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## Applying Behavioral Economics to Improve Adolescent and Young Adult Health: A developmentally-sensitive approach

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### Abstract

Each day, adolescents and young adults (AYAs) choose to engage in behaviors that impact their current and future health. Behavioral economics represents an innovative lens through which to explore decision-making among AYAs. Behavioral economics outlines a diverse set of phenomena that influence decision-making and can be leveraged to develop interventions that may support behavior change. Up to this point, behavioral economics interventions have predominantly been studied in adults. This paper provides an integrative review of how behavioral economics phenomena can be leveraged to motivate health-related behavior change among AYAs. We contextualize these phenomena in the physical and social environments unique to AYAs and the neurodevelopmental changes they undergo, highlighting opportunities to intervene in AYA-

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specific contexts. Our review of the literature suggests behavioral economics phenomena leveraging social choice are particularly promising for AYA health. Behavioral economics interventions that take advantage of AYA learning and development have the potential to positively impact youth health and well-being over the lifespan.

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## INTRODUCTION

Adolescents and young adults (AYAs) engage in daily behaviors that impact their current and future health. Some behaviors promote well-being (e.g., being physically active, seeking preventive services) whereas others detract from health (e.g., unsafe sexual practices, use of illicit substances, nonadherence to chronic disease medications). Influencing AYA adoption and maintenance of beneficial health behaviors, however, has proven challenging.<sup>1</sup>

Multiple models have been used to inform behavioral interventions to improve health, including the health belief model, theory of reasoned action, cognitive-behavioral theory, and motivational interviewing.<sup>2–6</sup> Behavioral economics is among the more recent frameworks, establishing insights about human decision making in health and other contexts that can be leveraged to develop interventions for individual decision makers. Whereas traditional economics assumes rational choices, behavioral economics outlines a set of phenomena informed by cognitive, emotional, and social factors that influence decision making in ways that, at times, contradict rational choice.<sup>7,8</sup> This perspective offers an important reframing for interventionists, since unlike many other models, behavioral economics' account of "irrationality" may increase the impact of certain interventions.<sup>9,10</sup> Developmentally-sensitive targeting of these phenomena presents further opportunities for novel behavior change interventions.

Health interventions informed by behavioral economics have predominantly been studied in adult populations. The interventions, which often use financial or social incentives,<sup>11</sup> have helped adults increase physical activity, adhere to medications, and stop smoking.<sup>12–15</sup> When considering how behavioral economics might be used with AYAs, the distinct health behavior challenges and developmental changes during adolescence and young adulthood warrant special attention. AYA health-related decisions are uniquely influenced by a convergence of developmental processes, such as identity exploration and growing autonomy in self-care, in the context of immense neurodevelopmental plasticity.<sup>16,17</sup> Thus, behavioral economics interventions that work in adults<sup>18,19</sup> may not be optimal for AYAs. Despite opportunities for targeted behavioral interventions created by AYA developmental changes, relatively little has been done to examine whether behavioral economics interventions that have been effective in adults might also promote healthy behaviors in AYAs.<sup>20</sup> Recent work has begun to address this gap, such as the potential of behavioral economics for pediatric chronic disease treatment adherence<sup>21</sup> or indirect effects on child and adolescent health behaviors through behavioral economics interventions for parents.<sup>22</sup>

The objective of this paper is to explore how behavioral economics phenomena can be leveraged to motivate behavior change and improve AYA health. We summarize in this integrative review recent empirical and theoretical work and offer a new synthesis with relevance to a wide array of health behaviors<sup>23</sup>; importantly, we account for the role of

psychosocial and neurocognitive development in both the evolution of behavioral economic phenomena *and* in their potential for targeted intervention. We consider AYAs as 10–26 year-olds, as defined by the World Health Organization and National Academies of Medicine.<sup>1</sup> Specifically, we first review eight core behavioral economics phenomena within the context of existing AYA research. Second, we contextualize behavioral economics in AYA neurocognitive development.

