Positive effects were also obtained in a Chilean study using high frequency text messaging (Berlinsky et al., 2016) and a study in Malawi providing parents with information about their child's

performance on tests (Dizon-Ross, 2017).[14] However, in the latter study, positive effects were mostly confined to high performing students. Dizon-Ross (2017) provide evidence suggesting that parents of low performing children have more biased beliefs about the performance of their children and the benefits of schooling and hence could benefit more from the information. However, as parents also believe that the returns to education investments are greatest for high performing children, information about child performance only increases parental investment in schooling for high performing students.

Overall, with just a few exceptions, the studies providing easy access to information for parents have positive effects on student outcomes. Moreover, there is indication that parents value the information as parents in Berlinsky et al. (2016) indicated a positive willingness-to-pay to continue the messages. This is consistent with the findings of e.g. Bursztyn & Coffmann (2012) and Bergman & Chan (2017).

Table 8: Studies easing access to information

Paper	Target group	Intervention	Outcome	Effect
Hastings & Weinstein (2008)	US. Parents at low-performing schools.	Information about school quality	School choice	Positive
Harackiewicz et al. (2012)	US. Parents of secondary school students (age 15-17).	Information about benefits of taking maths and science classes	Number of maths and science classes taken in high school	Positive
Haelermans & Ghysels (2016)	The Netherlands. Parents grades 7–9 (age 12–15).	Information about child effort	Use of learning tool	No
			Language test scores	No
			Maths test scores	Positive
Balu et al. (2016)	US. Parents of secondary school students (age 14–18).	Information about child absenteeism	Attendance	No
Rogers & Feller (2017)	US. Parents of primary and secondary school children with medium-high absenteeism.	Information about child absenteeism	Attendance	Positive
Bergman (2016a)	US. Parents of middle and secondary school students (age 11–17).	Information about child's missed assignments and grades	Student effort	Positive
			Grades	Positive
Bergman & Chan (2017)	US. Parents of middle and secondary school children. Grades 5-11 (age 10-18).	Information about child missed assignments, grades and attendance	Parent-school contact	Positive
			Classes passed	Positive (especially for below average students and high school students)
			Classes attended	
			Persistency	
			Grades	
			Test scores	No
			Missed assignments	No
			Suspensions	No
			Parental awareness	Positive
Bergman et al. (2016)			Persistency	Positive
			Grades	Positive

[14] Sirvani (2007) also find positive effects of a small scale intervention providing information about child performance to parents of secondary school children. The study is, however, done on a very small sample including only 52 students in 4 classes with randomization at the class level.

	US. Parents of middle and secondary school students (age 11–17).	Information about child missed assignments, grades and attendance	Test scores	No
			Attendance	No
			Suspensions	No
Kraft & Dougherty (2013)	US. Parents of middle and secondary school childern (age 11-15).	Information about child performance	Homework completion	Positive
			Attention in class	Positive
			Class participation	Positive
Miller et al. (2016)	UK. Parents of grade 7, 9 and 11 (age 11-16).	Information about missed assignments, upcoming tests and deadlines and curriculum	Test scores	Postive for math, no effect for science or English
			Attendance	Positive
Kraft & Rogers (2015)	US. Parents of secondary school students (age 14–18).	Information about child performance	Earned course credits	Positive
			Drop-out rate	Reduced
Berlinsky et al. (2016)	Chile. Parents in grades 4 to 8 (age 9-14) in two deprived school districts.	Information about child attendance, behaviour and math test scores	Math grades	Positive
			Attendance	Positive
			Child behaviour	Positive
			Passing grade	Positive
			Parent awareness	Positive
Dizon-Ross (2017)	Malawi. Parents in grades 2-6 (age 7-11).	Information about test scores	Persistency	Positive (for high performers and negative for low performers)
			School expenditures	Positive (for high performers with more educated parents)

3.7.2 Information about behaviour and ability

Students may also lack accurate information enabling them to assess their own ability and behaviour. For example, students may (intentionally or not) lack information about what constitutes plagiarism. Moreover, students with self-control problems might find plagiarism an appealing alternative to hard work. A US intervention, informing students about what plagiarism is and how to avoid it substantially decreased the likelihood of plagiarism (Dee & Jacob, 2012). The effects were strongest among students with low test-scores, who otherwise had the highest rates of plagiarism. A follow-up survey suggested that the randomised intervention significantly improved awareness of what constitutes plagiarism among students in the treatment group but did not influence beliefs about the likelihood that plagiarism would be identified. We note that an important difference between providing information on plagiarism and the informational nudges discussed above is that informing about plagiarism naturally also brings up the morality issue, which may be important for the success of the nudge.

University students may also lack information enabling them to judge whether they personally are likely to graduate given their current performance and behaviour. Consequently, some students may not be aware they behave sub-optimally and they may drop out too soon, give up trying to learn a subject, or apply to degree programmes that do not fit their skill level. Martinez (2014b) studied an intervention telling students in a MOOC that evidence suggests “that students who choose to do the quizzes later perform worse than those who do them earlier”. Martinez (2014b) found positive effects of the intervention on course engagement measured by quiz-taking, on grades and on course completion. In France, a reform providing secondary school students in their senior year with personalised assessments from their preferred university degree programme was

intended to lead to a better match between student skills and degree programmes (Pistolesi, 2017). University admission is non-restricted in France, and prior to the reform there was concern that students applied for and enrolled in programmes they did not have the skills to complete. This could potentially explain the very high drop-out rate among first-year students. Pistolesi (2017) studied the effect of the information on enrolment into the economics programme in Toulouse, finding that negative student evaluations reduced enrolment. Positive evaluations had no impact on enrolment.

Very similar effects have been found in the UK, where some university departments provided feedback on tests in one semester before students started exerting effort towards their next tests, while other departments did not (Bandiera et al., 2015). Grades were positively affected by feedback provision and the effects were significant for almost all students. Only the grades of the worst-performing students did not improve, but there were no signs of any discouragement effect. We note that the largest effects were among new students who were likely to be less informed about their own performance and their returns to effort. Similar diverging results were found in a Mexican study that provided disadvantaged students with feedback on their performance on a mock version of an admission test before they had to apply for secondary schools and take the real test (Bobba, et al., 2016). The study found that feedback information substantially reduced the gap between perceived and actual performance and that students who updated their beliefs upward responded to the new information by applying for and enrolling in more academically oriented secondary schools. The study found no effects on grades at the end of the first year of secondary school, but students who switched to a more academic track may nevertheless be expected to have the potential to achieve better education and labour market outcomes.

Students may also lack information about the value of courses offered to them. Dengler-Roscher et al. (2016) implemented an intervention providing academics involved with teaching at a German university with information about the value of an in-house didactic course aimed at academics. As a measure of the course value, the authors gave information about the cost of a comparable private sector training course. The authors found a very small and insignificant increase in the course participation rate. This information experiment is similar to the costs and benefits experiments discussed in the two previous subsections and it is therefore perhaps not surprising that the study reports no effects.

Overall, it appears that experiments providing information that make individuals reflect on whether current behaviour is optimal are beneficial. A common feature of the interventions in Pistolesi (2017), Bandiera et al. (2015) and Bobba et al. (2016) is that they provide personalised information which may potentially de-bias beliefs about own ability or effort level, and therefore induce individuals to re-optimise behaviour (e.g. effort choices) and pathway (e.g. major choice). Dee & Jacob (2012) and Martinez (2014a) also find positive effects for interventions of this kind.

