Narrative Review Article

Behavioral Economics and Nudging Strategies in Educational Contexts

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ABSTRACT

Behavioral economics departs from the notion that people always make rational choices and provides insights into how predictable cognitive biases affect educational behavior. This narrative review explores the use of behavioral economics, heuristics, and nudge theory, specifically focusing on educational nudges to enhance students' engagement, persistence and attainment. This literature narrative review examines the role and the application of behavioral economics and nudging strategies in education such as present bias, goal setting, reminders, social comparisons, default options, framing, loss aversion, and mindset interventions, noting that they may be effective in different contexts and with different populations such as high school and college students. It also addresses ethical considerations related to the use of nudges in education, particularly transparency, data privacy, autonomy, equity and persuasive technologies. Overall, the literature suggests that low-cost behavioral interventions can add to, but not be a substitute for, more comprehensive education policies and pedagogical approaches.

Keywords: Behavioral economics; heuristics; nudges; education; framing; present bias

INTRODUCTION

Behavioral economics emerges as a field that challenges the traditional view of full rationality in human decision-making. In contrast to classical models, this approach considers cognitive limitations, heuristics, and biases. Various school behaviors, such as procrastination, present bias (preferring immediate pleasure over future benefit), and academic risk-taking can be explained by behavioral biases. Furthermore, research highlights an overemphasis on routine, cognitive errors resulting from information scarcity or choice overload (1).

Behavioral economics therefore provides a complementary perspective to traditional educational economics by focusing on how small changes in the decision environment, often referred to as *nudges*, can encourage more desirable educational behaviors without restricting freedom of choice. Examples include reminder messages sent to parents regarding attendance or examination dates, goal-setting interventions, social comparison messages, and default enrollment in educational programs. These low-cost interventions have attracted increasing attention because they can often improve participation and engagement while requiring relatively limited institutional resources.

This narrative review examines the application of behavioral economics and nudge theory in educational

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contexts. It focuses on studies involving primary, secondary, and higher education and reviews evidence on present bias, goal setting, reminders, social comparison, default options, framing, loss aversion, and mindset interventions. The review distinguishes between immediate behavioral outcomes, such as attendance, assignment completion, and participation, and longer-term educational outcomes, including academic achievement, learning gains, retention, and graduation. In addition, it discusses the principal ethical issues associated with educational nudges, including transparency, autonomy, informed consent, privacy, and equity, with the aim of providing a balanced assessment of both their potential benefits and limitations.

BEHAVIORAL ECONOMICS

BE emerged from the integration of economics, psychology, neuroscience, and other social sciences. Contrary to the traditional view of the rational agent, it considers that decisions are influenced by habits, heuristics, emotions, cultural patterns, and social interaction. Behavioral economists seek to explain choices and markets by taking psychological behavior into account, incorporating them into economic models to better predict individual outcomes and develop more effective public policies. These predictable behavioral patterns help explain why individuals often fail to act in accordance with their long-term intentions, despite having adequate information.

Adam Smith (2) is often regarded as one of the pioneers in BE. He proposed a view of human behavior that anticipated later dual-process theories of other psychologists and neuroscientists such as Kirkpatrick and Epstein, 1992 (3); Sloman, 1996 (4); Metcalfe and Mischel, 1999 (5); Loewenstein and O'Donoghue, 2004 (6). During the 1970s BE consolidated itself through the work of psychologists Kahneman and Tversky (7), who reported that the human brain uses cognitive shortcuts called heuristics to facilitate day-to-day decision-making. However, on certain occasions, they can lead us to systematic errors. They used the terms "System 1" and "System 2" suggesting that there are two modes of information processing. System 1, or the "automatic" system, is fast, effortless, associative, and unconscious. It relies on cognitive shortcuts, biases, enabling rapid decision-making. By contrast, System 2, or the "reflective" system, is slower, controlled, effortful, deductive, and self-aware.

The Thaler-Sunstein nudging principle (8) has proved to be one of the most important insights in behavioral economics. Nudges are small changes that encourage people to make better decisions without restricting their choices. In educational contexts, nudges have been introduced in the form of reminders, goal-setting prompts, default options, social comparison, framing strategies, and other behavioral interventions that have the potential to increase engagement, persistence and learning outcomes.

