Philipps Universität Marburg

Health Behaviors Among Adolescents and Emerging Adults

Expectations and Expectation Violations

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1. ABSTRACT AND SUMMARY

1.1 Abstract

While health risk behaviors are present among the general population, adolescents and emerging adults often show a critically high incidence of health deteriorating behaviors and are at high probability of related consequences (DiClemente et al., 2009). Risky health behaviors with a high incidence among young people include the frequent consumption of unhealthy food (Maillet & Grouzet, 2021), physical inactivity (Deng et al., 2021), and high consumption of alcohol/binge drinking (Romm et al., 2020).

Expectations are important cognitions as they can help individuals prepare for future events (Roese & Sherman, 2007), can be significant behavioral predictors (Rief et al., 2015), and can be useful as individuals may enact certain behaviors in order to be coherent with their expectations (e.g., Fan & Chen, 2001). In the context of health behaviors, associations between expectations and actual health behaviors have been demonstrated (e.g., Werner et al., 1993 regarding alcohol use). Nonetheless, expectations are often disconfirmed or violated based on novel evidence. When identified, expectation violations may activate a cognitive response to address the inconsistency, and individuals may react by altering or conserving their original expectations. In addition, individual (e.g., previous experiences and the current state), social (e.g., behavior of social ties), and environmental (e.g., living arrangement) factors can influence an individual's expectations and the stabilization or change of expectations. Lastly, characteristics of an expectation disconfirming event may predict coping with expectation violations as these may promote or hinder expectation maintenance or change (Pinquart et al., 2021). Research investigating expectations in association with food consumption, physical activity, and alcohol use among young people is limited for the most part. Moreover, the association between these health

Footnotes

[1] A filter was included so that only participants who reported having a partner completed the last three questions.

behaviors and expectation violations has not been widely investigated, and the role of expectations and expectation violations in interventions aimed changing unhealthy behavior among young people has received little attention.

This doctoral thesis aimed to narrow these gaps in knowledge by first assessing how expectations, prior experiences, the current state, social tie's efforts to motivate behavior, and coresidence with parents are related to health behaviors and expectations (Study 1). By longitudinally analyzing data from 163 first-year students (M_{age} = 21.20, SD = 2.66; 81% female), we found that change in expectations for physical activity and drinking behaviors were predicted by the initial respective behavior. Moreover, perceived parental attempts to influence drinking and physical inactivity predicted the respective student behavior and expectations. Lastly, moving out of the parental home predicted an increase in current and expected drinking behaviors. This leads to the assumption that expectations as well as individual and environmental factors indeed have an impact on first-semester students' health behaviors.

Second, we implemented an experimental design to investigate whether characteristics of an expectation disconfirming event (i.e., valence, discrepancy magnitude, and controllability) predict expectation maintenance or change among 297 university students (M_{age} = 23.76, *SD* = 4.42; 75.8% female; Study 2). A questionnaire containing vignettes presenting expectation disconfirming events about healthy food consumption and physical activity was administered. We found that, regarding physical activity, students showed higher expectation change when experiencing a better-than-expected event and higher expectation maintenance when experiencing a worse-than-expected event. In addition, regarding food consumption and physical activity, students experiencing lower discrepancy showed higher expectation maintenance, students with control over the source of disconfirmation showed higher determination to achieve their

expectations, while students without control over the source of disconfirmation showed higher expectation change.

Third, we investigated the effects of challenging alcohol expectations of high school and college students on their drinking behavior and alcohol expectations (Study 3). Alcohol Expectancy Challenge interventions are, as of now, the best-researched intervention that implements expectation violations to promote healthy behavior among young people. Therefore, we collected all available studies to conduct a meta-analysis (23 studies; 4,122 participants; M_{age} = 19.0, *SD* = 2.32; 57% males) on this topic. The intervention showed significant yet small effects at modifying alcohol consumption and alcohol expectancies in the desired direction. Change in expectations explained change in alcohol use. More favorable results were observed for college students as compared to high school students and for interventions delivered at a higher dose.

The results of this dissertation show the connection between expectations, expectation violations, and health behaviors among adolescents and emerging adults. Results also show aspects of an expectation disconfirming event that predict expectation maintenance or change, which can inform intervention strategies. As such, important insights to optimize health promotion interventions targeting young people are presented. Lastly, the practical importance of challenging health-behavior-related expectations through interventions targeting adolescents and emerging adults is also demonstrated.

1.2 Summary

Während gesundheitsgefährdendes Verhalten in der Allgemeinbevölkerung vorhanden ist, zeigen Jugendliche und Emerging Adults oft eine kritisch hohe Inzidenz von gesundheitsschädlichem Verhalten und haben eine hohe Wahrscheinlichkeit von damit verbundenen Folgen (DiClemente et al., 2009). Riskantes Gesundheitsverhalten mit einer hohen

Inzidenz bei jungen Menschen umfasst den häufigen Konsum ungesunder Lebensmittel (Maillet & Grouzet, 2021), körperliche Inaktivität (Deng et al., 2021) und hohen Konsum von Alkohol/Rauschtrinken (Romm et al., 2020).

Erwartungen sind wichtige Kognitionen, da sie Individuen helfen können, sich auf zukünftige Ereignisse vorzubereiten (Roese & Sherman, 2007), signifikante Verhaltensprädiktoren sein können (Rief et al., 2015) und nützlich sein können, da Individuen bestimmte Verhaltensweisen ausführen, um mit ihren Erwartungen kohärent zu sein (z. B. Fan & Chen, 2001). Im Kontext des Gesundheitsverhaltens wurden Zusammenhänge zwischen Erwartungen und tatsächlichem Gesundheitsverhalten nachgewiesen (z. B. Werner et al., 1993 zum Alkoholkonsum). Allerdings werden Erwartungen aufgrund neuer Erfahrungen oft widerlegt oder verletzt. Wenn Erwartungsverletzungen erlebt werden, können sie eine kognitive Reaktion aktivieren, um mit dieser Inkonsistenz umzugehen, und Individuen können reagieren, indem sie entweder ihre ursprünglichen Erwartungen ändern oder diese aufrechterhalten. Darüber hinaus können individuelle (z. B. bisherige Erfahrungen und der aktuelle Zustand), soziale (z. B. Verhalten von engen Bezugspersonen) und umweltbedingte (z. B. Wohnform) Faktoren die Erwartungen und deren Stabilisierung oder Veränderung beeinflussen. Zudem können Merkmale eines die Erwartung nicht bestätigenden Ereignisses den Umgang mit Erwartungsverletzungen vorhersagen, da diese die Aufrechterhaltung oder Änderung der Erwartung fördern oder hemmen können (Pinquart et al., 2021). Bisher gibt es wenig Forschung zu Erwartungen junger Menschen im Zusammenhang mit Nahrungsmittelkonsum, körperlicher Aktivität und Alkoholkonsum. Darüber hinaus wurde der Zusammenhang zwischen diesem Gesundheitsverhalten und Erwartungsverletzungen nicht umfassend untersucht, und die Rolle von Erwartungen und

