

# Delay discounting and health risk behaviors: the potential role of stress

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This article explores recent research in delay discounting, stress and the relationship of these constructs with health risk behaviors. Recent findings have confirmed that both delay discounting and stress are important correlates of risky health behaviors and have advanced our understanding of the relationship between discounting and stress and their role as processes related to the initiation and maintenance of risky health behaviors. An integration of the available research literature suggests that when individuals are under stress, they shift to a more immediate-oriented mindset (as reflected by more impulsive delay discounting), the immediate motivation being to relieve stress, and so individuals engage in maladaptive coping mechanisms, such as engaging in risky health behaviors. Establishing linkages between stress, delay discounting, and risky health behaviors could provide a more specific mechanism (i.e., delay discounting) on which to focus prevention and intervention strategies.

## Addresses

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## Introduction

Health behaviors (e.g., exercising, getting regular check-ups, eating, etc.) play a crucial role in the maintenance of health and well being [1,2<sup>\*\*</sup>]; however, many individuals engage in behaviors that increase risk of disease, injury, or mortality defined as health-risk behaviors [3]. Statistics show that the majority of premature death in the top leading causes in the United States are caused by preventable factors, such as: tobacco use, physical inactivity, unhealthy dietary habits, and risky sexual practices [4]. There have been a number of models and theories proposed to explain why people engage in different types of health-risk behaviors (see [1] for review). Increasingly,

research has begun to focus on trans-disease processes that are associated with lifestyle choices such as diet, exercise, and drug use as a means of providing specificity for prevention and intervention programs. The purpose of this paper is to review the work related to delay discounting as a process related to the initiation and maintenance of a variety of health-risk behaviors. In addition, we will review the role of stress in these processes. Lastly, we will examine how these two constructs may interact to increase risk of engaging in health-risk behaviors.

## Delay discounting

Delay discounting describes the extent to which an individual discounts the value of an outcome because of a delay to its occurrence. Assessments of delay discounting typically require participants to make choices between smaller rewards available immediately (e.g., \$6) and more valuable rewards (e.g., \$10) available after a specified delay (e.g., [5]). A choice pattern reflecting comparatively more choices for smaller immediate rewards at the expense of larger but delayed rewards indicates impulsive choice. In such cases, the individual may be behaviorally under-controlled by temporally distant events or long-term outcomes and instead be greatly influenced by immediate circumstances and outcomes.

In relation to health risk behaviors specifically, individuals may choose to forgo future health to enjoy the benefits of substances, food, sedentary lifestyle, etc. Delay discounting has been associated with a variety of health risk behaviors, including substance use, obesity, and risky sexual behavior [6–10].

## Delay discounting and health risk behaviors

There is robust evidence that substance users demonstrate higher rates of discounting than non-substance users (see [11<sup>\*\*</sup>] for a meta-analysis). Current cigarette smokers discount delayed money more than ex-smokers or non-smokers (e.g., [12]). Further, amongst current smokers those who score higher on nicotine-dependence measures discount more than those who are low on dependence [13]. Alcohol use shows a similar pattern such that active alcoholics discount more than abstinent alcoholics and controls [14]. Opioid dependency has been consistently linked to greater levels of discounting (e.g., [15,16]), while cocaine-dependent individuals demonstrate a similar pattern for both money and crack/cocaine (e.g., [17]). Evidence also suggests that early age of onset for substance use results in greater discounting rates across substances [18].

Delay discounting has recently been shown to be related to obesity and poor eating in some populations. In one study, women who were obese discounted more by delay than healthy-weight control participants, though this effect was not reported for obese men [10]. A more recent study showed that high rates of delay discounting were associated with higher body fat percentages in both women and men when the discounting measure involved making choices for either delayed or immediate food items [19]. Obese adolescents have been shown to discount more than healthy-weight adolescents [20], and adolescent obese smokers have been shown to have higher discount rates than healthy-weight smokers suggesting that being both obese and a smoker may be associated with more extreme discounting than smoking alone in this population [21].