Unlike classical economics of education, which focuses on technical skills, BE explores socio-emotional skills and how they influence performance. Students and teachers are subject to bounded rationality, where they do not always make optimal decisions due to cognitive biases. Several behavioral biases are particularly relevant in educational contexts. Present bias, also known as hyperbolic discounting, refers to the tendency to favor immediate rewards over larger future benefits. Self-control problems arise because educational success often requires individuals to incur immediate costs, such as effort and persistence, in exchange for delayed rewards. Loss aversion describes the tendency for losses to be perceived as psychologically more significant than equivalent gains (7). Overconfidence may lead students to underestimate the preparation required for academic tasks and assessments. Students may also exhibit reference dependence, reducing their effort once they reach what they perceive to be an acceptable or average level of performance. Default bias reflects the tendency to accept pre-selected options because changing them requires additional cognitive effort. Likewise, choice overload may lead students to rely on simple decision rules, such as selecting the easiest alternative or following their peers when confronted with numerous educational options. Finally, social image concerns and social norms influence educational decisions because individuals often care about how they are perceived by others and tend to adjust their behavior to conform to perceived social expectations (9).

BE uses "nudges" to teach people about heuristics and how to make better decisions. Nudging can be defined as "any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (8).

When applied to education, several low-cost behavioral interventions have the potential to improve academic outcomes. For example, reminder messages sent to parents regarding school attendance or academic deadlines have been used as public policy tools to

improve student engagement and reduce absenteeism. Changes in choice architecture, such as default enrollment in educational programs or tutoring services, can increase participation by reducing decision friction. Symbolic rewards, including certificates and public recognition, may reinforce desirable academic behavior without relying on financial incentives. Social norm interventions encourage positive behaviors by informing students that a high proportion of their peers engage in desirable activities, such as completing assignments or participating in class. Commitment devices, in which students voluntarily establish academic goals or deadlines, may also promote self-regulation by increasing the psychological cost of failing to meet previously stated objectives.

Economics of education has traditionally relied on the human capital model, which emphasizes the long-term investment dimension of schooling decisions (10). Individuals invest in education if the expected present value of the benefits is higher than the expected present value of the costs (11). Empirical studies generally report positive economic returns associated with schooling, although the magnitude of these returns varies across populations and study designs approaches. Bhuller *et al*. (12) estimated an internal rate of return from schooling is around 10%. Lindahl and Krueger (13) reported that an additional year of schooling was associated with earnings increase of approximately 10% in the population that they examined. Lochner (14) stated that education has benefits on crime, health and good citizenship. Higher education is associated with better productivity and wages, fostering innovation, reducing inequality, and encouraging economic growth.

Because many education-related choices are complex and made at young ages, they are especially susceptible to behavioral biases, making education a natural area for BE. Although BE offers promising contributions to education, only 4% of the studies examined nudges in education (15). The following sections review the main nudging interventions that have been applied in educational contexts. An important distinction should be made between short-term behavioral effects and long-term education effects. Numerous behavioral interventions can improve short-term behaviors, which include turning in assignments, showing up to classes, test participation and enrollment in educational programs. Although these outcomes are useful indicators of student engagement, they should not be interpreted as evidence of improved learning, academic achievement, knowledge retention, or graduation rates. Whenever possible, the evidence presented throughout this review is separated into immediate behavioral effects and longer-term educational outcomes. Table 1 summarizes the interventions discussed in this article.

Table 1. *Summary of Behavioral Interventions in Educational Contexts. It provides a high-level thematic synthesis of the intervention categories discussed in the review. Mindset interventions are included because they are frequently discussed alongside behavioral interventions in education, although they are not generally classified as conventional nudges.*

Intervention type	Target Population	Behavioral mechanism	Outcome	Effect	Duration	Major limitation
Present bias	Secondary and higher education	Reduce procrastination	Study engagement; assignment completion	Positive	Short-term	Limited long-term evidence
Goal setting	Secondary and higher education	Commitment/ self-regulation	Persistence; engagement	Generally positive	Short-term	Mixed academic effects
Information/ Reminders	Secondary and higher education	Improve decision making	Attendance; enrollement; submission	Positive	Short-term	Poor Long-term effect
Comparison nudges	Secondary and higher education	Social norms	Participation Task completion	Mixed	Short-term	Context dependent
Extrinsic motivation	School children and college students	Financial/ symbolic incentives	Compliance; participation Task completion	Mixed	Short-term	May affect students differently
Default	Prospective and enrolled students	Choice architecture	Enrollment participation	Positive	Short-term	Few long-term studies

Continued Table 1. *Summary of Behavioral Interventions in Educational Contexts. It provides a high-level thematic synthesis of the intervention categories discussed in the review. Mindset interventions are included because they are frequently discussed alongside behavioral interventions in education, although they are not generally classified as conventional nudges.*

Intervention type	Target Population	Behavioral mechanism	Outcome	Effect	Duration	Major limitation
Loss aversion	Secondary and higher education	Loss-framed architecture	Performance compliance	Mixed	Short /medium-term	Context dependent effectiveness
Framing	Secondary and higher education	Changes in information presentation	Decision-making engagement	Mixed	Short-term	Context dependent
Mindset	Secondary and higher education	Belief intervention	Motivation; achievement	Mixed	Medium/ Long-term	Not a conventional nudge

IMMEDIATE BEHAVIORAL AND LONG-TERM EDUCATIONAL OUTCOMES

The effects of behavioral interventions reported in the literature vary considerably depending on the intervention, population, and educational context. While many studies attempt to investigate student's behavior following an intervention, other studies aim to understand broader educational outcomes that emerge over longer periods.