Erwartungsverletzungen bei Interventionen, die darauf abzielen, ungesundes Verhalten bei jungen Menschen zu ändern, wurde bisher wenig beachtet.

Diese Dissertation zielte darauf ab, diese Wissenslücken zu verringern, indem zunächst untersucht wurde, wie Erwartungen, frühere Erfahrungen, der aktuelle Zustand, Bemühungen sozialer Partner, das Verhalten zu motivieren, und das Zusammenleben mit den Eltern mit Gesundheitsverhalten und Erwartungen verbunden sind (Studie 1). In einer Längsschnittanalyse von Daten von 163 StudienanfängerInnen (Durchschnittsalter = 21,20, *SD* = 2,66, 81 % weiblich) fanden wir heraus, dass die Veränderung der Erwartungen an körperliche Aktivität und Alkoholkonsum durch das jeweilige anfängliche Verhalten vorhergesagt wurde. Darüber hinaus sagte der erlebte elterliche Einfluss, zu trinken und körperlich inaktiv zu sein, das jeweilige Studierendenverhalten und die Erwartungen vorher. Schließlich ging der Auszug aus dem Elternhaus mit einer Zunahme des aktuellen und erwarteten Trinkverhaltens einher. Dies lässt vermuten, dass Erwartungen und soziale Bezugspersonen einen Einfluss auf das Gesundheitsverhalten von Studierenden im ersten Semester haben.

Zweitens implementierten wir ein experimentelles Design, um zu untersuchen, ob Merkmale eines erwartungswidrigen Ereignisses (d.h. Valenz, Stärke der Diskrepanz und Kontrollierbarkeit) die Aufrechterhaltung oder Veränderung der Erwartung bei 297 UniversitätsstudentInnen vorhersagen (Durchschnittsalter = 23,76, *SD* = 4,42; 75,8% weiblich; Studie 2). Die Teilnehmenden bearbeiteten einen Fragebogen mit Vignetten, in denen Erwartungen widersprechende Ereignisse über den Verzehr gesunder Lebensmittel dargestellt wurden. Wir fanden, dass die Studierenden in Bezug auf körperliche Aktivität eine höhere Erwartungsänderung zeigten, wenn sie ein besser als erwartetes Ereignis erlebten, und eine höhere Erwartungspersistenz, wenn sie ein schlechter als erwartetes Ereignis erlebten. Darüber hinaus

zeigten Studierende bei geringeren Erwartungsverletzungen in Bezug auf Ernährung und körperliche Aktivität eine höhere Erwartungspersistenz. Wenn Personen Kontrolle über die (Nicht-)erfüllung einer Erwartung hatten, zeigten sie eine höhere Entschlossenheit, ihre Erwartungen zu erfüllen, während Studierende ohne Kontrolle über die Quelle der Erwartungsverletzung stärker ihre Erwartungen veränderten.

Die dritte Studie untersuchte die Auswirkungen von Interventionen, welche Erwartungen von Highschool- und College-StudentInnen über Wirkungen des Alkoholkonsums in Frage stellten, auf Veränderungen des Trinkverhaltens und ihrer Alkoholerwartungen. Die Alkoholerwartungs-Challenge-Interventionen sind derzeit die am besten erforschten Intervention, um Erwartungsverletzungen zu implementieren zur Förderung gesunden Verhalten bei jungen Menschen. Daher haben wir alle verfügbaren Studien gesammelt, um eine Metaanalyse (23 Studien; 4.122 Teilnehmer; mittleres Alter = 19,0, *SD* = 2,32, 57 % Männer) zu diesem Thema durchzuführen. Die Intervention zeigte im Mittel signifikante, aber kleine Effekte auf die Veränderung des Alkoholkonsums und der Alkoholerwartung in gewünschter Richtung. Die Änderung der Erwartungen erklärte hierbei die Änderung des Alkoholkonsums. Günstigere Ergebnisse wurden bei College-Studierenden im Vergleich zu Highschool-Studierenden und bei Interventionen mit höherer Dosis beobachtet.

Die Ergebnisse dieser Dissertation zeigen den Zusammenhang zwischen Erwartungen, Erwartungsverletzungen und Gesundheitsverhalten bei Jugendlichen und Emerging Adults. Die Ergebnisse zeigen auch Aspekte eines die Erwartung nicht bestätigenden Ereignisses, welche die Aufrechterhaltung oder Änderung der Erwartung vorhersagen, was für Interventionsstrategien informieren kann. Auf diese Weise werden wichtige Erkenntnisse zur Optimierung von Maßnahmen zur Gesundheitsförderung für junge Menschen präsentiert. Schließlich wird auch die

praktische Bedeutung aufgezeigt, die Erwartungen an das Gesundheitsverhalten durch Interventionen zu hinterfragen, die sich an Jugendliche und Emerging Adults richten.

2. THEORY

Adolescents and emerging adults often engage in health risk behaviors which can be associated to their expectations. As such, it is first needed to introduce health behaviors during adolescence and emerging adulthood. Thereafter, I will focus on expectations about health behaviors as well as on expectation violations. Finally, I will address the use of expectation violations in interventions aimed at changing risky health behavior.