## REVIEW OF RELEVANT LITERATURE

### Behavioral Economics Phenomena and Adolescent and Young Adult Health Research

We introduce specific behavioral economics phenomena by defining eight core concepts, explaining how the phenomena arise in AYA decision-making and behavior, and describing how interventions can leverage each phenomenon to improve AYA health-related behaviors (Table 1). A critical assessment of the combined behavioral and neuroscientific literatures identified eight core concepts (present bias, overweighting of small probabilities, loss aversion, availability, social norms, relative social ranking, ordering effects, and choice overload) where our multidisciplinary lens offers not only new understanding of behavioral phenomena, but also suggests interventional targets with the highest potential for efficacy based on the strength of evidence from both fields.

**1) Present Bias (Hyperbolic temporal discounting)**—*Present bias* applies to the tendency to weight payoffs received sooner more strongly than those received later.<sup>24,25</sup> For example, in behavioral experiments, participants generally prefer receiving smaller amounts of money immediately (e.g., \$5 today) to larger amounts of money later (e.g., \$10 in two weeks).<sup>26,27</sup> Evidence suggests the degree to which future outcomes are discounted decelerates over time.<sup>26,28,29</sup> For instance, individuals may show a strong preference for a one-day versus a one-week delay in receiving a reward, but indifference when comparing the same interval much later, such as a one-year versus a one-year-and-one-week delay in receiving a reward.

Present bias is often used as an index of impulsivity.<sup>17</sup> Data suggest present bias is likely more prevalent among AYAs than older adults. Compared to older adults, sixth graders and young adults had higher rates of discounting (i.e., overweighting present compared to delayed outcomes) in a study that examined present bias over the lifespan.<sup>30</sup> Another study showed younger adolescents (ages 12–17) were more willing to accept smaller immediate rewards than young adults (ages 18–27) and adults.<sup>31,32</sup> Longitudinal evidence suggests present bias declines sharply around 15 to 16 years of age.<sup>27</sup> These findings have been linked to outcomes. For example, stronger present bias is associated with risky sexual behaviors in adolescents, including having sex before 16, teenage pregnancy, and sexually transmitted infections.<sup>33</sup> Present bias in AYAs has also been linked to a willingness to smoke.<sup>34,35</sup>

**Applications to AYA health:** AYA health interventions can take advantage of present bias by emphasizing the immediate benefits or risks of health choices. For example, to motivate sun protection behaviors, researchers directed college students to focus on the shorter-term impact on skin aging rather than the long-term skin cancer risk.<sup>36</sup> Students exposed to

shorter-term negative effects of sun radiation through UV photographs and photoaging information (e.g., wrinkles and age spots) were more likely to increase sun protection intentions and behaviors, and showed less skin darkening one year post-intervention.

**2) Overweighting of Small Probabilities**—*Overweighting of small probabilities* refers to the disproportionate influence of small probabilities in decisions.<sup>37</sup> For example, state lotteries are fueled by individuals' attention to the possibility of winning a big prize, despite awareness of the small likelihood of success, and by the positive emotion associated with how it would feel to win or spend prize winnings.<sup>38</sup>

When AYAs focus on the likelihood of an outcome rather than the outcome itself, they tend to overweight the possibility of winning a gamble. They are also less adept at considering the outcomes of prior gambles when making risky decisions.<sup>39</sup> In addition to overweighting benefits compared to risks in gambles, AYAs are more likely to overweight the probability of negative outcomes (e.g., having cancer or dying young) compared to adults.<sup>40,41</sup>

**Applications to AYA health:** Evidence is mixed on the potential of leveraging this phenomenon to influence AYA behaviors.<sup>42,43</sup> In a study of 8–17 year-olds in Zimbabwe, teens randomized to fixed or lottery-based \$2 incentives for participating in HIV testing and counseling were more likely to undergo HIV testing than those in a group with no incentives.<sup>44</sup> In another study of 16–24 year-olds, participants were offered several different financial incentives, including a lottery to win retail gift cards, for returning a chlamydia screening kit.<sup>45</sup> The lottery incentives did not increase kit return, although other financial incentives had small positive effect sizes. Further investigation is needed to better understand whether lottery incentives should be avoided in AYAs or if there are specific scenarios or types of lottery incentives that can be effective.