Distinguishing between these two categories is essential for interpreting the available evidence. Immediate behavioral outcomes refer to observable behaviors that occur shortly after an intervention, such as opening messages, attending classes, completing assignments, taking examinations, asking questions during class, and enrolling in or participating in educational programs. These results are mainly related to student participation and adherence to academic activities.

In contrast, long-term educational outcomes include broader indicators of academic success, such as academic achievement, learning gains, knowledge retention, course completion, persistence, and graduation. Immediate changes in behavior can enhance the opportunities for students to learn, but do not guarantee sustained learning gains. Consequently, evidence of improved behavioral engagement should not be interpreted as evidence of improved learning outcomes.

Throughout this review, immediate behavioral outcomes and long-term educational outcomes are discussed separately whenever possible. This distinction provides a more balanced interpretation of the literature and highlights that interventions demonstrating positive short-term behavioral effects do not always produce meaningful or lasting improvements in academic performance.

NUDGES IN EDUCATION

The BE used in education focuses on understanding students, parents and teachers' decision-making process to help all stakeholders make better choices. One way of doing so is through "nudging". Nudging aims to align people's actions with goals they already endorse but often fail to follow because of automatic responses. In education, this may involve meeting deadlines, applying to college, or simply arriving on time. Students generally want to do these things yet often struggle because automatic habits get in the way. It is important that nudges have an ethical design, particularly in interventions that target children, adolescents or any other vulnerable population.

Hansen and Jespersen (16) classify nudges into two categories: "Type 1" and "Type 2". The first type targets automatic behaviors (System 1) and involves no reflective thinking or conscious deliberation. Type 2 nudges encourage more reflective, deliberate thinking, like messages that says: "students who attend 80% of classes are significantly more likely to pass. Your attendance is 65%". Type 1 and Type 2 nudges use different cognitive processes but ultimately, both types aim to influence behavior without coercion, preserving freedom of choice and avoiding large economic incentives or punishments.

The main difference is that Type 1nudges focus on automatic and default behaviors that are associated with habits, heuristics and emotions while Type 2 attempts to change deliberate actions and choices. Type 1 nudges are more effective in situations where cognitive load is high while type 2 is better in achieving long-term sustainable behavioral changes (17).

Present Bias

In BE, present bias is the tendency to overvalue immediate rewards (like leisure) while heavily discounting future outcomes (like career opportunities). Children and adolescents ignore or heavily discount the future and are more likely to overemphasize immediate rewards and engage in risk-taking behaviors that may lead to suboptimal outcomes (Lavecchia *et al*., 2016). The costs of education become immediate, and the benefits remain in the future, therefore present-biased students prefer to discontinue education programs that they previously enrolled in (11). Additionally, poor self-control and the present bias may interfere with making the best decisions. Present bias greatly impacts student performance, drop-out rates, and financial decision-making. According to Green, Fry and Myerson (18), children and adolescents may exhibit poor self-control because their brains and in particular their executive functions are less developed, leading them to overweight immediate rewards and ignore the future returns of education. The brain's prefrontal cortex, which regulates forward looking and critical thinking, may not be fully developed until early adulthood years (19). Moreover, when self-control is low, students may repeatedly procrastinate on several tasks.

One approach to address this problem is to set interim deadlines that act as commitment devices that encourage students to begin studying earlier rather than postponing academic tasks (20). Students who recognize their own self-control problems often choose to impose deadlines when given the opportunity. However, grades are lower under self-imposed deadlines than under externally imposed ones, suggesting that students may not choose optimally (21,22). Overall, the positive effects of setting deadlines on grades reported by Ariely and Wertenbroch (21) are consistent with findings from Tuckman (23). Similar findings were reported by Bisin and Hyndman (22) who concluded that self-imposed deadlines do not necessarily improve task completion and may even be counterproductive because students tend to overestimate their ability to complete tasks and persist after an unsuccessful attempt.

Burger *et al* (24) paid university students for completing monitored study. Participants were randomly assigned to two groups: in the first, they could schedule their study time freely; in the second, they had to meet intermediate deadlines and complete 12 hours of study per week to receive payment. There were lower completion rates in the group with intermediate deadlines, indicating that deadlines are not always beneficial.