2.1 Health Behaviors in Adolescence and Emerging Adulthood

Health preserving behaviors can be generally defined as actions that reduce an individual's susceptibility to disease, facilitate recovery from illness, and enable a healthy lifestyle in all aspects (Safaa et al., 2016). Conversely, health risk behaviors are activities or behavioral patterns that increase an individual's predisposition and exposure to diseases and injuries, which in turn influence their quality of life as well as their cognitive performance and psychological wellbeing (Safaa et al., 2016). Danaei and colleagues (2009) identified five main categories of health behaviors associated with higher morbidity and mortality which include (a) elevated consumption of unhealthy food (high in calories, fat, and sodium and low in nutrients), (b) low levels of physical activity and high levels of sedentary behavior, (c) substance abuse (alcohol, licit and illicit drugs), (d) smoking, and (e) risky sexual behavior.

While health risk behaviors are present among the general population, existing literature has consistently posited that adolescents and emerging adults often show a critically high incidence of health deteriorating behaviors (e.g., DiClemente et al., 2009; Romm et al., 2020). Adolescence represents a bridge between childhood and adulthood and corresponds to the period of development between the ages of 10 (onset of puberty) and about 18 (reaching the legal age of adulthood) years (Singh et al., 2019). Adolescents are at a higher risk of engaging in risky health

behaviors than other age group and most of the morbidity and mortality observed among adolescents is associated with risky health behaviors (DiClemente et al., 2009). In addition, risky health behaviors often develop during adolescence and become well established behavioral patterns during young adulthood (DiClemente et al., 2009). Furthermore, Arnett (2000; 2015) proposed the term "emerging adulthood" to conceptualize developmental aspects of young people between the ages of 18 to 25/29. During emerging adulthood, young people undergo a feeling of being in-between as they may no longer feel like an adolescent but do not yet completely feel like an adult (Arnett, 2000). Emerging adulthood represents a distinctive period as young people tend perceive it as a time of exploration of possibilities in which they take on greater autonomy and self-responsibility, make decisions independently, and yet still remain with substantial personal freedom (Arnett, 2000). Risk taking is expected to decline between adolescence and emerging adulthood (Steinberg, 2008). This decline can be associated with several factors including the gradual maturation of cognitive control mechanisms in the brain which heighten individuals' capacity for self-regulation and inhibit impulsive sensation/reward-seeking behavior, and the incompatibility between adult roles and some risk behaviors (Steinberg, 2008). Moreover, improvements in the modulation of social and emotional arousal (e.g., challenging peer influences) and in decision making have also been associated to the decline in risk taking between adolescence and emerging adulthood (Steinberg, 2008). The dual process model of risk taking posits that these changes occur throughout adolescence and emerging adulthood as brain regions involved develop at different times, with the socioemotional system (e.g., increased motivation to pursue rewards) showing strong maturation after puberty while the maturation of the cognitive control system (e.g., restrained risky impulses) is delayed (Shulman et al., 2016). Thus, an increase in risk behaviors from early to mid-adolescence is usually observed with a later decline of these behaviors (Shulman

et al., 2016). As such, adolescents and emerging adults present a high probability of engaging in health risk behaviors as brain regions responsible for decision-making, self-regulation, and judgement are not fully developed (Shulman et al., 2016). Accordingly, adolescence and emerging adulthood are critical periods for health risk taking as well as for related consequences.

As young people experiment with a novel lifestyle characterized by increased autonomy and freedom, decreased parental monitoring, and increased social influence of peers, risky activity in the context of health is likely to occur (Krieger et al., 2018; Nelson et al., 2008). Risky health behaviors among young people that require particular attention due to the potential future negative consequences include the frequent consumption of unhealthy food (i.e., diet low in fruits, vegetables and fiber and high in saturated fats, sodium, and refined sugar; Maillet & Grouzet, 2021), physical inactivity (Deng et al., 2021), and high consumption of alcohol as well as binge drinking (Romm et al., 2020). Consistently, a wealth of research demonstrates that the dietary patterns of young people are often not in line with healthy eating (e.g., Munt et al., 2017), that young people show physical activity levels below the levels recommended by physicians (e.g., Plotnikoff et al., 2015), and that alcohol consumption is critically high among this population (e.g., Krieger et al., 2018). Poor dietary habits are often present among young people who recognize lack of time to eat healthy due to academic obligations, lack of healthy options in their surroundings, high costs and low shelf life of healthy food, and, among others, not having enough willpower to follow a healthy diet as barriers to healthy food consumption (Hilger et al., 2017). Moreover, young people report not meeting the recommended physical activity parameters due to lack of time, laziness, lack of suitable facilities, lack of training companions, not feeling competent, and not enjoying physical activity (Carballo-Fazanes et al., 2020). Regularly consuming unhealthy food and sedentary behaviors are recognized as substantial risk factors for

increased morbidity and mortality generating vast array of adverse consequences on individuals and on the health system (World Health Organization, 2020; World Health Organization, 2022b). As such, unhealthy food consumption as well as sedentary behavior have been consistently associated with health issues like diabetes, obesity, cardiovascular diseases, and even cancer (World Health Organization, 2020; World Health Organization, 2022b). Furthermore, sound evidence demonstrates the high prevalence of alcohol use among adolescents and emerging adults (e.g., Arnett, 2005; Simons-Morton et al., 2016). Studies investigating reasons for drinking among young people consistently identified mood enhancement, facilitation of social interactions, and coping with anxiety, depression, and anger as main motives for drinking (O'Hara et al., 2015). Moreover, alcohol consumption is highly correlated with the development of mental health disorders (e.g., alcohol use disorder), major physical diseases (e.g., liver cirrhosis, cancer, infectious and cardiovascular diseases), intentional and unintentional injuries (e.g., traffic accidents/drunk driving, violence, deaths, sexual assault, and suicide), unsafe sex, poor academic performance, as well as with negative consequences on society (World Health Organization, 2022a).

The transition to university represents a stage of heightened vulnerability for the development of health behaviors as many health behaviors are further established during this period and greater independence may afford increased exposure to health risk behaviors of other persons (Poobalan et al., 2014). Moreover, alterations distinctive to this stage, lifestyle changes and other psychological factors may impact young people's health behaviors (El Ansari et al., 2012). In addition, more freedom combined with an environment where peers undergoing similar processes present increased opportunities to adopt and engage in risky health behaviors (e.g., Romm et al., 2020). Furthermore, young people undergoing the transition from high school to

university face several social, emotional, and academic challenges which may increase their susceptibility to engaging in health risk behaviors that could lead to present and future physical as well as psychological complications and to social dysfunction (Safaa et al., 2016). As such, young people in high school, transitioning to university or undergoing their first semester at university are at high risk of engaging in risky health behaviors that will consequently negatively impact future health and personal outcomes (DiClemente et al., 2009; Hilger et al., 2017; Maillet & Grouzet, 2021).