**3) Loss Aversion**—With *loss aversion*, individuals are more motivated to avoid losses than to achieve corresponding gains.<sup>46</sup> For example, loss aversion suggests someone would prefer to avoid losing \$50 than to gain \$50.

Studies have found that potential losses have a more significant impact on choice than potential gains in both adolescents and adults.<sup>47</sup> Some studies suggest that loss aversion increases from childhood to adulthood,<sup>48–50</sup> while other studies have identified a peak in reward sensitivity between 14–21 years old, suggesting an inverted U-shaped trajectory for loss aversion.<sup>31,48</sup> These dynamic changes suggest that motivational and emotional processes may overshadow cognitive control for both potential gains and losses in youth compared to adults.<sup>50</sup> Studies also suggest that loss aversion in adolescents is regulated by social factors, such as the presence of peers.<sup>48</sup>

**Applications to AYA health:** Researchers have leveraged loss aversion to promote healthy choices by putting financial incentives at risk if they choose unhealthy behaviors.<sup>51–53</sup> One randomized control trial used loss of financial incentives to increase adherence to daily glucose self-monitoring and glycemic control in 14–20 year-olds with type I diabetes.<sup>54</sup> Participants in the loss-framed arm received an initial cash endowment and lost \$2 for every day of nonadherence to their self-monitoring goals; they achieved their glucose monitoring

goals more frequently during the incentive period than those in the control arm. Other studies among AYAs have also found standard gain-framed incentives effective in improving outcome or adherence goals.<sup>55,56</sup> More research directly comparing loss-vs. gain-framed incentives to promote health in AYAs is needed.<sup>42,57</sup>

**4) Availability**—The *availability heuristic* refers to the tendency to assess the chances of an outcome based on how easily an instance of that outcome comes to mind.<sup>58</sup> For example, adults tend to overestimate the chance of being killed in a car accident compared to dying of a common illness such as heart disease. Although death in adults from heart disease is statistically 15 times more likely,<sup>59,60</sup> the car accident is more *available* because it is more frequently reported in the media and thus comes to mind more quickly.

Adolescents are less likely than adults to address the uncertainty of outcomes by seeking information when making a decision,<sup>61</sup> suggesting that they are susceptible to acting on whatever knowledge is readily available and accessible to them. Direct personal experience is an important factor in determining availability. A study examining adolescent smoking intentions found attitudes formed through direct experience were more likely to predict both intentions and actual smoking behavior, compared to less accessible indirect experiences.<sup>62</sup> Another study in youth aged 15–24 found that knowing someone who died of AIDS was linked to considering HIV to be a serious health risk and changing risk behavior accordingly.<sup>63</sup> This risk assessment pattern existed regardless of educational level, suggesting that direct experience strongly informs perceptions.

**Applications to AYA health:** The availability heuristic suggests that AYAs may be particularly susceptible to interventions that use memorable, vivid anecdotes to prevent or promote behavior. For example, young adults might be more responsive to a drug prevention program following a celebrity death from a drug overdose.<sup>64</sup> Creating opportunities for direct experience, such as through interactive games that simulate health choices, have promising early results for making health-promoting choices more accessible. A diabetes self-management game for children decreased diabetes-related urgent care visits and emergency care visits by 77%.<sup>65</sup> Similarly, an asthma-management game for adolescents found that a 40-minute “play period” improved asthma knowledge, self-management, and communication at an evaluation conducted a month after.<sup>65</sup> It is worth noting, however, that highlighting unhealthful behaviors may inadvertently promote them, with potentially significant negative health outcomes.<sup>66–68</sup> More work is needed to determine how and under what conditions positive and negative health examples may differentially impact AYA health behaviors.

**5) Social Norms**—*Social norms* signal appropriate behavioral expectations or rules within a group.<sup>69</sup> Individuals tend to conform to the behavior of people similar to them and acting the way they believe similar peers would act.