Table 9: Studies providing information about behaviour and skills

Paper	Target group	Intervention	Outcome	Effect
Dee & Jacob (2012)	US. University students.	Information about plagiarism	Plagiarism	Reduced
Martinez (2014a)	US. Students in a MOOC with initial intent to complete course.	Procrastination of quiz-taking associated with low performance	Course engagement	Positive
			Grades	
			Course completion	
Pistolesi (2017)	France. Secondary school students (age 17–18).	Information about match of student skills and major choice	Enrolment in Economics programme	Reduced (by negative evaluations)
Bandiera et al. (2015)	UK. University students.	Feedback provision	Grades	Positive (especially for high-performers)
Bobba et al. (2016)	Mexico. Middle school students (age 14) with low-SES.	Feedback provision	Secondary school applications and enrolment	Positive
			Grades	No
Dengler-Roscher et al. (2016)	Germany.University teachers.	Information about value of didactic course for academics	Course participation	No

3.7.3 Returns to schooling

Information may also be provided in an attempt at de-biasing beliefs about the returns to schooling. By making the benefits of schooling more salient, interventions providing information about the returns to schooling possibly also reduce self-control problems. British (McGuigan et al., 2016) and Canadian (Oreopoulos & Dunn, 2013) studies show that information campaigns informing secondary school students about tuition costs and potential earnings can influence beliefs about the net returns to education but our review suggests that the change in beliefs does not necessarily translate into a change in behaviour (for an overview, see Table 10).

In one US intervention, Fryer (2016) studied middle school children who were sent daily text messages with information about financial and non-financial benefits of education. In the short term the study identified positive effects on awareness of benefits but no effects on test scores or effort. In the long term the study reported positive effects on the scores on college entry exams. In another US intervention, secondary school students identified as being on the margin of applying to college received letters highlighting the financial and non-pecuniary benefits of attending college (Carrell & Sacerdote, 2017). In some cases, the information was combined with personalised follow-up letters encouraging the students to apply. The study found no effect on college enrolment. Similarly, a field experiment in Finland revealed that, on average, an intervention informing secondary school graduates about the earnings distribution and employment rates for different post-secondary educations did not increase enrolment into post-secondary education or the type of education programmes selected (Kerr, et al., 2015). However, there was evidence that students were updating their views on employment prospects and that a small group of students who were disappointed by the information changed their education choice in response to the intervention. A Chilean experiment providing applicants for post-secondary federal student aid with information about earnings potentials and costs also found no effect on enrolment, but some effects on education choice for low-SES students who tended to switch to study programmes with a higher net value (Hastings, et al., 2015). A German experiment targeted districts with a large share of secondary school students from non-academic backgrounds. It consisted of an information workshop given by a trained person with a precise script and revealed a positive effect on information absorption as well as college enrolment intentions, in particular among low-SES students (Peter and Zambre,

2017). Karlsen & Varhaug (2016), however, found no effect of providing information about financial (and non-financial) returns to education in their intervention targeting teacher college applicants. Applicants exposed to the informational nudge were no more likely to complete enrolment after being accepted at the college than applicants who did not receive the information. However, the intervention did result in more accurate beliefs about the financial returns to completing teacher training.

The scattered positive effects for low-SES students are supported by similar studies in developing countries that have generally had positive effects. A study among boys in the last year of compulsory school in the Dominican Republic showed that students significantly underestimated the returns to education and an intervention providing students at randomly selected schools with accurate information about the returns to secondary schooling led to an approximately 0.2-year increase in the number of completed years of schooling (Jensen, 2010). Interestingly, the effects were greatest for students from higher income families. Jensen (2010) argues that this is because credit constraints are less important for higher income families, and they are therefore better able to change their education choice in response to the information provided. However, it is also possible that (other) behavioural barriers are more important in poorer households. A similar intervention in Madagascar found that parents updated their beliefs in response to statistical information about earnings potential and that test scores and attendance subsequently improved (Nguyen, 2008). An alternative to providing statistical information about earnings potentials is to use role models. Nguyen (2008) tested a role model intervention wherein an actual person told students and families about their family background, education experience and current occupation. Importantly, the role models were moderately or highly successful and therefore share success stories. The study found that role models from poor backgrounds had almost the same effect on test scores as statistical information, whereas role models from rich backgrounds had no effect.

Overall, nudging with information about the returns to schooling has mostly had no effects on student outcomes in developed countries but positive effects in developing countries. It appears that effects are potentially larger for low-SES students, and also, there is some indication that the interventions providing information about the (financial or non-financial) returns to schooling are more likely to produce positive effects if done at young ages. Fryer (2016), Jensen (2010) and Nguyen (2008) found positive effects for elementary or middle school children, while other studies involving secondary school and more mature students rarely found effects (see Table 10).

Table 10: Studies providing information on the returns to schooling

Paper	Target group	Intervention	Outcome	Effect
Fryer (2016)	US. Grade 6-7 students (age 11-13)	Statistical information	Awareness	Positive (especially for non-financial benefits)
			Effort	No
			Test scores	No
			Taking college entry exam	No
			Scores on college entry exams	Positive
Carrell & Sacerdote (2017)	US. Secondary school students (age 17–18).	Statistical information	University enrolment	No
Kerr et al. (2015)	Finland. Secondary school students (age 18–19).	Statistical information	University enrolment	No
			Education choice	No
Hastings et al. (2015)	Chile. Secondary school students.	Statistical information	University enrolment	No
			Education choice	Some (for low-SES students)
Peter and Zambre (2017)	Germany. Secondary school students in low-SES districts (age 18-19).	Statistical information	Intended university enrolment	Positive (especially low-SES students)
Karlsen & Varhaug (2016)	Norway. Teacher college applicants.	Financial and non-financial returns	Enrolment	No
Jensen (2010)	Dominican Rep. Grade 8 students (age 13–14).	Statistical information	Years of schooling completed	Positive (especially for high-SES students)
Nguyen (2008)	Madagascar. Grade 4 children (age 9–10) and their parents	Information from role models	Test scores	Positive
			Attendance	Positive

3.7.4 Financial aid

Several studies investigate the effects of providing information about financial aid. By bringing attention to available financial aid schemes, these interventions potentially lower the perceived immediate costs of continuing education and, hence, might indirectly reduce the effects of self-control problems. For example, a Dutch study randomly provided students with information about student loan conditions in a setting where students were believed to be aware of the universal eligibility for student loans (Booij, et al., 2012). The study found that students who received the information remained better informed about loan conditions six months later but that their borrowing decisions were no different than those in the untreated group. This suggests that the student loan take-up in the Netherlands is not constrained by any lack of information. Similarly, an American study providing low-income individuals with information comparing estimates of financial aid with the tuition costs of nearby colleges found no effects on financial aid applications or college enrolment (Bettinger, et al., 2012). It is worth noting that the information was given to people receiving tax preparation help living in a household with someone aged 15–30 years. The information was therefore not exclusively given to individuals in the process of applying to a higher education institution. However, Bergman et al.

(2017) targeted information about financial aid and tax credits for college precisely at individuals who had previously or currently applied to college. They also found no effects on enrolment (regardless of *how* the information was provided and whether information on the returns to education was also provided). Similarly, Bird et al. (2017) targeted information about the potential returns to financial aid applications at high school seniors who had registered with Common Application, an organisation facilitating applications to several colleges and university with just one application. Bird et al. (2017) also found no effect on college applications or enrolment.

Interestingly, in some cases there may even be adverse effects of information provision on the take-up rates for financial aid. An experiment among college student loan applicants in Baltimore found that applicants who received text messages with simplified information about loan rules, loan flexibility and repayment possibilities were less likely to take out a loan (Barr, et al., 2017). The effects were greatest among low-SES students and there were also short-term negative effects on student outcomes with the results suggesting that some students dropped out sooner than they otherwise would have. In another study, providing borrowing information to undergraduate students who already had taken out a student loan, Darolina & Harper (forthcoming) report no effects of information on borrowing decisions or academic outcomes.

However, positive effects have been found in some cases. For example, an intervention in Chile found positive effects on college preparatory secondary school enrolment, school attendance and financial aid knowledge for eighth grade students shown a video with financial aid information (Dinkelman & Martinez, 2014). The gains came from medium- and high-grade students and did not increase if parents were also provided access to the same video. Similarly, a US intervention mailing information about i) application steps, ii) net costs of attending college or iii) fee waivers to high-achieving low-income students has been shown to make students apply to more universities and specifically to more selective universities (Hoxby & Turner, 2015). It also led to higher admission, enrolment and progression.