Although only a few studies have focused on investigating health behaviors during the transition to university, unhealthy behaviors among first semester university students have been generally detected in existing studies. For instance, unsought weight gain is often reported by first semester students (Vadeboncoeur et al., 2015). The observed weight gain has been associated with higher consumption of unhealthy food and low consumption of healthy food as well as with increased sedentary behavior and low physical activity during the first semester at university (Deng et al., 2021; Keller et al., 2008). Moreover, university students often initiate or increase alcohol consumption during their first semester, which can lead to binge drinking, risky alcohol consumption, and related problems (Riordan & Carey, 2019).

As young people's behaviors are likely to become unhealthier during the transition to university and during their time at university, understanding individual (e.g., expectations) and environmental (e.g., social influences, living arrangement) factors that could influence their behaviors is fundamental in order to avert harmful behavior as well as long-term disadvantageous health outcomes among this population.

2.2 Expectations about Health Behaviors

Expectations can be defined as subjective appraisals about the probability of future events and one's own as well as other's behavior (Carr et al., 2001). Depending on the situation, the degree of specificity of an expectation can vary. Generalized expectations are generalizations of more specific expectations regarding similar situations and probable outcomes and can derive from beliefs, previous experiences, and other specific expectations (Panitz et al., 2021). On the other hand, situation-specific expectations are informed by generalized expectations, are more concrete, and can be based on several factors such as the physical and social environment, an individual's current state, their prior experiences, social influences, and other individual aspects (Rief et al., 2015). Moreover, expectations can be significant behavioral predictors as they can influence an individual's behavior (Rief et al., 2015), and can be useful as individuals may enact certain behaviors in order to be coherent with their expectations (e.g., Fan & Chen, 2001; Jussim & Harber, 2005). Generalized expectations tend to be highly adaptive as they deliver guidance about what to expect even in unfamiliar circumstances that cannot be thoroughly analyzed (Panitz et al., 2021). Thus, expectations are important cognitions as they can help individuals prepare for future events thereby facilitating adaptation processes (Roese & Sherman, 2007). Nonetheless, expectations can also be maladaptive as dysfunctional expectations concerning future events may contribute to the development and continuation of several mental disorders (Kube et al., 2017). Therefore, expectations influence many aspects of an individual's life.

In the context of health behaviors, expectations can predict future behavior among young people as associations between expectations and actual health behaviors have been demonstrated (e.g., Werner et al., 1993 regarding alcohol use). Expectations about intended future health behavior may impact present and future well-being as they can guide individuals to act in healthy or in unhealthy manner through their influence on performance, effort, and persistence (e.g.,

Anderson et al., 2006; Rief et al., 2017; Werner et al., 1993). Moreover, expected future behavior may influence behavioral changes in order to equal expectations (e.g., Smit et al., 2018), and current as well as previous experiences and behavior can inform expectations and thereby influence adaptations in an individual's expectations (e.g., Herriot et al., 2008). As such, expectations also play an important role in health behaviors, yet little empirical research has addressed the influence of expectations on behavior among young people.

As adolescence and emerging adulthood (particularly the time at university) are often represented as periods in which unhealthy behaviors are probable, normal, and somewhat accepted (DiClemente et al., 2009; Reynolds, 2014), young people may therefore expect this period to involve unhealthy behaviors on their part and that these are to be justified by their status as a young person or student (Silver, 1996). However, these expectations may lead young people to give less precedence to healthy behaviors and defer them, failing to acknowledge the challenges of modifying established behavior and the adverse consequences of years of cumulative unhealthy behavior (Harris, 2017).

2.3 Expectation Violations

Individuals often experience outcomes that are not in line with their expectations. That is, expectations are often disconfirmed or violated based on novel evidence. When identified, expectation violations may activate a cognitive response to address the inconsistency and individuals may react by altering or conserving their original expectations. In order to optimize their predictive power in future situations, individuals are able to update their expectations by integrating information provided by the experience of having their original expectation disconfirmed (Panitz et al., 2021). However, individuals often uphold their expectations despite disconfirming evidence so that their vision of a situation does not match reality (Rief et al., 2015;

Roese & Sherman, 2007). Maintaining one's expectations in the face of disconfirming evidence can be both advantageous and disadvantageous depending on the situation. For instance, the maintenance of disconfirmed expectations can help individuals continue to pursue expectations that are relevant for achieving their goals and lessen the negative impact of worse-than-expected outcomes (Panitz et al., 2021). Given the significant role of expectations and expectation violations on human behavior and cognition, it is necessary to further understand the processes related to the maintenance or change of expectations in the context of health behaviors and among emerging adults.

2.3.1 Violated Expectations (ViolEx) Model

The ViolEx Model provides an interdisciplinary framework for investigating expectation maintenance or change following expectation violation (Gollwitzer et al., 2018; Rief et al., 2015). The model proposes that the maintenance or change of disconfirmed situation-specific expectations can be predicted by three psychological processes for coping with expectation violations, namely: immunization, assimilation, and accommodation (Panitz et al., 2021).

Immunization refers to the minimization of the impact of expectation-disconfirming evidence (by ignoring or downplaying its relevance) and has been associated with the persistence of expectations (Panitz et al., 2021). Moreover, assimilation occurs when an individual increases their efforts to fulfill their expectations (search for or produce future expectation-confirming evidence) and has been associated with persistence of expectations (Panitz et al., 2021). The revised version of the ViolEx model redefines assimilation as an anticipatory reaction aiming at obtaining or creating expectation-confirming situational outcomes and at avoiding expectation-disconfirming situational outcomes (Panitz et al., 2021). Lastly, accommodation occurs when

individuals update their expectations in the direction of the experienced outcome, thus indicating expectation change (Panitz et al., 2021).