Adolescent sensitivity to social norms increases as adolescents experience “social reorientation,” a process wherein they place more value on social evaluation and perceived social status.<sup>70,71</sup> In a study of participants 8–59 years old, young adolescents (12–14 years old) displayed greater propensity to change their perception of risk to match how others

rated the risk and a greater sensitivity towards a teenaged social-influence group than an adult social-influence group, highlighting the importance of peers to adolescents.<sup>72</sup> Families also play an important role in setting social norms for AYAs; adolescent behaviors are influenced by whether they believe their parents, in addition to peers, will approve.<sup>73</sup> Individuals may also vary in their response to social norms, with some taking pride in being outside the perceived norm or actively rebelling against it.<sup>74</sup>

**Applications to AYA health:** Social norms influence a range of AYA health-related behaviors.<sup>75,76</sup> Familial social norms influence 13–17 year-old adolescent girls' intentions to eat healthy and exercise.<sup>77</sup> Peer social norms may also affect AYAs when parents do not provide input. For example, teens who did not talk to parents about sex or condom use were more likely to rely on peer social norms to guide their behavior.<sup>78</sup>

Interventions to improve AYA health can encourage healthy behaviors by using accurate data to “reset” social norms. One study showed when college students learned that they consumed more alcohol than their peers, they reduced their consumption to conform to this social norm.<sup>79</sup> In another study, instances of personal bullying and victimization decreased after middle schoolers were given information about the local prevalence of bullying and pro-bullying attitudes, both of which students had grossly overestimated.<sup>80</sup>

**6) Relative Social Ranking—***Relative social ranking* describes how individuals are motivated by how they compare to others.<sup>81</sup> Comparisons with others who are familiar or in close proximity on opinions, abilities, behaviors, and performance impact not only behavior but also happiness, satisfaction, and well-being.<sup>82,83</sup>

Researchers have demonstrated that adolescents (13–15 years old) with higher peer status, measured on characteristics like popularity, power, and sociability, were more likely to smoke and drink than those with lower status. This school-based status more strongly predicted risky behaviors than other characteristics, including socioeconomic status.<sup>84</sup> Another study of Swedish teens (ages 12–18) found a significant positive relationship between peer and personal engagement in risky behaviors, such as binge drinking, smoking, and illicit drug use.<sup>85</sup>

**Applications to AYA health:** Social networks and status may be used to reduce risky behaviors. An anti-bullying campaign tested in 56 middle schools found that recruiting students with high social influence to implement an anti-conflict intervention resulted in greater adoption of anti-conflict behaviors by peers compared to partner-school students.<sup>86</sup> Competition can also be leveraged to improve health; one study demonstrated that the ‘Smoke-Free Class competition’ was effective for adolescent school-based smoking prevention.<sup>87</sup> In another study, participants who played a social computer game that incentivized physical activity by visualizing growth of a virtual character reported that the ability to see their teammates’ progress was helpful for benchmarking and comparison.<sup>88</sup> Social ranking within the health domain is most linked to health behaviors<sup>89,90</sup>, although some data suggest that other domains (e.g., academics, socioeconomic status, identity) may also impact health behaviors.<sup>91–93</sup>



**7) Ordering Effects**—*Ordering effects* refer to how the presentation order of options influences the option chosen. For example, an option presented at the beginning (*primacy effect*) or at the end (*recency effect*) of a series is often more frequently chosen than those presented in the middle.<sup>38,94</sup> An option presented as the default (*default bias*; e.g., a pre-selected option, endorsed option, or automatic enrollment) also tends to be chosen more often.<sup>95</sup>

In adolescents aged 10–21, respondents asked to identify local community resources (e.g., ‘youth center’) more often chose options placed at the beginning of the presented list than those who received a reordered list with the same options appearing later in the list.<sup>96</sup> Another study showed the ordering of Marketplace health insurance plans influenced plan selection among young adults and broader populations; participants’ plan choices differed significantly when the same five insurance plans were presented in different orders.<sup>97</sup>

**Applications to AYA health:** Ordering effects can be leveraged in several AYA health domains. An intervention found that ordering menu items from lowest to highest calories resulted in significantly more low-calorie meals purchased.<sup>98</sup> Another study in middle school cafeterias showed that students at schools with salad bars located within the main serving line consumed more fruits and vegetables than students at schools with salad bars outside the main serving line.<sup>99</sup>