Overall, studies of interventions providing financial aid information have mostly reported no effects on student outcomes. There are a few exceptions where positive effects have been found for selective groups of high achieving students.

Table 11: Studies providing financial aid information

Paper	Target group	Intervention	Outcome	Effect
Booij et al. (2012)	The Netherlands. Higher education students (avg age 21).	Information about loan conditions	Borrowing	No
			Awareness	Positive
Bettinger et al. (2012)	US. Tax preperatory assistance recipients with low-SES and household member aged 15–30 years (avg 18 yrs).	Information about financial aid and tuition costs	Financial aid applications	No
			College enrolment	No
Bergman et al. (2017)	US. Current or previous college applicants.	Information about tax credits and financial aid	College enrolment	No
Bird et al. (2017)	US. Low-SES high school seniors registered with Common Application.	Information about expected returns to financial aid applications	College application	No
			College enrolment	No
			College choice (characteristics)	No
Barr et al. (2017)	US. Low-SES loan applicants (avg. age 29).	Information about loan conditions	Borrowing	Reduced (especially for low-SES)
			Earned any course credits	Negative
Darolina & Harper (Forthcoming)	US. Undergraduate students who obtained student loans in a prior year.	Information about loan conditions	Borrowing	No
			Drop-out, earned credits	No
Dinkelman & Martinez (2014)	Chile. Eighth grade (avg. age 15) low-SES students (and their parents).	Information about financial aid	College preparatory secondary school enrolment	Positive (greatest for medium to high-ability students)
			School attendance	
			Financial aid awareness	
Hoxby & Turner (2015)	US. High-achieving low-income secondary school students.	Information about application steps, college costs and fee waivers	College application	Positive
			College admission	
			College enrolment	

3.8 Assistance

As evidenced by this review informational nudges and reminders do not necessarily improve student outcomes. A possible reason is that that recipients have limited attention and therefore may not pay attention to the information provided to them. Even if people do pay attention and want to act on the information, cognitive limitations and other behavioural barriers such as lack of self-control may imply that they are unable to do so. Basic one-on-one assistance (e.g. to fill out a form) might therefore be necessary to overcome the behavioural barriers.

A US intervention has demonstrated that basic assistance may be effective at changing behaviour. Low-income individuals who had received assistance completing their tax returns were provided with personal assistance to complete financial aid applications (Bettinger, et al., 2012). In addition, individuals were given personalised aid estimates that were compared to local college tuition fees. The intervention potentially targeted several behavioural barriers, including limited attention, cognitive limitations and procrastination. The intervention led to an increase in financial aid applications and college enrolment in the treated families. The effect came

from both secondary school seniors whose parents were treated and from adult secondary school graduates with no prior college experience.

Oreopoulos & Ford (2016) studied another assitance intervention. The intervention incorporated college application assistance into the curriculum for seconday school students in their final year. They considered two implementations (two years apart) and found positive effects on college applications and enrolment in the first implementation which combined assistance with application fee waivers. In the second, implementation there were positive effects on college applications only in treatments that combined assistance with fee waivers, suggesting that the removal of application fees was crucial for the success of the first implementation. Oreopoulos & Ford (2016) found no effect on enrolment in the second implementation regardless of whether fee waivers were included. The authors aruge that the differential effects are caused by less guidance in choosing eligible programs in the second implementation.

The two interventions have differing results and there is thus indication that the provision of basic assistance on it's own may also not be sufficient to ensure better student outcomes.

Table 12: Studies offering basic assistance

Paper	Target group	Intervention	Outcome	Effect
Bettinger et al. (2012)	US. Tax preperatory assistance recipients with low-SES and household member aged 15–30 years (avg 18 yrs).	Assistance applying for financial aid	Financial aid applications	Positive
			College enrolment	Positive
Oreopoulos & Ford (2016)	US. Secondary school students (age 17–18)	Assistance (+ application fee waivers)	College applications	Positive (if combined with fee waivers)
			College enrolment	Mixed (Positive in original implementation. No effect in replication study)

3.9 Boosting skills to alleviate self-control problems

Recognising that people may be unable to overcome the behavioural barriers they face (even if they are motivated to do so), an alternative to providing assistance, would be to teach students and parents skills that may enable them to do so. Boost policies teach people about possible behavioural barriers and general skills which may be used to mitigate the effects. For example, a number of recent interventions in education aim to boost skills alleviating self-control problems (for an overview, see Table 13). The goal of these interventions is to promote more active (conscious) decision-making across a *broad* range of contexts. In contrast, specific deadlines and goals (discussed in sections 3.4 and 3.5) have a rather narrow focus on de-biasing choices in a *specific* context through better active (conscious) or passive (subconscious) decision-making.

An example of a boost intervention, is a field intervention in Turkey that taught 4th grade students to be 'grittier' by providing cases and videos highlighting the role of effort and goal setting in skill enhancement and goal achievement (Alan, et al., 2016). Education outcomes are likely to be influenced by grit, which is generally defined as perseverance in a productive task and closely related to self-control.[15] The intervention was shown to increase standardised test scores in maths and Turkish by 0.28 and 0.13 standard deviations, respectively.

[15] We note that by highlighting the the role of effort the intervention also includes some ideas of growth mindset interventions discussed in section 3.12.

Also in Turkey, a learning programme aimed at teaching 3rd and 4th graders to be more forward-looking had positive effects on their behaviour (Alan & Ertac, forthcoming). Similarly, an Italian study has found that encouragement to attend a learning programme that included instruction in how students should organise their time and material, how to set goals and stay motivated, positively influenced the number of credits acquired in the following two years at university (De Paola & Scoppa, 2015). The positive effects were driven by people classified as heavy procrastinators. Furthermore, a one-year US programme tested across eight institutions of higher education taught participants goal-setting skills, study skills and better time management (Bettinger & Baker, 2014). One year after the end of the programme, persistency was increased by about 5 percentage points, and the persistency of the treatment group remained about 3 percentage points higher than that of the control group one year later.

A less intensive intervention was studied by Yeoman & Reich (2017). They provided planning prompts to students in three MOOCs at Harvard. Students in the planning treatments were prompted to write down their specific plans to engage with the course. The authors reported positive effects on course completion. Similarly, a US study found that an intensive goal-setting programme teaching 85 college students *how* to set goals impacted their grades positively (Morisano, et al., 2010). Compared to the goal-setting interventions discussed in Section 3.5, the focus of the intervention in Morisano, et al. (2010) was not to get students to set a goal for a specific task but rather to teach them goal-setting skills that could be used more broadly.[16] Dobronyi, et al. (2017) implemented a similar goal-setting intervention among a larger sample of nearly 1500 undergraduate Economics students in Canada and Schippers, et al. (2015) studied a similar large scale intervention in the Netherlands. Schippers, et al. (2015) found positive effects on grades and retention for university students, especially for male and minority students. Dobronyi, et al. (2017) also tested the effect of combing or replacing part of the goal-setting curriculum with a curriculum intended to promote a growth mindset and in some treatments they regularly reminded participants of their goals. In contrast to Morisano, et al. (2010), Dobronyi, et al. (2017) did not find positive treatment effects on grades or retention rates in any of their treatments. The different findings are likely due to the fact that Dobronyi, et al. (2017) used a less selected sample and in particular there was no self-selection into the treatment group as in Morisano, et al. (2010). Hence, the sample in Dobronyi, et al. (2017) may be less motivated. In Schippers, et al. (2015) pre- and post-intervention cohorts are compared and this could potentially explain the differential effects compared to Dobronyi, et al. (2017).

Generally, the effects of interventions teaching students and parents' skills like grit, forward-looking behaviour and goal setting have been positive and some evidence suggests that the effects are largest for individuals with the greatest self-control problems. However, recently Dobronyi, et al. (2017) failed to find positive effects for a large scale intervention. This is possibly due to the use of a less selected sample with on average less motivation to improve skills. Lacking motivation may arguably undermine the effectiveness of boost policies (Grüne-Yanoff & Hertwig, 2016).