Overall, it appears that interventions that target present bias may have positive effects on immediate behavioral outcomes like assignment completion. Whether these nudges translate into more durable educational improvement remains unclear because the available evidence is limited.

Goal Setting

Goal setting is a low-cost tool, scalable behavioral intervention that can be implemented without mobilizing significant resources (25). The earliest work on goal setting theory was done by Edwin Locke (26). Goals can act as powerful motivators, improving effort, persistence, and performance (27, 28). They can act as reference points, triggering loss aversion when individuals fail to achieve them (29). It is believed that subjects with present-biased issues may benefit from self-set goals as internal commitment devices. Furthermore, goal-setting interventions have also been associated with reduced stress (30) and appear to be particularly beneficial for lower-performing students.

Clark *et al*. (31) reported that students who set goals took more practice exams. Locke and Latham (27) showed that specific, clear, measurable and challenging goals lead to better performance than vague ones.

Since the original work on Goal Setting Theory, several other studies evaluated different aspects of goal setting and their effect on academic performance like the type of goal (32) and extent of engagement with goal setting (33).

Schippers *et al* (33) investigated the impact of a written and staged personal goal-setting intervention on academic performance. Participants were asked to write about their personal goals, including academic goals, non-academic goals, or a combination of both. The authors found that the specific type of goal was less important than the goal-setting process itself. Rather than the content of the goals, the act of reflecting on and writing about personal goals appeared to be associated with improved academic performance.

Moeller *et al* (34) reported that long-term academic planning and self-monitoring improved performance.

Additionally, Martin and Elliot (35) suggested that personal best goals predict higher motivation and engagement in students. Islam *et al*. (25) obtained positive outcomes on self-reported student time planning, study effort, and self-discipline, along with a positive but statistically insignificant impact on test performance with goal setting. Moreover, they found higher impact on test performance for students in the middle of the distribution of baseline learning levels. Weijers *et al*. (36) tested goal-setting nudge to encourage college students to ask questions during class. They showed a positive effect of the goal-setting nudge on students' grades and a marginally positive effect on the number of questions asked by students.

Van Jaarsveld *et al*. (37) published a systematic review on goal setting in higher education. Results showed a strong trend toward partial digitalization, with most studies using technology to deliver their goal setting activities, but very few adopting technologies for any further enhancements or support. According to Gollwitzer and Sheeran (38), holding a strong goal intention does not guarantee goal achievement, because most students have self-regulatory problems. Some argue that combining extrinsic motivation (recognition) and intrinsic incentive (self-set goal) may have better outcomes than goal setting alone (39, 40).

Overall, the evidence on the effects of setting specific goals is not totally clear and there is no consensus whether task-based or performance-based goals are more effective. Oreopoulos *et al*. (41) state that goal-setting nudges do not generate better academic outcomes, although they improve student's time use behavior. Oreopoulos and Petronijevic (42) reported that students' study approximately five to eight fewer hours per week than they intend to and different nudges strategies did not change this pattern. Caution is needed when encouraging individuals to set very high goals, since proposing higher targets may sometimes produce negative effects. In general, goal-setting interventions consistently have a positive impact on short-term behaviors including assignment completion, persistence and study engagement. There is less consistent evidence, however, of similarly positive gains in longer-term learning outcomes, such as learning gains or grades.

Information And Reminder Nudges

Information and reminder nudges help students and sometimes parents focus on a particular problem or task by providing access to information, and/or reminders of the benefits of completing a task. Several studies have found positive effects of informational nudges on academic performance. Some information can be generic, non-personalized like information about procrastination (43), grit (44), and strategies for persisting in college (45) and can have positive outcomes.

Smith *et al*. (46) proposed a software platform that delivered personalized messages about current grades and reported improvement in student performance. Similarly, Kraft and Rogers (47) investigated the impact of parental involvement with student performance by sending weekly messages to them. They noted a reduction in dropouts and improved communication between parents and children about school affairs. Castleman and Page (48) examined a personalized text-messaging intervention designed to remind students of pre-matriculation requirements while providing access to counseling and peer mentoring. The intervention increased college enrollment, particularly among students with limited access to college guidance and support.

Avery *et al*. (49) evaluated the effectiveness of text-messaging interventions designed to support students throughout the college search, application, selection, and transition process. The authors examined two separate interventions. In the national study, students received one text message per month, whereas in the Texas study, messages were sent every one to two weeks. The national intervention had no significant effect on college enrollment, whereas the Texas intervention produced positive effects on several stages of the college application process and increased college enrollment. These findings suggest that the effectiveness of reminder interventions may depend on factors such as message frequency, local implementation, and the characteristics of the target population.