**8) Choice Overload**—*Choice overload* occurs when people encounter multiple choice options, which can sometimes result in decision postponement,<sup>100,101</sup> fatigue,<sup>102</sup> or myopic choice driven by only a subset of information.<sup>103</sup> A seminal study showed that grocery store customers presented with six rather than 24 jam varieties made more purchases.<sup>101,104</sup>

Adolescents report higher dissatisfaction and decision-making difficulty compared to children and older adults when faced with many options.<sup>105</sup> Research has shown, however, that compared to older adults, AYAs (mean age: 19.6 years) value having a larger number of options and are willing to pay for more choice.<sup>106</sup> These findings suggest simply reducing or withholding choices may unsatisfactorily mitigate choice overload in AYA populations.

**Applications to AYA health:** Research has demonstrated that choice overload may be counteracted by simplifying choice architecture (i.e., the manner in which options are presented)<sup>7</sup> or the number of options presented.<sup>102</sup> For example, presenting contraceptive options in three tiers of effectiveness, rather than lists of over a dozen contraceptive methods, could alleviate information and choice overload.<sup>107</sup>

## Behavioral Economics in the Context of Adolescent and Young Adult Neurocognitive Development

Adolescence and young adulthood represent a convergence of immense neurocognitive developmental changes; these changes provide the developmental context for applying behavioral economics to promote healthy behaviors in AYA populations. AYAs do not have a large historical repertoire of direct life experiences, and the task of developing into an independent adult is extraordinarily complex. It is therefore not surprising that the brain is optimized for learning and strategic exploration in maturing youth.<sup>108,109</sup> In general, risk

taking in the context of value-based learning reflects maximizing positive outcomes by seeking new information (exploration) or by relying on existing knowledge. Exploration serves an important purpose: seeking and experiencing rewarding outcomes, even when the probability of rewards is low. Individuals can seek rewarding outcomes through *both* positive and negative risk taking.<sup>110</sup> While much of the focus for intervention designers has been on negative risk taking (e.g., substance use, reckless driving), positive risk taking (e.g., talking to a new group of people, trying a new sport) is also critical for healthy development. The need for positive risk taking can also be leveraged, especially because adolescents who take negative risks are also more likely to take positive risks.<sup>111–113</sup>

Risk taking of both types changes over the course of development. Compared to the more random exploration of childhood, the strategic exploration of adolescence and young adulthood aligns with individual goals.<sup>108,109</sup> These information-seeking behaviors are an important part of learning and are further impacted by neurodevelopmental processes. The way that feedback is processed is a critical example of development's changing impact over time. Importantly, learning occurs on both long (months to years) and short (minutes to hours to days) timescales. While much of the work relating learning and neurocognitive development has focused on the long timescales, the short timescales are also important for identifying intervention targets because feedback can have different effects depending on the phase of learning when it's received. For example, in adolescents and not children or adults, feedback received during early learning is prioritized relative to feedback received later.<sup>114</sup> These short-timescale data suggest that interventions based on behavioral economics phenomena may be especially potent when AYAs are in the early stages of learning new information.

Information seeking and learning are modulated by the development of risk and reward processes, both of which can influence health choices. Broadly, risk taking increases between childhood and adolescence<sup>50,115</sup> with hormonal changes at pubertal onset marking an inflection point for both accelerated risk taking and changes in socioemotional processing. Recent work has shown that adolescents do not necessarily prefer risky options but may instead have higher tolerance for ambiguity, or incomplete knowledge of probabilities.<sup>50,61,116</sup> These developmental changes have been linked, potentially bidirectionally, to the dramatic remodeling of the structure and function of the dopamine system, which affects not only risk taking and reward seeking but also how emotional responses to rewards influence other psychological processes<sup>31,51,117,118</sup>