[16] The Sense-of-purpose interventions of Yeager et al. (2014a) and Paunesku et al. (2015) also are related to interventions boosting goal-setting because they also induce students to reflect on the overall goal of learning.

Table 13: Studies boosting skills to alleviate self-control problems

Paper	Target group	Intervention	Outcome	Effect
Alan et al. (2016)	Turkey. Grade 4 (avg age 10). Mostly low-SES.	Grit, goal setting.	Test scores	Positive
Alan & Ertac (forthcoming)	Turkey. Grades 3–4 (age 9–10).	Forward-lookingness	Behaviour	Positive
De Paola & Scoppa (2015)	Italy. University students	Planning, time-management, goal setting.	Earned course credits	Positive (especially for high procrastinators)
Bettinger & Baker (2014)	US. Students at higher education institutions.	Goal setting, time-management.	College persistency	Positive
Yeomans & Reich (2017)	US. Students in 3 MOOC.	Planning	Course completion	Positive
Morisano et al. (2010)	US. Low-achieving university students.	Goal setting	Grades	Positive
Schippers et al. (2015)	The Netherlands. University students.	Goal setting	Earned course credits	Positive (especially for male and minority students)
			Persistency	Positive
Dobronyi et al. (2017)	Canada. Undergraduate Economics students.	Goal setting	Grades	No
			Persistency	No

3.10 Social comparison nudges

Nudges providing social comparison information are special cases of informational nudges. The nudges provide information that facilitates comparisons with others and in doing so may appeal to people's preferences for adhering to the social norms and/or may create social pressure to adhere to the norms.

An example of a classical social information nudge in the education sector is provided by Coffman et al. (2017). They study an intervention providing a random subset of high-achieving college graduates admitted to the Teach for America program with information about the percentage of people who accepted the job in the previous year. Teach for America recruits college graduates and professionals to teach for two years in public schools. Coffman et al. (2017) found that adding the line "Last year more than 84 percent of admitted applicants made the decision to join the corps, and I sincerely hope you join them" in the admissions letter significantly increased the likelihood of accepting the offer, starting to teach and returning to teach in the following year.

Relative performance feedback may also be used to facilitate social comparisons and nudge better education decisions. However, this requires knowledge of the norms in place and alignment between social norms and the desired behaviour. A German study illustrates the difficulties involved. Wagner & Riener (2015) found negative effects of an intervention that made test performance public, either to peers in the classroom or to parents. Negative effects only appeared for students attending the academic-track upper secondary school, which generally attracts higher-SES students. No effects were found for students attending the non-academic-track or comprehensive secondary school. The negative effects were mitigated when students were able to select the type of public information provided (i.e. whether parents or classmates would learn that they had improved their performance).

Similar adverse effects were found in a US intervention introducing a performance-based leader board which announced the top three performers in the classroom, school and among all users of the computer-based course

tool (Bursztyn & Jensen, 2015). This led to a 24% *decrease* in performance, primarily driven by a decline in effort provided by students who were top performers prior to the introduction of the leader board. This suggests that the students wanted to avoid such mention. Another intervention offered students access to an online test preparation course, and students were randomly told that the decision to enrol in the course would be kept private from other students (Bursztyn & Jensen, 2015). In advanced classes, the sign-up rates were unaffected by whether the enrolment decision was public. In less advanced classes, however, the enrolment rate was 11 percentage points *lower* when the decisions were made public. The response of those students enrolled in *both* advanced and non-advanced courses appeared to depend on the type of course and, hence, the type of peers and social norms in the classroom. In advanced classes (where many people enrolled), these students were eight percentage points more likely to sign-up for the course. In contrast, in less advanced classes (where fewer people enrolled), they were 15 percentage points less likely to sign-up. These results suggest that the social norm may be to make relatively little effort in some classrooms; in such settings, it may be counterproductive to make effort choices public.

Relative grading also involve social comparison information and several interventions have investigated the effects. Jalava, et al. (2015) conduct a randomised trial on more than 1,000 sixth graders in Swedish primary schools, finding that student performance was significantly higher with relative grading than with standard absolute grading (on an A–F scale).[17] Boys seemed to be motivated more by relative grading. The study also found that the effects were smaller for students for whom the questions were harder because they were tested early in the school year. This suggests that relative grading may be ineffective when obtaining a high rank is more difficult.[18] In contrast to these findings, a Dutch study among bachelor students found no difference in effort provision (homework handed in, homework grades, attendance, preparation time) or exam grades under relative and absolute grading (Cizbor et al., 2015). The choice only seemed to matter for marginal students who were close to the pass/fail cut-off. In that case, the exam performance of male students was greater with relative grading.

A natural experiment in Spain also provided evidence on the effect of relative performance feedback (Azmat & Iriberri, 2010). In one school year, secondary students were provided with relative performance feedback (average student grade point average (GPA)) in addition to absolute performance feedback (own GPA). The study found that this information led to a 5% increase in grades, and the effect was significant for high and for low-performing students alike. The effect did not persist, however, disappearing as soon as the information was removed. Tran & Zeckhauser (2012) found positive effects on test scores of providing Vietnamese university students with information about their rank in the class. There were no statistically significant differences between providing the information *only* in private or both privately *and* publicly. Davis et al. (2017) and Martinez (2014b) studied relative feedback provision in a MOOC environment with typically low levels of course engagement. Davis et al. (2017) found positive effects on course completion of feedback comparing performance and engagement with that of a previously successful student. There were, however, only small and insignificant effects on course engagement. Martinez (2014b) found positive effects on some measures of

[17] Absolute grading is also sometimes referred to as criterion-based grading because grades are determined by comparing the student's performance with an objective criterion. Relative grading is also sometimes referred to as ranked based grading or norm-referenced grading.

[18] These effects are in line with the non-experimental results reported by Murphy & Weinhardt (2016). Besides effects on student performance within subjects, the results from this English study suggest that, conditional on ability, a high-rank position in primary school in a particular subject has long-term effects on test scores and subject choice, particularly for boys. This might suggest that a high rank boosts confidence in the subject, which makes the student improve in the subject and choose to specialise in it.

course engagement in the short-term, and in the longer term effects on grades and course engagement are confined to low-performing and engaged students who followed the schedule of quizzes.

However, not all studies have found positive effects of providing relative performance feedback. Azmat et al. (2016) found negative effects of giving Spanish university students access to information about their position in the grade distribution on the number of exams passed. The negative effect was driven by students who initially underestimated their position in the distribution and therefore seemed to lower effort in response to the information. This again highlights that using social norms and social comparisons can backfire for high performing students. Azmat et al. (2016) found no effects on a self-reported measure of the number of hours studied or on exams attempted. However, they did find positive effects on student satisfaction with the course.

We note that relative performance information may have both motivational and informational effects. In fact, Azmat & Iriberri (2010) only found significant effects for students in the first and last years of secondary school. For students in their first year the relative performance feedback information likely provides new information (hence the information effect is large) but in the last year students are likely to me more responsive to the information (hence the motivational effect is larger). Especially for the motivational effect, it could be important that there is enough time between the time at which the feedback information is provided and testing allowing students to respond to the information. Fischer & Wagner (2017) provide evidence that positive effects of relative performance feedback on tests scores only arise if the feedback is provided at least 1-3 days in advance. Their findings also suggest that feedback about the level (i.e. the rank on the previous test) is as effective as information about the change (in ranking). Information about the change in rank was, however, only effective for the subset of students for whom the rank worsened.

Social comparison nudges may also target parents. Rogers and Feller (2017) studied an intervention providing parents a comparison of their child's absenteeism with that of a 'typical' student. The intervention was targeted towards the parents of childen attending primary or secondary school who had a relatively high level of absenteeism but not excessively high (more than 2 standard deviations above the mean student). Compared to a treatment provding information about absolute levels of absenteeism, the study reported no effect on the level of absenteeism of providing relative information. This is despite the fact that the authors did find evidence that parents' beliefs about relative absenteeism were debiased by the intervention.