Information can be a powerful tool in helping students and parents improve decision-making and academic performance. Bandiera *et al*. (50) studied this effect on students' performance and found that providing feedback has a positive effect on performance. Franklin Jr. *et al*. (51) studied the effects of information and social norm nudges on task completion among online students (DAACS assessments and feedback). The Social Norms nudge informed students of the high percentage of students who have completed the DAACS, and the Performance nudge informed students of the success previous students have had after using DAACS. The Performance nudge had a positive effect on students' completion of the DAACS, while the Social Norms nudge did not maybe because the first provided motivational

information ("students who use the DAACS are 1.5 times more successful than those who have not."). Nudges that combined features of reminder, social comparison, and informational were more effective than nudges that only provided information. Other studies also found positive impact on students' performance (52, 53). However, some found no benefit on messaging students (54, 55).

As stated earlier in this paper, education has a positive influence on future income. When transitioning to higher education, many students and parents aren't aware of these benefits. Booij *et al*. (56) reported that in the Netherlands, only 35% of available loan-based financial aid is utilized. Additionally, lowering tuition costs has been shown to have little impact on college enrollment rates (57, 58). One explanation is that students may overestimate the tuition costs or are misinformed about the returns to college education. Increasing information for prospective college students has therefore been an important endeavor (59). Nguyen (60) randomly assigned students to receive information on the returns to education through national statistics scored higher on tests. Mc Guigan *et al*. (61) provided Information on the potential earnings, benefits, net costs of attending college, and information on financial aid options. Students in the treatment group were less likely to believe that the costs of higher education are a barrier to attending and that university graduates have better labor force outcomes.

Reminding students to complete tasks may have a positive effect on a variety of outcomes. Debrah and Timmis (62) investigated the impact of phone calls and personalized email/messaging on student engagement. They found that initial personalized telephone calls can enhance student engagement with their studies, but achieving measurable academic success requires sustained intervention. Unkovic *et al*. (63) sent reminders to graduate students about presentation to an academic conference. They reported an increase in numbers of submissions. Similarly, Motz *et al*. (64) reported that sending reminders about upcoming deadlines increased student's on-time assignment submissions and grades. Oreopoulos *et al*. (65) evaluated two low-cost college support programs designed to target poor time management. They helped students to construct a weekly schedule and to receive weekly study reminders or coach consultation via text message. Although they had high participation and engagement, the treated students had no effect on credit accumulation, course grades, and retention.

Therefore, studies show that reminder nudges may improve immediate behavioral outcomes, especially attendance and participation. However, evidence that these behavioral outcomes translate into sustained academic success remains mixed.

Comparison Nudges

In educational setting, social comparison nudges provide information that facilitates comparisons with peers and appeal to individuals' preference for conforming to social norms. They may also create social pressure to adopt similar behaviors. Azmat and Iriberri (66) studied the effect of providing relative performance feedback information on performance. Students received feedback indicating whether they were performing above or below the class average. The intervention resulted in a 5% increase in grades. However, once the information was removed, the effect disappeared. Schubert (67) examined social norm nudges by giving students information about peer performance and market conditions, along with extra points for meeting specific goals. The intervention had no significant effect among women but produced positive effects among men.

Eyinck *et al*. (68) reported that sending messages to college students that provided information about what other students had done was more effective than sending them messages about what students should do. Martinez (43) sent an e-mail highlighting that students who procrastinate tend to perform worse than those who do not. The students who received the email were 17% more likely to complete the course. Tran and Zeckhauser (69) found that giving students information about their class rank improved test scores regardless of if the information was reported privately or publicly. However, other studies have not consistently found positive effects of relative performance feedback (70, 71, 72), and the evidence regarding long-term educational outcomes is less consistent and appears to depend on the context and implementation of the intervention.

Extrinsic Motivation

Extrinsic motivation, like subsidies, has been used in economics for a very long time. It can also be used in education for improving attention, attendance and habit formation. However, they are less effective at fostering long-term intrinsic motivation. According to the self-determination theory, excessive external rewards can undermine autonomy and intrinsic motivation.

Extrinsic motivations can be achieved in different ways: monetary incentives, symbolic rewards or teachers' incentives. Although these interventions may be sometimes grouped as extrinsic motivations, they

work through different behavioral mechanisms. For instance, monetary rewards provide straight financial incentive, symbolic rewards rely on social value, pride and recognition and educator incentives may influence educational outcomes by altering teachers' behaviors. Consequently, these interventions may affect student academic outcomes differently.

Some authors state that school children, especially girls, may be positively influenced by non-monetary rewards such as a certificate or a trophy (73, 74). Probably because non-financial rewards derive from status, self-image concerns, and relative performance feedback mechanism that can affect behavior. Levitt *et al* (75) found that non-financial incentives are considerably more cost-effective than financial incentives for younger students but were less effective with older students. External motivation can be financial like paying students for attendance, rewards for reading and cash incentives for desired grades. According to Damgaard and Nielsen (10), these incentives may not improve deep learning outcomes consistently.