Such subtleties in risk seeking and reward sensitivity may be critical to understanding behavioral economics phenomena in youth. For example, the emotional context can nudge reward-sensitive teens towards more generalized representations (e.g., a shift from “a 10% chance of losing \$5” to “some chance of losing \$5”)<sup>119</sup> and riskier choices.<sup>120,121</sup> The combination of heightened emotional responses and increased sensitivity to rewards suggest that interventions informed by behavioral economics that leverage emotional responses to outcomes like potential losses (i.e., loss aversion) may have a significant impact on choice among AYAs.<sup>47,122,123</sup>



The adolescent brain is also highly responsive to social context.<sup>17</sup> Compared to adults, adolescents show greater modulation of brain activity by social information in regions that support emotion processing, such as the amygdala and orbitofrontal cortex.<sup>124</sup> For example, the mere presence of a peer during a cognitively demanding car driving task leads to increased activity in reward-related brain regions; this increased brain activity predicts subsequent risky decisions.<sup>125,126</sup> Similarly, loss aversion in adolescents is influenced by high emotional contexts as well as social factors, such as the presence of peers.<sup>48</sup> These effects decline with maturation to young adulthood, a period that has been associated with increased ability to resist peer pressure.<sup>31,127,128</sup> These findings highlight the potential of interventions that leverage peers or family to impact AYA behaviors.

In tandem with these changes, the ability to control one's behavior is developing in adolescence and young adulthood. AYA cognitive control and attentional processes mature significantly,<sup>129–132</sup> along with brain regions—especially the prefrontal cortex<sup>133–135</sup>—that are thought to exert top-down control over reward-related processes to support learning and decision-making.<sup>136,130,137</sup> The robust body of evidence demonstrating the behavioral and neural trajectory of cognitive control development in adolescence may have fueled a common misconception: AYAs are incapable of impulse control and thus engage in riskier, less-rational behaviors, especially in emotional situations.<sup>133–135</sup> Recent data suggest a more nuanced picture. Although adolescents have the capacity to exert adult-like cognitive impulse control, they may do so through different neural mechanisms<sup>130,133–135</sup> and with less consistency.<sup>138</sup> Such findings offer a new lens for AYA behaviors and what is “optimal.” Critically, these findings suggest that directly translating adult behavioral economic interventions to AYA without accounting for neurocognitive development could influence AYA behavior differently than expected. Neurocognitive development must, therefore, be considered both when evaluating targets for intervention and the interventions themselves.

## DISCUSSION

Linked insights from the fields of behavioral economics and neurocognitive sciences highlight the potential and unique developmental considerations for leveraging behavioral economics to improve AYA health. These opportunities to use behavioral economics interventions to favorably influence AYA decision-making occur during a time of extraordinary learning and strategic exploration. This unique window of opportunity builds upon the AYA neurocognitive changes and the timing of shaping health-promoting behaviors during AYA years that may persist into adulthood with impacts on long-term behavior and health outcomes.

Based on our synthesis, social norms and relative social ranking emerged as the most promising behavioral economics phenomena for further exploration in AYA health, largely because of their relationship to developing social and emotional cognition. Moreover, the near ubiquity of social media use among AYAs and accessibility of digital health tools provide ready platforms for deploying and testing socially based interventions informed by behavioral economics.<sup>139</sup> Technological advances (e.g., widely accessible high-speed internet, mobile devices) have given AYAs—and indeed, all of us—an unprecedented level of awareness of world events; this constant information access is undoubtedly shaping

attention, information processing, and decision making.<sup>140,141</sup> The COVID-19 pandemic is one example where the interactions between rapid societal change, information availability, and psychosocial and neurocognitive development can have a significant impact on both AYA decision making and health-promoting intervention efficacy.<sup>142</sup>

Social influences on choice can also boost interventions designed around other principles, such as loss-framed financial incentive in the context of a social healthy behavior competition. Interventions that leverage social norms by highlighting the behavior of a majority of peers may produce more sustainable effects,<sup>143</sup> potentially mitigating the extinguishing effects often seen with financial incentives alone.<sup>54,144,145</sup> An important consideration, however, is that individuals vary in their responses to social context manipulations; for example, some may be discouraged rather than motivated by social ranking information.<sup>17,48,146,147</sup>