Disclosure interventions have also been used with the aim of increasing teacher performance. Such disclosure policies provide feedback to teachers and facilitates social comparisons but at the same time the performance information may influence student sorting if parents and students "vote with their feet" and teacher attrition if low-performing teachers are removed (Rockoff et al., 2012). Bergman& Hill (2015) studied the disclosure of value-added test scores for Los Angeles teachers. They found that the publication of performance information had positive effects on the performance of low-performing teachers and negative effects on the performance of high-performing teachers. This mean reversion effect is consistent with effort being adjusted to fit the social norm (average). There were no effects on teacher attrition but there was evidence that higher ability students were sorted into classrooms with high performing teachers. However, Bergman & Hill (2015) provide evidence that this sorting of potentially top-coded students into the classrooms of high performing teachers did not drive the results. Pope (2015) studied the same disclosure of teacher performance data but using fixed effects estimations instead of the regression discontinuity approach used by Bergman & Hill (2015) which exploited that only performance information for teachers with at least 60 students was made public. In contrast to Bergman & Hill (2015), Pope (2015) did not report a negative impact on performance for high performing

teachers nor did Pope (2015) find effects on student sorting. The differing results are likely caused by the different estimation approaches.

Overall, social comparison nudges in education have provided mixed and heterogeneous results with some studies reporting overall positive effects and others reporting no or even negative effects on student outcomes. Interventions providing relative performance information (in private or in public) may backfire because high-achieving students who perform better than the norm (who tend to have higher SES) reduce effort to adhere to the norm or because low-achieving students are demotivated by a high norm. It seems important that social comparison information is provided with enough time for students to adjust their effort level. Otherwise the information may also be demotivating. There is also some evidence that males respond more to social comparisons. Coffman et al. (2017) studies the only intervention included in our review that provides information about the behaviour of others without providing *performance* feedback. The positive effects suggest that such nudges may be more effective, perhaps because they avoid some of the pitfalls that can make social comparison nudges backfire. Such nudges are close to nudging social belonging which will show to be more effective (see section 3.12).

Table 14: Studies using social comparison nudges

Paper	Target group	Intervention	Outcome	Effect
Coffman et al. (2017)	US. New teachers admitted to Teach For America.	Social information	Accept teaching job	Positive
			Start teaching	Positive
			Continue teaching	Positive
Wagner & Riener (2015)	Germany. Secondary school students (age 10–11).	Disclosure of test performance	Test scores	Negative (for high-ability students)
Bursztyn & Jensen (2015)	US. Secondary school students.	Disclosure of top-3 on leader board	Number of correct answers	Negative (especially for top students)
		Disclosure of enrolment in test preparation course	Enrolment	Negative (for students in less advanced courses)
Jalava et al. (2015)	Sweden. Grade 6 (age 12–13).	Relative (vs. absolute) grading	Test scores	Positive (strongest effect for boys)
Czibor et al. (2015)	The Netherlands. University students	Relative (vs. absolute) grading	Study effort	No
			Grades	Positive (for male students on the margin of passing)
Azmat & Iriberri (2010)	Spain. Secondary school students (age 14–17).	Relative performance feedback	Grades	Positive
Tran & Zeckhauser (2012)	Vietnam. University students.	Relative performance feedback (private + public)	Test scores	Positive and no difference between private and public
Davis et al. (2017)	The Netherlands. Students in a MOOC.	Relative performance feedback	Course completion	Positive
			Course engagement	No
Martinez (2014b)	US. Active students in a MOOC.	Relative performance feedback	Grades	Some positive effects
			Course engagement	Some positive effects (especially for already engaged students)
Azmat et al. (2016)	Spain. University students.	Access to relative performance feedback	Course satisfaction	Positive
			Hours of study	No
			Exams taken	No
			Exams passed	Negative
Fischer & Wagner (2017)	Germany. Secondary school students (age 10-12).	Relative performance feedback: level vs. change in level + 1-3 days vs. immediately before test	Test scores	Positive (for level feeback and negative change if provided 1-3 days in advance)
Rogers & Feller (2017)	US. Parents of primary and secondary school children with medium-high absenteeism	Relative (vs. absolute) absenteeism information	Attendance	No
Bergman & Hill (2015)	US. Teachers grade 3-5.	Disclosure of value-added test scores	Test scores	Mean reversion
			Student sorting	Highly rated teachers get high ability students
			Teacher attrition	No
Pope (2015)	US. Teachers grade 3-5.	Disclosure of value-added test scores	Test scores	Positive (for low performing teachers)
			Student sorting	No
			Teacher attrition	No

3.11 Extrinsic motivation

Interventions using extrinsic motivation explicitly tie rewards to the desired behaviour (e.g. test performance or number of books read). The use of extrinsic motivation is not exclusive to behavioural approaches. Traditional policy tools based on economic incentives (e.g. taxes, subsidies) also provide extrinsic motivation to behave in a certain way. As nudges by definition *"do not significantly change economic incentives"* (Thaler and Sunstein, 2008), we limit our review to interventions with extrinsic motivation of limited monetary value: non-monetary rewards. Table 15 provides an overview of the studies.

Extrinsic motivation provided through non-monetary rewards may be somewhat similar to social comparison nudges because rewards often are provided in public. However, in addition to possible social recognition, the interventions considered in this section involve material gains. For example, Jalava, et al. (2015) conducted a randomised trial in Swedish primary schools finding that student performance was significantly improved when students could earn a certificate or win a prize. Girls seemed to be motivated more by non-monetary rewards than boys and the effects were smaller for students for whom the questions were harder because they were tested early in the school year. This suggests that non-monetary rewards may crowd-out intrinsic motivation when obtaining the reward is more difficult.

Levitt et al. (2016) also found positive effects of non-monetary incentives and their results suggest that non-monetary incentives announced immediately before a test may offer a very cost-effective way of increasing test performance because the possibility of winning a $3 trophy had greater effects on test scores than a $10 cash reward. [19] The study also suggested that non-monetary incentives were most effective for primary school children, particularly when combined with a loss frame (i.e. if the student was given the reward before a test and then told to return it if test scores did not improve). Positive effects of non-monetary incentives were also found in a US study providing primary school children with incentives to read books over the summer holiday (Guryan, et al., 2016). By reading books students could earn points to 'spend' on items such as art sets, board games or sports equipment. The study found positive effects on the number of books read and on vocabulary test results. There were no effects on comprehension or English language test scores. In contrast Fryer (2016) found no effects on test scores or effort provision for 6th grade students offered phone credit as an incentive to read books and complete comprehension quizzes. The study, however, found some positive effects on English and comprehension scores at a later college entry exam.

Interestingly, a recent German study reported heterogeneous effects of non-monetary incentives (Wagner & Riener, 2015). The study used a randomised field experiment to test the effect of three different types of non-monetary incentives on more than 2,000 students in grades 5–6. A control group received no incentives to improve their test scores, the first treatment group were given a medal in front of their classmates if they improved test scores, parents of students in the second treatment group received a letter if students improved their test scores, and students in the last treatment group were offered a choice between the medal and the letter. The study found positive but insignificant effects of all treatments for students attending non-academic secondary school or comprehensive secondary school. However, the medal and letter treatments on average led to negative and significant effects on test scores for students attending academic-track secondary school, suggesting either crowding out of incentives or that students did not like performance information to be public. Interestingly, however, the effects turned positive but insignificant in the choice treatment, possibly because students who did not like information to be provided to parents could select peer recognition instead and vice

[19] We note that general study effort leading up to the test is unaffected by construction.

versa. The study also found that low performers in both types of secondary school were more likely to choose the letter than high performers. This was particularly the case for low performers in the academic track.