The ViolEx Model has been applied in several disciplines to investigate the development, maintenance, and change of expectations (Panitz et al., 2021). For instance, the model has been applied in educational settings to investigate the persistence or change of student's academic achievement expectations when confronted with a worse-than expected outcome (Pinquart et al., 2020). Furthermore, the ViolEx model has been applied by clinical psychologists to assess patients' preservation of violated negative expectations about the future that contribute to the maintenance of depressive symptoms (Lüdtke & Westermann, 2022). Nonetheless, the ViolEx model has not been previously applied in the context of health behaviors (i.e., food consumption, physical activity, alcohol use) among young people.

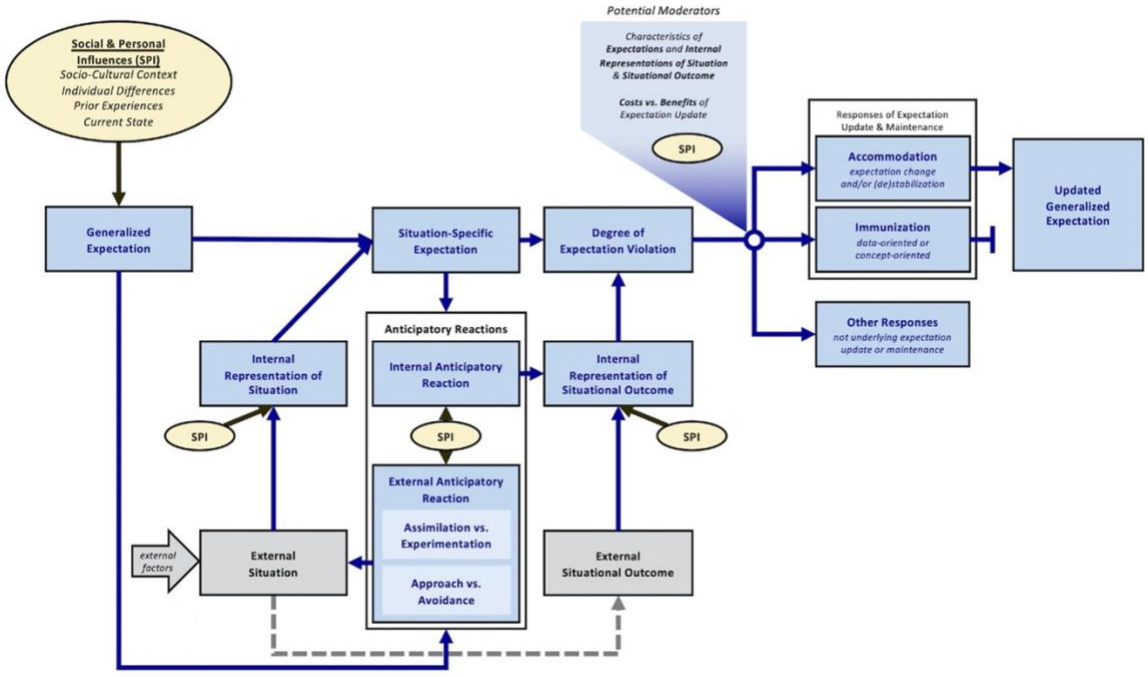

Fig.1: The ViolEx 2.0 model (Panitz et al., 2021, p. 6)

2.3.2 Influences on Expectation Maintenance or Change

The ViolEx model further postulates that individual (e.g., previous experiences and the current state), social (e.g., behavior of close social ties, influence of close social ties), and environmental (e.g., living arrangement) factors can influence an individual's expectations and the stabilization or change of expectations.

According to social learning theory (Bandura & Walters, 1977), some processes through which social ties may influence an individual's behavior include behavioral modeling and observation as well as explicit persuasion or encouragement. Moreover, social ties may provide opportunities for behaviors (e.g., supply of food and alcohol) and spending more time with social ties (e.g., sharing a household) can provide increased opportunities for these processes (Borsari & Carey, 2001).

Although the ViolEx model has not yet been applied to expectations about health behaviors, the following section will discuss the aforementioned factors as the effects of prior experiences, current state, social ties' behaviors, social influences and of living arrangement on health behaviors and related expectations are investigated in Study 1.

2.3.2.1 Prior Experiences and Current State

When inconsistencies between an individual's current state and related expectations are observed, expectation change in the direction of the current state or change in the current state in the direction of expectations may occur (Rief et al., 2015). Therefore, expectation change can be influenced by past (e.g., expectations formed through prior experiences) and present (e.g., current state) experiences in order to diminish discrepancies between behavior and related expectations (Herriot et al., 2008). Prior experiences can represent anything that an individual has lived in the past which can prompt the formation of expectations and thereby guide behavior (Herriot et al., 2008). In other terms, individuals often expect things to happen as they have previously so that

previous experiences inform changes in behavior and expectations. For instance, prior participation in programs fostering healthy eating and physical activity appears to influence future outcome expectations and behavior (Herriot et al., 2008). Furthermore, an individual's present state may also be a motivator for expectation change overtime so that their expectations become more aligned with the present behavior (Rief et al., 2015). Therefore, this can be regarded as an indicator that expectations influence changes in behavior to equal expectations, and that prior and present experiences support expectations and influence expectation change (e.g., Herriot et al., 2008).

2.3.2.2 Health Behaviors of Social Ties and Their Influence on Behavior and Expectations

In line with the ViolEx model, social factors, such as the behavior of close social ties (e.g., parents, partner, and peers) as well as their influence on behavior, can affect an individual's actions (Kaseva et al., 2017) and expectations (Panitz et al., 2021). The role of social influences on behavior (i.e., subjective social norms) has previously been emphasized in dominant theoretical perspectives in health psychology, as, for instance, in the Theory of Planned Behavior (TPB; Ajzen, 1991) where perceptions of social ties' behavior, of what they would want an individual to do, as well as motivation to conform with social ties' preferences are significant determining factors for health actions. In accordance, it has been demonstrated that close social ties play a significant role in an individual's health behaviors with facilitating accessibility to healthy/unhealthy behavior (Simons-Morton et al., 2016), modelling of behavior, and social encouragement being mechanisms through which social ties' influence on health behaviors can be established (Jones et al., 1992; Liu et al., 2017). Although the influence of parents diminishes during adolescence, parents remain important figures for an individual's health behaviors as many behavioral patterns are formed and established through early exposure to parental behavior (Center