Across these potentially high-yield targets and other decision-making phenomena, a developmentally-sensitive behavioral economics approach offers several practical benefits for AYAs. Behavioral economic interventions can be more engaging, less time-intensive, and flexible for use outside of patient care settings than traditional approaches.<sup>21,148</sup> Accounting for developmental processes also allows for more precise targeting and potential cost-savings, since the delivery schedule of financial incentives can be fine-tuned for optimal reinforcement of health-promoting behaviors.<sup>149,150</sup> Finally, behavioral economics-based interventions are also compatible with other evidence-based frameworks, such as the Health Belief Model, and can augment interventions to overcome weaknesses and boost efficacy.<sup>21</sup>

The promise of behavioral economics for AYA health must be balanced by potential downsides and ethical considerations. Many behavioral economics interventions rely on financial or social incentives, which function as extrinsic motivators that could undermine intrinsic motivation,<sup>151</sup> which is critical for long-term behavior change.<sup>151–153</sup> This undermining effect has been strongly demonstrated in psychology and economics; evidence suggests the effect may be weaker for health-related behaviors, though data are limited for AYA populations.<sup>154</sup> With adolescence and young adulthood characterized by rapidly increasing autonomy,<sup>70</sup> ethical considerations related to respect for AYA agency are particularly important when considering behavioral economics applications. Care must be directed towards intervention design and implementation for AYAs who may be at disproportionate risk of potential, real, or perceived exploitation or coercion. The strength of interventions informed by behavioral economics, from light nudge to paternalism and coercion, should be assessed.<sup>155</sup>

Developmental stage for various neurocognitive processes is another key consideration, such as how the timing of social and emotional cognition acceleration in youth may influence the effectiveness of socially informed interventions. Detecting the presence of these phenomena in AYAs is likely influenced by pubertal timing and other psychosocial factors, such as educational achievement.<sup>156</sup> The current evidence base is not rich enough to make recommendations on ages or pubertal stages during which different phenomena may begin to be influential, but these temporal relationships represent an important area for future research. At present, psychological measures may offer one route to personalization,

indexing personality traits such as impulsivity, reward sensitivity<sup>157,158</sup>, and social motivation, thus allowing for stratification by likelihood of responding to interventions targeting self-regulatory and/or social phenomena. Presumed sex differences in these phenomena should also be considered, since male and female youth have shown to make distinct health-related choices<sup>159</sup> and also physiologically mature at different rates.<sup>160–162</sup>

## SUMMARY AND IMPLICATIONS

Leveraging behavioral economics for AYA health is in its early stages. The foundation outlined in this review presents opportunities to leverage behavioral economics in AYA-specific health and developmental contexts. More high-quality empirical data are needed to demonstrate which behavioral economics phenomena can be effective for improving AYA health, and among which groups of youth (Table 2). Considerations for advancing the application of behavioral economics among AYAs include accounting for shared decision-making between parents and AYAs, combining behavioral economic insights with other AYA theoretical frameworks (e.g., positive youth development<sup>163</sup>) and further describing the neurocognitive processes in the developing AYA brain when behavioral economics phenomena are tested. The neural and behavioral plasticity marking AYA neurodevelopment underscore the importance of the decision-making environment not only for one-off choices, but also for shaping future behaviors into adulthood. Behavioral economics can serve as a framework for shaping the extraordinary learning and strategic exploration occurring among AYAs in a way that favorably benefits health among young people and that can be realized over a lifetime.

### Abbreviations:

**AYA** Adolescents and young adults

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### **IMPLICATIONS & CONTRIBUTIONS**

This review explores the utility and promise of leveraging behavioral economics phenomena to promote healthy behaviors and decision-making in adolescents and young adults. Studies investigating the application of these phenomena to intervention design and the importance of the unique neurocognitive developmental context are summarized.