Extrinsic motivation interventions may influence behaviors and emotions like stress, anxiety, persistence and deep learning, highlighting the importance of choosing the appropriate incentive mechanism for the educational context. Moreover, there is less consistent evidence that these incentives produce sustained learning gains or long-term academic achievement.

Default

Default bias is the human tendency to accept a pre-defined option instead of making an active one, making us stick with whatever choice is presented. In a classic study, Madrian and Shea (76) automatically enrolled employees of a large company in a savings plan, unless they actively opt-out. Although none of the economic features of the plan changed, this switch to automatic enrollment dramatically changed the savings behavior of employees. The authors argue that default behavior arises from inertia, procrastination and perceived endorsement (some employees interpret the default option as implicit advice).

In an educational context, default options have a profound behavioral effect because changing the *status quo* requires cognitive effort and time. Therefore, one of the best-known nudging strategies is to set default options (opt-in vs opt-out settings). Some examples of default options in education are automatic enrollment in tutoring and support programs, automatic enrollment of college students in recommended course sequence and advising appointments and automatic enrollment in preselected study schedules. The default options work because of present bias, limited attention and status quo bias. This nudge can reduce decision friction and procrastination.

A study done by Marx and Turner (77) confirms that students tend to borrow more if they are offered non-zero loan offer. Students who received a non-zero loan offer were 40% more likely to borrow than those who received a $0 offer. They also reported that GPA and completed credits increased by 30%. Bergman, Lasky-Fink Rogers (78) say that automatically enrolling parents increases take-up to 95% and improves student achievement as measured by GPA and course passing. Studies suggest that default options may increase participation and enrollment consistently. However, relatively few studies evaluated their effectiveness on long-term educational achievements.

Loss Aversion

Loss aversion is the BE principle that losses are psychologically more powerful than equivalent gains (7). In education, this principle manifests primarily through grading structures, student motivation, and educator incentives. A student's reference point dictates how intensely they experience loss aversion.

According to this theory, the psychological forces linked to approach motivation (gain in points) and avoidance motivation (loss in points) may be asymmetric. Moreover, there are two types of loss (failure) that result from intrapersonal and interpersonal comparisons. In the first condition, students compare the 80 points that they received on a midterm to the 85 points that they usually average on class quizzes. In the second condition, students compare the 85 points that they receive on a midterm to the 90-point class average on the midterm (79).

Brain imaging studies show that losses and gains might be processed in different regions of the brain (80), suggesting that they are evaluated in qualitatively different ways. Loss-aversion interventions have different approaches. Some research provides advance endowments that participants may lose if they do not achieve specific goals, whereas others frame grading in terms of potential losses rather than gains. While both interventions rely on loss aversion, they may affect performance and motivation in rather diverse psychological pathways.

There is some evidence that risk preferences are related to schooling, but the direction of the effect is

unclear. For example, Brañas-Garza *et al*. (81) found no relationship between math skills and risk profile. Burks *et al*. (82) found a weak negative association between risk aversion and GPA, but the correlation vanishes as controls are added to the model. Grijalva, Koford, and Parkhurst (83) examined whether loss aversion affected students' likelihood of completing extra-credit work and their overall grades. The results showed no loss aversion effect on grades. However, students with higher grades were more likely to complete extra-credit assignments.

Wu (79) examined loss aversion in academic grading by distinguishing between intrapersonal and interpersonal comparisons. The findings showed that students were more sensitive to changes in performance than to their absolute level of achievement, and that loss aversion depended on the reference point used for comparison. Specifically, students exhibited loss aversion only in interpersonal comparisons, where their performance was evaluated relative to that of their peers, but not in intrapersonal comparisons, where they compared their current performance with their own previous achievements. These results suggest that concerns about being perceived as less competent than others may be a stronger driver of loss aversion than declines relative to one's own past performance. Consequently, the predictions of prospect theory were only partially supported, as loss aversion was observed exclusively in the interpersonal context.

Horn and Kiss (84) noted that risk-averse students perform a little better than more risk-tolerant ones. Probably because risk-tolerant students may try to pass the exam less prepared. Several studies reported that there is a negative correlation between time discount rates and risk aversion (85, 86, 87). Epper and Fehr-Duda (88) state that both risk tolerance and patience are on average higher for payoffs that materialize in the future compared to payoffs in the present.

These studies demonstrate that loss-aversion may affect educational behaviors, but the available data is still insufficient to conclude if these effects are effective in the long-term across different educational settings and populations.