on the Developing Child at Harvard University, 2010). As such, similar patterns of health behaviors have been demonstrated between parents and their offspring regarding food consumption (e.g., El Ansari et al., 2012), physical activity (e.g., Yang et al., 1996), and alcohol use (e.g., Rossow et al., 2016). Parenting practices that have been associated with healthier behavior among their offspring include parental monitoring (Rozmus et al., 2005), setting clear rules and expectations, positive parent-child relationship quality, parental involvement, general communication, parental support, parental modelling, disapproval of risky behavior, and general discipline (Ryan et al., 2010). As the transition to university is characterized by a decrease in parental influence and monitoring, an increase in opportunities to enact health risk behaviors is often observed during this period (Rozmus et al., 2005). Romantic partners and peers take on a more substantial influencing role on an individual's health behaviors and may provide opportunities for engaging in healthy as well as in unhealthy behaviors (Umberson et al., 2011). Consistently, correlations between young people's and their partner's food consumption and physical activity patterns have been observed (Berge et al., 2012), indicating that having a partner that engages in healthy behavior increases the likelihood of healthy behavior among young people while having a partner who does not engage in healthy behaviors increases the probability of observing unhealthy behaviors among young people. Furthermore, peer influence is particularly high between adolescence and young adulthood (Simons-Morton et al., 2016). Behaviors observed within the peer group considerably impact the kind of behavior that young people choose to engage in due to the major role that the norms and values existent in the peer group play in an individual's behavior (Umberson et al., 2010). Peer behavior can affect young people's immediate decision making (e.g., drinking at a social gathering) thereby furthering risky health behaviors (Staff et al., 2010). Moreover, young people are expected to develop affiliations with peers who share their

interests (i.e., selection) and with peers who show similar behavioral patterns (i.e., socialization; Simons-Morton et al., 2016). Therefore, time spent with peers has been associated with greater problematic alcohol use while time spent with parents/family tends to prevent problematic drinking among young people (Barnes et al., 2007).

2.3.2.3 Close Social Ties' Efforts to Influence Health Behaviors

In addition to social ties' health behaviors, social ties' efforts to motivate health behaviors can have an effect on an individual's behavior (Kaseva et al., 2017) as well as on changes in their expected behavior (Panitz et al., 2021). Individuals may adapt their health behavior as well as their expectations in accordance with social ties' actual attempts to encourage behavior as well as through related information delivered by close social ties (Legros & Cislaghi, 2020; Panitz et al., 2021). Overt social pressure to engage in risky health behavior is a mechanism through which social ties influence behavior (Bandura & Walters, 1977). Although some literature has demonstrated that social ties' efforts to encourage behavior can play a role in young people's health behaviors (e.g., Deliens et al., 2014; Kaseva et al., 2017; Simons-Morton et al., 2016), and that young people perceive that their health behaviors and expectations are considerably influenced by their close social ties (e.g., Deliens et al., 2014), scant reports exist addressing social influence on expectation maintenance or change among young people in the context of health behaviors.

2.3.2.4 Living Arrangement

The ViolEx model further posits that environmental characteristics, as for example, an individual's living arrangement, may influence the expectations that individuals have about their future behavior (Panitz et al., 2021). In consistency with this approach, reports exist indicating that young people believe that living with their parents has an effect on whether they expect to behave in a healthy or in an unhealthy manner in the future (Deliens et al., 2014). Therefore, young people

tend to perceive living with their parents as a barrier to health risk behaviors. This perception corresponds with relevant literature which indicates that living with parents usually provides a framework that foments healthy behaviors and prevents risky behaviors (Jones et al., 1992). For instance, university students who live with their parents show, on average, a higher consumption of healthy food (e.g., fruits and vegetables) than students who do not live with their parents (El Ansari et al., 2012; Maillet & Grouzet, 2021). Evidence regarding physical activity has not been consistent as some studies report that living with parents is associated with increased physical activity among students (Fan et al., 2019), whereas other studies report that living with parents is associated with less physical activity (Jones et al., 1992). Furthermore, living with parents has been associated with a decreased likelihood of alcohol consumption among young people over time (Jones et al., 1992). Conversely, living outside of the parental home has been associated with a higher probability of problematic and increased alcohol use among youth as drinking may be prevalent in these environments and alcohol may be affordable and easily accessible (Simons-Morton et al., 2016). Nonetheless, there may be exceptions, such as living with a parent who has a substance use disorder (Lander et al., 2013). Increased unhealthy behavior among youth that moved out of the parental home may be associated with changes in the environment that may allow for increased opportunities for health risk behaviors and facilitate engagement in these behaviors as opposed to healthier alternatives (Small et al., 2013). Sharing housing with social ties that participate in unhealthy behaviors may present occasions for young people to partake in risky behavior thereby enabling such activity. In accordance, similarities between couples that live together have been observed regarding food consumption, physical activity, and drinking (Monden, 2007). Moreover, peers that live together have shown correspondences in drinking patterns (Monden, 2007). As such, moving out of the parental home tends to allow for increased

opportunities for health risk behaviors and young people appear to foresee that their health behaviors and expectations are to be influenced by their place of residence.

2.3.3 Characteristics of the Expectation Violating Event as Predictor of Coping

As proposed by the ViolEx model, characteristics of an expectation disconfirming event may predict coping with expectation violations as these may promote or hinder expectation maintenance or change (Pinquart et al., 2021). Aspects of the expectation disconfirming event that can influence coping with expectation violations include valence (better or worse than expected), discrepancy size (higher or lower discrepancy), and controllability of the disconfirming event (Pinquart et al., 2021). However, the role of these factors has not been widely investigated regarding violated health-related expectations among young people. Characteristics of an expectation disconfirming event as predictors of coping with expectation violations play a role in Study 2.