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**Table 1.**

## Behavioral Economics Phenomena: Definitions and Potential Applications to Adolescent and Young Adult Health

Behavioral Economics Phenomenon	Definition	Example Applications for Motivating AYA Health Behaviors
<b>Present bias (Hyperbolic temporal discounting)</b>	Tendency to place stronger weight on payoffs closer to the present when considering trade-offs between two future moments <sup>25</sup>	<ul style="list-style-type: none"> <li>• <b>Highlight immediate benefits:</b> Adolescents more likely to use sun protection after focusing on shorter-term effects of skin aging rather than long-term risk of skin cancer<sup>36</sup></li> </ul>
<b>Overweighting of Small Probabilities</b>	Small probabilities have disproportionate influence on choices and decisions <sup>37</sup>	<ul style="list-style-type: none"> <li>• <b>Use lottery incentives:</b> HIV testing increased among teens randomized to fixed and lottery incentive groups compared to the no incentive group<sup>44</sup></li> </ul>
<b>Loss Aversion</b>	Individuals are more strongly motivated to avoid losses than to achieve corresponding gains <sup>46</sup>	<ul style="list-style-type: none"> <li>• <b>Frame incentives as losses:</b> Adolescents with type 1 diabetes had improved blood glucose monitoring with daily loss-framed \$2 incentives<sup>54</sup></li> </ul>
<b>Availability</b>	Overstating the probability of an outcome based on how easily an instance of the outcome comes to mind <sup>58</sup>	<ul style="list-style-type: none"> <li>• <b>Use memorable anecdotes:</b> Young adults may be more likely to enroll in a drug prevention program after a celebrity drug overdose<sup>64</sup></li> </ul>
<b>Social Norms</b>	Tendency to conform to in-group expectations of appropriate behavior <sup>69</sup>	<ul style="list-style-type: none"> <li>• <b>Reset social norms with accurate data:</b> College students reduced alcohol use after learning about the lower-than-expected average alcohol consumption of other students<sup>79</sup></li> </ul>
<b>Relative Social Ranking</b>	Individuals care about how they compare to others, especially those who are familiar or in close proximity <sup>81</sup>	<ul style="list-style-type: none"> <li>• <b>Leverage social networks and status to reduce risky behaviors:</b> Students were more likely to adopt anticonflict behaviors when students with high social influence implemented the intervention<sup>86</sup></li> </ul>
<b>Ordering Effects (Primacy Effect, Recency Effect, Default Bias)</b>	Presentation order of options (e.g., first, last, default) influences the option chosen <sup>38,94</sup>	<ul style="list-style-type: none"> <li>• <b>Use order to endorse healthier options:</b> More low-calorie meals purchased when menu ordered options from lowest to highest calories<sup>98</sup></li> </ul>
<b>Choice Overload</b>	Tendency to make a suboptimal choice or to defer choice when faced with multiple options <sup>101</sup>	<ul style="list-style-type: none"> <li>• <b>Reduce the number of options presented:</b> When counseling adolescents on contraception, offer three categories of methods, in order of efficacy<sup>107</sup></li> </ul>



**Table 2.****Critical Gaps and Key Questions for Behavioral Economics and Adolescent and Young Adult Health**

<b>Critical Gaps</b>	<b>Key Questions for Future Study</b>
Timing of applicability of behavioral economics phenomena in adolescence and young adulthood	<ul style="list-style-type: none"> <li>• At what pubertal stage do behavioral economics phenomena become effective?</li> <li>• How does the potential strength of behavioral economics phenomena differ by developmental stage in adolescence and young adulthood?</li> </ul>
Comparative strength of behavioral economics phenomena in AYA	<ul style="list-style-type: none"> <li>• For a given behavior (e.g., physical inactivity), which behavioral economics phenomena or combination of phenomena result in the greatest behavior change among AYAs?</li> <li>• How do AYAs differ in their response to interventions informed by behavioral economics compared to older adult populations?</li> </ul>
Ethical considerations for applying behavioral economics within AYA populations	<ul style="list-style-type: none"> <li>• As AYAs gain autonomy in health-related decisions, which behavioral economics nudges are ethically acceptable?</li> <li>• How should families and other stakeholders be included in interventions informed by behavioral economics for AYAs?</li> </ul>