Framing

The framing heuristic refers to how the presentation of information influences decision-making. People react differently to the exact same choice depending on whether it is presented as a gain or a loss. In education, framing nudges alter how choices, information, or feedback are presented to students or teachers without restricting options, influencing decision-making and academic performance.

Traditional grading in schools is usually on a gain-framed framework where students start with zero points and accumulate them. Researchers have experimented with reversing this architecture to leverage loss aversion. For instance, students begin with full credit on day one and every error or missed assignment subtracts points from that balance. The psychological discomfort associated with losing points could result in students being more attentive to their studies, enhancing both engagement and performance (89).

Apostolova-Mihaylova *et al*. (90), studied the loss frame in college students. The treatment group started each task with full points, and points were deducted for incorrect answers. The authors found no differences between the groups considering grades. Wagner (91) compared gain and loss framing in non-monetary test incentives. He divided students into three groups: (i) gain frame (control), (ii) gain frame with a negative endowment (Negative), and (iii) loss frame (Loss). They found that pupils in both treatment groups get more points on tests than pupils in the control group. When evaluated by their ability, high-performers increase performance in both treatment groups, but motivation is significantly crowded out for low-performers in the Loss Treatment. Fryer *et al*. (92) examined whether framing teacher performance incentives as losses was more effective than framing them as gains. In the loss condition, teachers were paid in advance and had to return the money if student test scores did not improve enough. In the gain condition, teachers receive an end-of-year bonus only if student performance improved. The study found significant gains only under the loss frame. According to Levitt *et al* (75), endowing students with a performance-based reward in advance of the incentivized task may increase their utility of keeping the reward and motivate greater effort. But contrasting with other laboratory experiments, they did not notice an increased response in effort when rewards are framed as losses.

It is important to notice that the educational environment has unique characteristics such as long-term goals. Therefore, successful nudges applied in other fields do not always work in education. It is believed that type 2 nudges are usually more effective in achieving long-term behavioral change. Framing approaches should be interpreted with caution as positive vs. negative; gain-framed vs. loss-framed do not necessarily produce similar effects. Their effectiveness varies according to studies design, target population and educational context.

Mindset

Student performance may also be limited by underconfidence in their own abilities. Mindset interventions attempt to encourage students to adopt a positive perspective when faced with setbacks or challenges and it may strengthen self-confidence, self-image, and ultimately enhance academic outcomes. Students inclined to view ability as innate—with a fixed mindset—were more likely to become discouraged by doing poorly on an initial test than students inclined to view their intelligence as malleable (93). Dweck suggests that a flexible mindset can be developed by introducing students to relatable stories of resilience and reflective writing exercises.

While not considered to be "nudges" *per se* following Thaler and Sunstein's (8) definition, growth-mindset interventions share a common goal with behavioral interventions, namely, to foster positive educational behaviors through modest changes in students' beliefs, expectations, and decision-making processes, and with comparatively small costs. For this reason, mindset interventions are presented here as complementary behavioral interventions, although they are a more comprehensive psychological and educational intervention than the more traditional nudges.

Building on the work of Yeager *et al*. (94), Oreopoulos and Petronijevic (42) evaluated the effectiveness of low-cost, scalable growth mindset interventions designed to improve academic performance. The intervention encouraged students to read stories describing how others had adopted more constructive perspectives to overcome academic challenges and to write about their own experiences in order to motivate future students. In contrast to the findings of Yeager *et al*. (94, the authors found no significant improvement in academic outcomes. Overall, the evidence on growth mindset interventions remains mixed, indicating that further research is needed to clarify their long-term effects and effectiveness across different student populations.

Concerns

Although nudges are designed to steer people toward beneficial choices while preserving autonomy, the recent surge of nudging, especially into e-learning, particularly with the increasing use of using persuasive learning technologies, has triggered critical discussions on maintaining the equilibrium between stimulating engagement and using psychological pressure. Nudges are perceived as less invasive than mandates or financial incentives, but their ethical acceptability depends on their design and how they are implemented. Educational nudges should be extra careful once these interventions involve children and adolescents, that are usually more vulnerable than adults.

Ethical principles should guide the design of educational nudges. These interventions should be as transparent as possible, preserving opportunities for opt-out, support informed decision-making rather than manipulate students through deception or excessive pressure.

Persuasive systems in education have been shown to be effective in motivating students. While there is as much evidence for nudges increasing learning engagement, there are still concerns about ethical acceptability, transparency, and learners' autonomy (95, 96). Learning analytics can foster adaptive learning environments that meet diverse learner needs. However, challenges arise from data privacy protection and ethical considerations (95) such as algorithmic profiling and digital surveillance. Data should be collected and used responsibly, protecting privacy and preventing unintended discrimination.