Delay discounting has also been linked to non-substance related risky health behaviors. Through the use of sexual discounting paradigms [22,23,24\*\*,25], it is clear that some individuals are more inclined to delay sexual activities, particularly when they involve greater risk (e.g., sex without a condom) while others still engage in the immediately pleasurable behavior despite long-term consequences. Further, initiation of sexual behaviors at an early age (a risk factor for the contraction of Sexually Transmitted Infections later in life) is associated with discounting rates [26]. Family history of suicidal behavior has also been associated with discounting [27]. Finally, failing to engage in a variety of pro health behaviors has been associated with more impulsive discounting including forgetting to wear sunscreen or a seat belt, lack of exercise, not having regular recommended check-ups and not getting vaccinated [28,29].

The wealth of research presented suggests that those who demonstrate greater discounting of delayed monetary rewards are more probably to engage in behaviors that endanger their overall physical and emotional well being. Research suggests that discount rates may be considered a stable trait but may be influenced by physiological and situational factors [30\*\*].

### Stress

Several models of health-risk have proposed a relationship between the initiation and maintenance of health-risk behaviors and stress [2\*\*,31,32]. Stress is the general response to a stimulus that is perceived as threatening or alarming. The particular stimulus, or stressor, can be an external or physical manifestation, but the nature of the stressor can also be an internal provocation. Stress is an experience that is often associated with physiological symptoms such as increased heart rate, rapid and shallow breathing, increased perspiration, as well as psychological symptoms like fear and anxiety. Stress can present itself as overt behaviors, but it can also manifest as alterations in

one's physical health, physiology, behavior, affect, and cognitions [33].

The relationship between stress and the engagement in health risk behaviors has been well documented across the lifespan. Pediatric studies reveal that children who experience stressful life events (e.g., war, natural disasters, accidents, life-threatening illness) are more probably to be depressed, attempt suicide, engage in HIV-risk behavior, and have substance use problems [34–36]. Further, children experiencing stress resulting from an at-risk family environment (e.g., unsupportive/neglectful or characterized by conflict/aggression) can experience disruptions in psychosocial functioning, including engagement in poor health related behaviors, especially substance abuse [37].

With regard to conflict, any exposure to violence in children has been associated with an increased likelihood of using tobacco and marijuana, drinking alcohol, using drugs before sex, and having intercourse with sexually-at-risk partners [38]. Adolescent females are more probably to experience traumatic life events and symptoms associated with traumatic stress, such as higher levels of substance use and greater HIV-risk behavior, compared to male counterparts [36]. In particular, adolescent females who experience stress related to childhood sexual abuse or intimate partner violence are found to be at increased risk for substance use, unhealthy weight control behavior, sexual risk behaviors, and suicidality [39,40].

Broadly, adult studies have linked perceived stress to higher fat diets, less frequent exercise, and cigarette use [41]. Chronic life stress was found to be associated with preference for energy-dense and nutrient-dense foods, particularly those high in sugar and fat (foods shown to be related to obesity), especially in men. Further, stress has also been found to play a key role in perpetuating drug abuse and relapse [31]. Similar to children, adults who experienced traumatic life events (e.g., September 11th terrorist attacks) were more probably to engage in increased alcohol, cigarette, and marijuana use during the acute post-disaster period [42]. Related to the sex differences broadly, men who experienced more masculine gender-role stress or identify situations as stressful due to gender-role identification have increased anger and anxiety as well as poor health behaviors involving diet, exercise, seat belt use, and alcohol intake [43].

### Evidence for the relationship between delay discounting and stress

While the relationship between stress and health-risk behaviors is well established, more research is needed to better understand mechanisms by which stress exerts its influence on engagement in these risky health behaviors. Most of the research examining the role of stress in maintaining risky health behaviors focuses primarily on

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