These results are consistent with the findings of Grove & Wasserman (2006) who found no effect of grade incentives for university students. The study exploited a natural field experiment to analyse the effect of whether grades on problem sets counted towards the final grade. The study only found positive effects on exam performance for first-year university students. Karlsen & Varhaug (2016) also found no effects of an incentive scheme targeted at applicants at teacher colleges in Norway. Applicants told that they would be entered into a lottery to win books for their studies, were no more likely to complete enrolment than students not entered into the lottery.

In summary, non-monetary incentive have highly heterogenous effects on student performance. Positive effects have consitently been found for primary school children but results are less consistent and less positive for older students.

Table 15: Studies using non-monetary rewards

Paper	Target group	Intervention	Outcome	Effect
Jalava et al. (2015)	Sweden. Grade 6 (age 12–13).	Certificate + refillable pencil	Test scores	Positive (strongest effect for girls)
Levitt et al. (2016)	US. Primary, middle and secondary school students.	Trophy	Test scores	Positive (especially for primary school children and with loss framing)
Guryan et al. (2016)	US. Primary school children. Grades 3-5 (age 8-11).	Points to "spend" on art sets, board games or sports equipment	Number of books read	Positive
			Test scores	Positive (for vocabulary). No effects on overall language.
Fryer (2016)	US. Grade 6-7 students (age 11-13).	Phone credits	Effort	No
			Test scores	No
			Taking college entry exam	No
			Scores on college entry exam	Positive or no
Wagner & Riener (2015)	Germany. Secondary school students. Grades 5-6 (age 10–11).	Medal, letter or choice	Test scores	No or negative
Grove & Wasserman (2006)	US. University students.	Grade incentives	Grades	Positive (for first-year students)
Karlsen & Varhaug (2016)	Norway. Teacher college applicants.	Lottery incentive	Enrolment	No

3.12 Social belonging, identity activation and mindset nudges

Student performance may also be inhibited by the students' underconfidence in their own ability or more broadly by biased or suboptimal self-images. Interventions targeting students' mindsets and beliefs may thus potentially improve self-confidence, benefit students' self-image and ultimately improve student outcomes. A number of (brief psychological) interventions fall in this category and Table 16 provides an overview.

An important aspect of students' self-image concerns is potentially feelings of social belonging. Wilson & Linville (1982) is an example of an early small-scale intervention trying to influence feelings of social belonging. First-year students at a US university were informed that grades typically improve from the first year to later years. This information could strengthening the student's sense of belonging to the university student group and address insecurities about their own abilities. The sample in the study was rather small (40 students in total), but the study nevertheless suggested that information about the academic performance of peers positively influenced grades and reduced the drop-out rate. Similar effects on grades were obtained by Walton & Cohen (2011) who gave new university students fictional descriptions of other students' difficulties in fitting in during the first year of university and in addition asked the new students to describe their own difficulties.[20] More recently Walton et al. (2014) tested the effect of a social belonging treatment and a affirmation-training treatment on university students. Both treatments used descriptions of the experiences of older students to convey the messages and treated students were then asked to write about the provided information. In the social beloning intervention, the information highlighted older students' struggles to fit in

[20] We note, however, that the use of fictional descriptions in general could raise ethical concerns about the possibility of manipulation and might also harm the credibility of those providing the information.

at university and in the affirmation-training intevention, the messages emphasised how older students gradually learned to incorporate broader values and self-identity into their life while studying.[21] Walton et al. (2014) found positive effects on first year grade point average of both treatments for females in male-dominated fields. Yeager et al. (2016b) implemented a large scale online social belonging intervention teaching participants that early struggels at university do not necessarily translate into a permanent lack of belonging. They found positive effects on college enrolment for US secondary school students from high performing schools who have been admitted to college. In addition, they found positive effects on student outcomes such as enrolment and grades for disadvantaged incoming university students at private and public universities. There were no effects for advantaged students. Kizilcec et al. (2017) found similar effects in a large scale study. A social belonging intervention involving students in two MOOC at Stanford University had positive effects on persistency and course completion, especially for students from low income countries. In contrast, Broda et al. (2018) also tested a social belonging intervention using quotes from older students and found no effects on any student outcomes. The authors argue that the lack of effects may be due to suboptimal adjustment of the treatment to the specific context studied in Broda et al. (2018).

Another set of interventions have tried to influence behaviour through identity activation nudges. Lin-Siegler et al. (2016) provided 9th and 10th grade students in the US with information about the struggles of famous scientists.[22] One treatment provided students with information about the academic struggles of Albert Einstein, Marie Curie and Michael Faraday over a five-week period. Another treatment provided students with information about the same scientists' personal struggles, while the control treatment provided students with information about their scientific achievements. The intervention led to an increase in science grades for students in both struggle treatments. Moreover, Gehlbach, et al. (2016) found that providing teachers and students with information about similarities in their values, interests etc. led to improved grades. The effects appeared strongest for African-American students. This result matches well with the results of non-experimental studies showing that minority students perform better when taught by teachers or instructors with similar ethnicity or race (Fairlie, et al., 2014; Lusher, et al., 2015).

Another nudging intervention trying to activate identity is Bird et al. (2017) who used text messages such as *"We know you're the kind of student who maximizes your potential…"* to get potential college applicants to complete a financial aid application. The authors found no effects of the nudge. Chande et al. (2015) also used text messages with positive identity activation to encourage UK adult learners enrolled in basic maths and/or English to attend class. In contrast Bird et al. (2017), Chande et al. (2015) found positive and sizable effects. Yet another intervention in this category is the *wise feedback* intervention in Yeager et al. (2014c) which provided middle school children who were getting feedback on an essay with a note that their teacher held them to a high standard and believed in their ability to reach those standards. The authors found positive effects on student effort measured by the likelihood of handing in a revised essay and the quality of the revised essay.

In addition, some studies have asked students to reaffirm their values with the aim to encourage positive identity activation. In one study, students were randomly assigned to treatment and control groups, both of which were given a 15-minute, in-class written assignment (Cohen, et al., 2006). Students in the treatment group focused on values important to them, whereas the control group students focused on values that were not particularly important to them. The teachers did not know which students were in which groups, and they

[21] The affirmation treatment thus differed from the affirmation treatments discussed below because it included decriptions of older students' experiences.

[22] The interventions in Wilson & Linville (1982) and Lin-Siegler et al. (2016) may be interpreted as illustrative of ability being malleable rather than fixed and, as discussed below, such interventions generally have positive results.

resumed their lesson plan immediately after the assignment was complete. Despite the seemingly small intervention, the study found significant improvements in end-of-term grades for African-Americans but no effects for Caucasian Americans. The authors argue that the differential effects are due to the reaffirmation of personal values in the treatment group working to lessen the impact of negative stereotypes for minority students.[23] A later 2-year follow-up study reported lasting effects on the grade point averages of treated African American students (Cohen et al., 2009). Low-achieving African Americans benefited the most. Sherman et al. (2013) found similar short- and long-term effects on grade point averages when comparing Latin American and White middle school children participating in a similar intervention.[24] However, a replication study undertaken on a larger US sample failed to replicate these results and on average found no statistically significant effect of the affirmation treatment (Dee, 2015). Positive grade effects for minority students were found only in more supportive classrooms (i.e. with a high growth in peer achievement), and the intervention was found to have a negative impact on female students in these classrooms. Miyake et al. (2010) tested the same personal value affirmation treatment in a university level introductory physics course. The performance of female students in science and technology courses may be influenced by negative gender stereotypes and the authors hypothesised that the affirmation treatment could reduce the gender gap in student achievement. The study involved nearly 400 students and led to positive effects for female students on exam scores and performance on a standardised national physics test. There were no effects for male students. Kost-Smith et al. (2012) replicated the self-affirmation intervention in a later semester of the same course, with the same instructor and report similar effects on course exam scores but fail to replicate the results for national test scores. The authors hypothesise that the failed replication may in part be due to a smaller sample size of 283 students but probably more likely is due to higher baseline math scores among females in the original sample than in the replication study as there is indication that the affirmation treatment has the strongest effect among female students with high math scores. Kizilcec et al. (2017) tested the effect of a value affirmation treatment using a large sample of students in a MOOC and found positive effects on persistency and course completion for students from less developed countries but negative effects for students from more developed countries.