2.3.3.1 Valence of the disconfirming event

When expectations are associated with wanted and unwanted outcomes, the subjective value attributed to the outcome (i.e., whether an event resulted as better or worse than expected) can affect how the individual responds to expectation violations (Pinquart et al., 2021). Greater expectation change, or accommodation, has been detected following better-than-expected outcomes compared to worse-than-expected outcomes (Lefebvre et al., 2017). The observed disproportionateness in expectation updating represents a phenomenon known as the good news/bad news effect or optimistic reinforcement learning (Lefebvre et al., 2017), a mechanism which underlies human tendency for optimism bias or overestimating the likelihood of favorable events and underestimating the probability of unfavorable events when establishing and revising beliefs about the future (i.e., optimism bias; Sharot & Garrett, 2016). For instance, in the context

of health behaviors, optimistic reinforcement learning has been evidenced on heavy smokers assessing their risk of premature mortality (Schoenbaum, 1997). On the other hand, a higher likelihood of immunizing against unexpected expectation-disconfirming information has been observed following worse-than-expected events as opposed to better-than expected outcomes as individuals are inclined to question the reliability of this expectation-disconfirming-feedback, to discard it, and to perceive it as an exception from the typical thereby obstructing the integration of new information (Kube et al., 2019a).

2.3.3.2 Discrepancy size of the disconfirming event

While the magnitude of the discrepancy is another important predictor of expectation conservation or update, no agreement has been established regarding whether larger discrepancies lead to more or to less change in expectations (Roese & Sherman, 2007). The Delta-Rule proposes that larger inconsistencies between expectations and disconfirming occurrences will lead to greater change in expectations as individuals are provided with more opportunity for learning (Rescorla & Wagner, 1972). In divergence with this notion, an alternative body of evidence proposes that larger discrepancies may be more likely perceived as an exception or as atypical and may lead to subtyping rather than to change of the general expectation, particularly if the disconfirming information is distinctively salient (Kube et al., 2019b; Niv, 2019; Roese & Sherman, 2007). In addition, this notion further proposes that smaller discrepancies are prone to be completely ignored or disregarded, while moderate discrepancies between expectations and disconfirming events are likely to produce the strongest change in expectations (Kube et al., 2019b; Niv, 2019; Roese & Sherman, 2007).

2.3.3.3 Controllability of the disconfirming event

If individuals are able to exert some level of control over the source of expectation violation, there is a higher probability that they will increase their efforts to fulfill their expectations (Pieters et al., 1995). On the other hand, when faced with an uncontrollable or stable expectation-disconfirming event, individuals are more likely to change their original expectations as a response to the expectation violation (Pieters et al., 1995).

2.4 Use of Expectation Violations in Interventions to Change Unhealthy Behavior

As adolescents and young adults show a high prevalence of unhealthy behaviors, and because risky health behaviors can be reinforced during these stages in development, adolescence and emerging adulthood are suitable and critical periods for implementing health promotion strategies (e.g., Hilger et al., 2017; Scott-Sheldon et al., 2012). Several intervention approaches have already been implemented with the aim of fostering healthy behaviors (e.g., Carey et al., 2016; Pfisterer et al., 2022; Plotnikoff et al., 2015), with high schools and universities being key settings for delivering targeted health promotion programs to provide young people with tools to enact adaptive rather than maladaptive behaviors during this critical period for future health outcomes (Safaa et al., 2016). Nonetheless, scant research exists focusing on implementing the disconfirmation of health-related expectations as an intervention strategy to foster healthy behavior. As interventions can help improve students' life quality by preventing future health problems related to unhealthy behaviors commonly observed during youth (Safaa et al., 2016), further understanding intervention aspects that can promote healthy behaviors among young people is crucial in order to optimize existing interventions, to develop new evidence-based strategies, and to reduce the burden of disease among future adult populations. The following section is pertinent to this dissertation as the focus of Study 3 is on investigating the

implementation of expectation violations in an intervention to change alcohol use among high school and college students.

As previously conferred, expectations are significant determinants of behavior as they may increase or decrease the likelihood of healthy or unhealthy behavior (Darkes & Goldman, 1993). Thus, assessing individual's health-behavior-related expectations and challenging expectations associated with unhealthy behavior are valuable strategies for interventions aimed at promoting healthy behaviors. Confronting individuals with expectation violations through interventions has been shown to be effective at changing unhealthy expectations and behavior (e.g., Darkes & Goldman, 1993). Some researchers and interventionists have incorporated strategies that focus on expectations and expectation violations to enhance interventional efforts and to prompt the desired behavioral change. For instance, considering the association between expectations and alcohol use, and the high prevalence of drinking among young people, interventional efforts have focused on targeting alcohol outcome expectations (i.e., beliefs about the positive or negative effects of drinking alcohol) to elicit behavior change in a healthier direction among youth (Scott-Sheldon et al., 2012). Alcohol outcome expectations tend to develop at early ages, even before the onset of drinking, and are crucial influencing factors regarding the initiation of alcohol use as well as regarding the likelihood of drinking among young people (Kuntsche et al., 2005). Positive expectations about the effects of drinking alcohol are particularly problematic as they can play a substantial role in initiating, maintaining, or increasing alcohol use among young people (Scott-Sheldon et al., 2012). Expectancy challenge interventions (EC; Darkes & Goldman, 1993) aim to confront positive alcohol expectations to prevent or reduce drinking among youth. The original EC protocol included a bar setting where university students were provided with drinks that could or could not contain alcohol, participated in learning and social activities, and were finally asked

whom they believed had consumed alcohol (including themselves) based on personal observations of changes in behavior (e.g., being more social; Darkes & Goldman, 1993). When presented with correct information regarding who had consumed alcohol and who had not, participant's positive alcohol expectations were challenged as their assumptions were, more often than not, incorrect (Darkes & Goldman, 1993). Participants in the EC condition showed significant reductions in alcohol consumption compared to the control condition (Darkes & Goldman, 1993). Variations of the original EC format have been implemented with adaptations in setting (bar-lab or no bar-lab), dose (number of sessions and session length), target population (high school and college students), and intervention components (included media literacy or not; Scott-Sheldon et al., 2012). A meta-analysis conducted in 2012 reported generally positive yet mixed results regarding the effects of at EC at modifying alcohol use and expectations among college students, and mixed results about moderating effects of age (Scott-Sheldon et al., 2012). Moreover, this meta-analysis investigated EC only among college students despite the high prevalence of drinking among adolescents. Therefore, further research is needed for expanding our understanding about intervention and individual characteristics that moderate the effects of EC to define under which circumstances EC are more likely to decrease or prevent alcohol use among young people. Furthermore, research in the context of health behaviors is needed to identify what kinds of expectation violations foster healthy behavior and expectations to potentiate intervention effects at promoting healthy food consumption and physical activity and at preventing problematic alcohol use.