Internet environments are nudging through slight data-based changes that do not claim to dictate decision but softly influence them. The increased implementation of persuasive educational systems and gamification (a design approach that applies game mechanics in non-game activities and situations to boost engagement, fun, and good behavior, highlights the increasing convergence between education and digital consumer technologies (97). Gamified micro-learning systems (the combination of gamification with super short, focused lessons) and chatbot-assisted learning platforms have been shown to have positive influences on intrinsic motivation, whereas nudging interventions have been able to effectively enhance online engagement and task completion (97, 98). Although, a skewed mix of gamification features, routine reminders, or social comparison items may debase learner autonomy, eliciting resistance or disaffection instead of long-term motivation (99).

Balaskas *et al*. (100) found that persuasive design elements had significant impacts on intrinsic motivation and interface designers, teachers, and policymakers should take these elements into consideration when supporting healthy and ethical learning environments. Equity is also one of the ethical factors to consider. While low-cost behavioral interventions are likely to lessen the barriers for a wide range of students, they may have varying effects by socioeconomic status, age, disability, language, access to digital resources, academic

attainment, and institutional environment. Therefore, the average impact of educational nudges should be assessed in addition to the distributional impacts that are likely to happen within the group of learners.

In educational contexts, choice architecture should be supportive, aligning choices with students' own goals to learn while maintaining some level of student freedom. Coercive or deceptive designs are associated with undue pressure, manipulation, or hiding of the intervention, and do not leave room for autonomy and informed decision-making. Ethically responsible educational nudging should be transparent, proportionate, evidence-based, respectful to privacy, equity and support rather than manipulate learners. Table 2 summarizes main ethical concerns addressed in this review.

Table 2. *Main Ethical Concerns Associated with Nudging Interventions in Educational Settings.*

Ethical concern	Description	Potential implications for education	Recommended safeguards
Autonomy	Nudges influence decisions without restricting available options, raising concerns about whether individuals retain genuine freedom of choice.	Students may unknowingly be steered toward specific behaviors or decisions.	Preserve voluntary participation and ensure that alternatives remain easily accessible.
Transparency	Learners may be unaware that behavioral interventions are intentionally designed to influence their decisions.	Lack of awareness may reduce trust in educational institutions if interventions are perceived as covert.	Clearly communicate the purpose, design, and objectives of behavioral interventions whenever feasible.
Manipulation	Nudges may exploit predictable cognitive biases rather than encourage reflective decision-making.	Excessive reliance on behavioral techniques may undermine students' independent judgment and critical thinking.	Use nudges only to promote learners' welfare and educational interests, avoiding institutional self-interest.
Informed consent	Ethical concerns are heightened when interventions involve minors or collect behavioral data.	Students and parents may not fully understand how behavioral information is being used.	Obtain appropriate consent when required and comply with ethical and legal standards.
Privacy and data protection	Digital nudges frequently rely on learning analytics and personal data.	Collection and processing of sensitive educational data may create privacy risks.	Minimize data collection, ensure secure storage, and comply with applicable data protection regulations.
Equity and fairness	Behavioral interventions may not produce equivalent effects across socioeconomic, cultural, or demographic groups.	Uniform interventions may unintentionally widen existing educational inequalities.	Evaluate differential effects across subgroups and adapt interventions to diverse learner needs.

CONCLUSION

The insights provided by behavioral economics have clarified the cognitive biases, heuristics, and contextual factors that influence educational decision-making. The evidence examined suggests that there are several immediate behavioral outcomes that can be enhanced with behavioral interventions, specifically nudges, such as attendance, assignment completion, engagement, and participation. However, these short-term behavioral improvements do not consistently lead to long-term educational outcomes, such as longer-term learning gains, academic achievement, educational attainment, or reduced drop-out rates. The effectiveness of the educational nudges depends on several factors, such as the target population, the educational context, the design of the intervention and its implementation. Behavioral interventions should therefore be considered

as complementary rather than replacement strategies to high-quality teaching, appropriate educational resources and overall educational policies. Equally important are the ethical considerations associated with the use of nudges in education. Design and implementation of behavioral interventions should be guided by the principles of transparency, respect for autonomy, informed consent, privacy protection, and equity, especially when involving children and adolescents. Poorly designed interventions may potentially exacerbate educational inequalities or undermine students' autonomy. Future research should prioritize rigorous longitudinal and randomized studies that evaluate both immediate behavioral outcomes and long-term educational outcomes across diverse populations. Greater attention should also be given to cost-effectiveness, differential effects across population subgroups, and ethical considerations to determine under which conditions behavioral interventions produce meaningful, equitable, and sustainable improvements in education.

CONFLICT OF INTEREST

The author declares that there are no conflicts of interest related to this work.

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