Earlier small-scale interventions in the US focused on mindset while teaching secondary school and undergraduate students that intelligence is malleable rather than fixed and showed positive effects on academic behaviour (Aronson, et al., 2002; Good, et al., 2003; Blackwell, et al., 2007). [25] However, simple priming to think about grades as being determined by effort rather than external factors or to think about having a high level of self-confidence does not necessarily deliver positive effects (Forsyth et al., 2007). Recently, a number of studies have tried to replicate the early growth-mindset interventions at a larger scale with a more representative student population. Paunesku et al. (2015) found positive effects on grades for a larger sample, but only for students at risk of dropping out. We note that the study by Paunesku et al. (2015) potentially suffers from selection bias because as little as 3% of the students in participating schools are part of the study. However, other studies using online growth-mindset interventions have had almost complete coverage at participating schools and found similar results on grades, continued college enrolment or academic performance some time later (Yeager et al., 2016a**;** Yeager et al., 2016b; Bettinger et al., 2018). Bettinger et al. (2018) showed that positive effects mainly arose for students who originally had a fixed mindset i.e. who

[23] This finding is complemented by lab experiments showing how priming students to think about negative student-athlete stereotypes can reduce performance on tests for athletes compared to non-athletes (Yopyk & Prentice, 2005; Harrison, et al., 2009; Dee, 2014). Similar results have been found for racial priming in the lab (see e.g. Steele & Aronson, 1995).
[24] We note that the intervention in Sherman et al (2013) involved more affirmation tasks which were administered on four to five occasions. Hence the intervention was not as brief as that studied in Cohen (2006, 2009).
[25] For a discussion of the motivational effect of believing that intelligence is malleable, see Dweck (1986) and Dweck (1999).

viewed ability as fixed. Nielsen & Andersen (2016) find similar results on test scores of an intervention targeting parents of primary school children in Denmark. In contrast to these positive results, one of the implementations studied in Yeager et al. (2016b) found no effect on college enrolment of a growth-mindset intervention targeted at secondary school students. The lack of effects is possibly due to their target population consisting of high school students at high performing schools who have already been admitted to college. There may thus be little margin for behavioural change. Broda et al. (2018) also found no effect of a growth-mindset intervention on most student outcome measures in a large-scale intervention involving more than 6,000 incoming students at a US university. They only reported positive effects on grades for Latin American students. Interestingly, there were no effects for African American students. The authors provide suggestive evidence that de differential effects for the two groups of minority students may be caused by more prevalent growth-mindset attitudes among African American students prior to the intervention.

Related to the growth-mindset studies, Yeager et al. (2014b) implemented a brief intervention that taught low ability secondary school students in the US that *personality* is malleable and found positive effects on grades. O'Rourke, et al. (2014) studied an intervention implementing growth-mindset ideas into feedback provision in a widely used online educational game targeting primary school children. The intervention changed the language used in the programme from praise of performance outcomes to praise of provided effort. The intervention led to an increase in the average amount of time children engaged with the tool, particularly for low-performing children.

Overall, the mindset, social belonging and identity activation interventions discussed in this section have almost all produced positive effects on student outcomes. However, in many cases there are only positive results for disadvantaged or minority students. A few studies result in non-positive effects and point to important learnings. First, the results of Broda et al. (2018) highlight a possible obstacle to scaling social-belonging interventions, namely the need to adjust the intervention to the local context using relevant quotes from local students. The quality of the quotes used may influence the effectiveness of the intervention making scalability harder. Second, the interventions by Bird et al. (2017) and Forsyth et al. (2007) suggest that some priming interventions may be too small to produce effects. Finally, given the largely positive results, it would be natural to think that combining several of these interventions would be more effective than doing them seperately. A few studies have tested the effect of combining treatments. Yeager et al. (2016b) combined social beloning interventions with growth-mindset interventions for high school graduates and incoming university students. They found similar or smaller effects of the combined treatment compared to a simple social beloning treatment. Paunesku et al. (2015) also find smaller effects of combining a growth-mindset and sense-of-purpose treatment.

Table 16: Studies using social belonging, identity activation or mindset nudges

Paper	Target group	Intervention	Outcome	Effect
Wilson & Linville (1982)	US. University students	Information about older students' struggles	Grades	Positive
			Persistency	Positive
Walton & Cohen (2011)	US. University students	Information about older students' struggles	Grades	Positve
Walton et al. (2014)	US. University students.	Social belonging treatment using older students' struggels	Grades	Positive (for females in male dominated fields)
		Affirmation training treatment using older students' struggels	Grades	
		Growth mindset	College enrolment	No

Yeager et al. (2016b)	US. Secondary school students from high performing schools admitted to college.	Social belonging (+ combined)	College enrolment	Positive (smaller effect if combined with growth-mindset treatment)
	US. Incoming students at a public university.	Growth mindset	First year college enrolment	Positive (for disadvantaged students, similar effects of all treatments)
		Social belonging (+ combined)		
	US. Incoming students at a selective, private university.	Social belonging	Grades	Positive (for disadvantaged students)
Kizilcec et al. (2017)	Students in two MOOC offered by Stanford University.	Social belonging treatment using previous students' struggels	Persistency	Positive (especially for students from less developed countries)
			Course completion	
		Reaffirming personal values	Persistency	Positive (especially for students from less developed countries, possibly negative for students from more developed countries)
			Course completion	
Broda et al. (2018)	US. Incoming university students.	Growth mindset	Grades	Positive (for Latin American students only)
			Credits completed	No
			Credits attempted	No
			Enrolment	No
		Social belonging treatment using older students' struggels	Grades	No
			Credits completed	No
			Credits attempted	No
			Enrolment	No
Lin-Siegler et al. (2016)	US. Secondary school students (age 14–16).	Information about academic struggles of scientists	Science grades	Positive
Gehlbach et al. (2016)	US. Secondary school students (age 14–15).	Information about teacher and student similarities	Grades	Positive
Bird et al. (2017)	US. Low-SES secondary school students registered with Common Application.	Text messages with positive identity activation	College application	No
			College enrolment	No
			College choice (characteristics)	No
Chande et al. (2015)	UK. Adult learners taking basic math and/or English (age 19+).	Text messages with positive identity activation	Attendance	Positive
			Drop-out	Reduced
Yeager et al. (2014c)	US. Middle school children (age 12-13).	Positive identity activation notes accompanying feedback	Likelihood of submitting a revised essay (study 1)	Positive
			Quality of revised essay (study 2)	Positive

Cohen et al. (2006) Cohen et al. (2009)	US. Middle school children (age 12–14). (Lower-) middle class.	Affirmation of personal values	Grades	Positive (for minority students)
Sherman et al. (2013)	US. Middle school children (age 11–14).	Affirmation of personal values	Grades	Positive (for minority students)
Dee (2015)	US. Middle school children (age 12–14).	Affirmation of personal values	Grades	Positive (in classrooms with high growth in peer achievment)
Miyake et al (2010)	US. University students.	Affirmation of personal values	Exam scores	Positive (for females)
			National test scores	Positive (for females)
Kost-Smith et al. (2012)	US. University students.	Affirmation of personal values	Exam scores	Positive (for females)
			National test scores	No
Aronson et al. (2002)	US. University students.	Growth mindset	Grades	Positive
Good et al. (2003)	US. Grade 7 (age 12–13). Mostly low-SES.	Growth mindset (+ social belonging)	Test scores	Positive
Blackwell et al. (2007)	US. Grade 7 (age 12–13).	Growth mindset	Grades	Positive
			Motivation	Positive
Forsyth et al. (2007)	US. University students.	Self-confidence	Grades	Negative (for low-ability students)
		Growth mindset	Grades	
Paunesku et al. (2015)	US. Seconday School students.	Growth mindset	Grades	Positive (for students at risk of dropping out)
Yeager et al. (2016a) Study 2	US. Secondary school students (age 14-15).	Growth mindset	Grades	Positive (for low performing students)
Bettinger et al. (2018)	Norway. Secondary School students (age 16).	Growth mindset	Performance on math task	Positive (especially for students with a prior fixed mindset)
Andersen & Nielsen (2016)	Denmark. Parents grade 2 (age 7-9).	Growth mindset	Test scores	Positive (especially for students of parents with a prior fixed mindset)
Yeager et al. (2014b) Study 2	US. Low ability secondary school students (age 14-15).	Malleable theory of personality	Grades	Positive
O'Rourke et al. (2014)	Users of educational computer tool.	Growth mindset feedback	Study effort	Positive (especially for low-performing children)

4. Conclusion

In recent years, nudging policies have rapidly made their way from research into policy design across a wide range of areas. Education policy is no exception. In many countries there is an interest in leveraging behavioural economics and especially cost-effective nudges to gently push children, adolescents, parents and teachers towards better education decisions and greater educational attainment.

The contribution of this paper is to take a step back and take stock of what can be learnt from existing research on field interventions that involve nudging. Our goal is to provide an overview of research on nudging interventions and their effectiveness in terms of effects on student outcomes; that is, when and under what conditions can the education decisions of children, adolescents, parents and teachers be nudged? Our hope is that the review will enhance the common knowledge base and be valuable to both academics and policy makers when designing future education interventions.

We categorise the existing literature by the type of intervention and in particular by two key characteristics of the intervention: 1) whether it is likely to induce active or passive decision-making and 2) whether it involves changes or additions to the decision environment. The underlying theory of change differs by these two dimensions. Active (or conscious) decision-making require that individuals have sufficient information, capacity, skills and motivation to make decisions. This is not required for passive decision-making. Interventions changing the decision environment presumes that the design of the choice environment inhibits desired behaviour whereas interventions involving additions to the choice environment assumes that behaviour is constrained by something which is missing in the decision environment.

Interventions involving passive decision-making include pure nudges (defaults, framing and peer group manipulations) and brief psychological interventions (social belonging, identity activation and mindset interventions). The former involve (small) changes to the decision environment whereas the latter add information to the decision environment. Our review suggests that, if effective, these two kinds of interventions can have broad and long term effects on overall student outcomes. However, some caveats are in place. First, if behaviour is in fact caused by active and not passive decision-making then the interventions may be ineffective. For example, peer group manipulations seem ineffective because students actively choose to engage with other peers than intended by the intervention. Second, interventions have to be significant enough to produce effects and there is a limit to how brief and subtle interventions can be to be effective. Third, heterogenous effects may arise. For example, many brief psychological interventions are especially effective for students who are likely to need them the most (e.g. disadvantaged students, minority students and students/parents with fixed mindsets).

Interventions that potentially induce active decision-making by adding something to the decision environment include informational nudges, assistance, boost policies. These interventions add information, capacity or skills to the decision environment. Often positive but highly heterogenous effects have been found. The positive effects suggests that many students and parents are motivated to make better education choices but sometimes lack the appropriate decision-making capabilities. The heterogeneity in effects points to the intuitive result that positive effects are more likely for groups who are primarily constrained by lack of the factor provided. For example, positive effects arise for information provided to parents who may lack information about child performance (and seem to have a demand for this information). Similarly, positive effects of providing information about returns to education are most likely to arise for low-SES students who likely lack such information because they often have less educated or low income parents. Further, there is some evidence that interventions boosting skills to alleviate self-control have the largest effect for individuals with the greatest self-control problems and if people are not constrained by lack of motivation. On the other hand, if interventions do not target the constraining factor in decision making, then the intervention is likely to be ineffective. This may explain why interventions informing about financial aid have generally not been effective.

Other interventions may influence behaviour both through active and through passive decision-making. These include nudges that rely on possibly underutilised self-regulatory tools (deadlines, goal-setting and reminders) as well as nudges that potentially influence motivation (social comparison nudges and nudges providing extrinsic motivation). The former alter the decision environment by exogenously imposing use of already available tools in very specific contexts. Deadline and reminder interventions have mostly found positive effects. Goal-setting interventions have had more mixed effects. Some evidence suggests that the interventions are more effective if people are highly motivated (e.g. in high stakes exam environments, reminders targeted at parents, deadlines for high ability students), if goals, deadlines and reminders involve specific tasks (e.g. completing college enrolment or aid applications) that may otherwise be procrastinated and if sufficient time is provided allowing people to change their behaviour. However, the evidence also suggests that care must be taken not to pressure individuals to set too ambitious goals as this may have adverse effects and it is unclear how short lived the effects are (e.g. reminder effects mostly seem short lived and the effect on long-term outcomes such as grades and earned course credits are more mixed). Recent studies outside the area of education have questioned whether the short-term benefits of using reminders might come at the cost of adverse effects in the longer term (Damgaard & Gravert, 2018). In particular, reminders may impose a cost on recipients who might therefore disengage from repeated reminders, implying that the effectiveness of reminders wanes in the long run. It is possible that externally imposed self-regulatory tools in general only can be expected to have short term effects because they do not add new skills, information or de-bias beliefs in a way that can be expected to lead to new habit formation.

The motivational nudges have had highly heterogeneous effects and in some cases even negative effects. This may be because the addition of social comparisons or non-monetary rewards (possibly provided in public) to motivate desirable behaviour can crowd-out intrinsic motivation. For example, people who perform above average (above the norm) may reduce performance and people who are offered a low value rewards may use this as a signal that high performance is not as valuable as previously thought. Our review also suggests that it may be important that social comparison information is provided with enough time for students to adjust their effort level. Otherwise the information may also be demotivating. However, if people perform below the norm or attach a high value to receiving a reward (which may be true for young children) then performance and motivation may improve. Allcott (2011) suggest a possible solution the boomerang problem for social comparison nudges: the use of injunctive norms that clearly indicate what behaviour is desired. In the context of home energy conservation, Allcott (2011) study an intervention using injunctive norms (in the form of smiley faces for low energy use) and find no boomerang effect. Our review also suggests that social comparison nudges are more effective if they provide information about the behaviour of others without providing relative *performance* feedback. We note that such nudges resemble identity activation nudges for which positive effects are common.

Our review clearly shows that few interventions produce positive effects for everyone. While some interventions (e.g. framing of test scores, deadlines and informational nudges providing feedback) seem most effective in terms of changing the behaviour of high-SES individuals other interventions (e.g. goal setting, reminders, information about the returns to education, boost policies and brief psychological interventions) seem most effective for low-SES students for whom there is the largest scope for improvements. The former raises concerns that some nudge interventions may serve to exacerbate existing inequality by being effective only among already-advantaged groups or sophisticates. The latter is consistent with the conjectures of scarcity theory as discussed by Mullainathan and Shafir (2013). There is also some indication that some interventions (non-monetary rewards and information about returns to schooling) are more effective if provided at young

ages. However, more research is needed to uncover differential effects by age and there is for example a general lack of nudging interventions targeting teachers.

Our overall conclusion from the existing evidence is that while nudging policies *do not always* lead to better education outcomes, these policies *can indeed* improve student outcomes. The studies considered in this review, however, focused mostly on short term effects and none of the studies considered overall welfare effects. In the context of education policy it seems clear that there are benefits for the individual and society of better education decision making but it seems increasingly clear that there are also costs associated with being nudged (Damgaard & Gravert, 2018; Allcott & Kessler; forthcoming). This calls for better targeted nudges. Our conclusions complement these findings and point to a general need for policy makers and researchers using nudging policies to carefully consider the underlying behavioural mechanisms including what behavioural barriers are targeted and what the theory of change for a given intervention is. This should enable policy makers and researchers to better predict whether a given intervention is likely to be effective and for whom.

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