3. RESEARCH OBJECTIVES

Research investigating expectations in association with food consumption, physical activity, and alcohol use among first-semester university students is limited for the most part. Moreover, the association between these health behaviors and expectation violations has not been

widely investigated. Numerous studies have investigated health behaviors among first-semester university students as well as factors that influence behavioral changes (e.g., Hilger et al., 2017; Riordan et al., 2019). However, previous studies have not assessed the role of expectations on health behavior change during the first semester, and research regarding the maintenance or change of health-behavior-related expectations and related processes is rare, does not target first-semester students, and mostly only refers to alcohol use. Furthermore, the relationship between individual and environmental factors (i.e., prior experiences, current state, behavior of close social ties, social tie influence, living arrangement) and health-behavior-related expectation change as well as behavior change has not been broadly investigated in existing literature. The aim of Study 1 is to increase the knowledge in this field by investigating how students' health behaviors and expectations change over the first semester, and which factors influence the maintenance or change of behavior and expectations.

Individuals often experience expectation violations related to health behaviors which may result in change towards healthier expectations (e.g., Scott-Sheldon et al., 2012). In addition, some literature has shown that certain characteristics of expectation disconfirming events predict the maintenance or change of expectations (see Pinquart et al., 2021 for a review). Nonetheless, evidence regarding characteristics of expectation disconfirming events that predict coping with expectation violations (namely valence, discrepancy magnitude, and controllability) in a health behavior context has not been previously reported. Furthermore, existing studies have rarely been based on the processes of coping with expectation violations proposed by the ViolEx model. These avenues for research are addressed in Study 2 regarding expectation violations in the context of food consumption and physical activity among university students.

Generally, the role of expectations and expectation violations in interventions to change unhealthy behavior among young people has received little attention. Nevertheless, several studies have examined the relation between alcohol expectations and drinking among this population as well as the use of expectation violations in interventions to prevent or reduce alcohol use (Darkes & Goldman, 1993). Not only have single empirical studies been conducted, but also a few reviews and a meta-analysis (Carey et al., 2016; Labbe & Maisto, 2011; Scott-Sheldon et al., 2012). However, previous work provided mixed evidence for the effects of EC at modifying alcohol use and positive alcohol expectations among college students. Notably, the previous meta-analysis was limited to samples of college students and therefore did not assess the effects of EC among adolescents/high school students, which is necessary as adolescence is a critical period to challenge positive alcohol expectations (Portelli, 2018). This gap motivated the meta-analysis included in this dissertation to examine the results of novel work in the field in order to obtain robust results regarding the effects of EC at changing expectations and alcohol use among high school and college students. The meta-analysis further assessed possible moderating effects of study and individual characteristics on these changes as some have been previously suggested, but either were not assessed in the previous meta-analysis or results held inconclusive.

The present dissertation addressed the abovementioned gaps by investigating the following overarching research questions:

Study 1: How do expectations, expectation violations, and the health behaviors of young people relate?

Study 2: What factors influence the maintenance or change of health-behavior-related expectations among young people?

Study 3: What are the effects of expectancy challenge interventions (EC) on young people regarding change in health behaviors and expectations, using the example of alcohol consumption?

4. EMPIRICAL STUDIES

All in all, Study 1 was conducted to increase the knowledge on longitudinal change of first-semester students' health behaviors and expectations as well as on factors influencing the maintenance or change of behavior and expectations. Moreover, Study 2 experimentally investigated whether characteristics of an expectation disconfirming event predict coping with expectation violations in a health behavior context based on the ViolEx model, which has not been the subject of previous studies. Lastly, the aim of Study 3 was to update prior meta-analytical work concerning the effects of EC on alcohol outcome expectations and alcohol use not only among college students, but also among high school students while also investigating possible moderating effects. The following section summarizes the three studies included in the present dissertation.

4.1 Study 1 – Influences on change in expected and actual health behaviors among first-year university students

Background: First-year students often adopt health risk behaviors during their first semester such as increased consumption of unhealthy food (Maillet & Grouzet, 2021), decreased physical activity (Deng et al., 2021), and increased alcohol use (Romm et al., 2020). Therefore, the transition to university marks a vulnerable period for the development of health risk behaviors and expectations that will consequently negatively impact future health outcomes (Hilger et al., 2017). Expectations (Herriot et al., 2008), social tie's efforts to motivate behavior (Kaseva et al., 2017), and coresidence with parents or other social ties can influence said behaviors (Deliens et al., 2014). We assessed how students' health behaviors and expectations change over the first

semester, and how the aforementioned factors influence the maintenance or change of behavior and expectations.

Method: A longitudinal survey design was implemented. A total of $N = 163$ German first-year students (81% female; 18% male; 1% non-binary; $M_{age} = 21.20$, $SD = 2.66$) completed online questionnaires, during the Covid-19 pandemic at the beginning (November 2020) and after the end (May 2021) of their first semester. Current and expected health behaviors (at time 1 and time 2) were investigated using the National College Health Risk Behavior Survey (NCHRBS; Douglas et al., 1997) to assess present/expected food consumption as well as physical activity; the Alcohol Use Disorders Identification Test (AUDIT; Saunders, 1993) was administered to assess alcohol use. Lastly, nine items were developed to assess social ties' efforts to encourage health risk behaviors (at time 1).

Results: We found that current and expected food consumption and physical activity became healthier over time and that the current and expected number of drinks consumed per month increased. Change in expectations for physical activity, number of drinks and binge drinking were predicted by the initial respective behavior. The number of drinks consumed and expected physical activity became unhealthier in relation to reported initial parental influence to drink and to be physically inactive. Moving out of the parental home predicted an increase in current and expected number of drinks consumed and in current and expected binge drinking. These effects of moving out were not mediated by perceived parental or peer influence.

Discussion: The observed changes in food consumption indicate that the consumption of unhealthy food among students occurs mostly during the initial month of the first semester, which may occur as a process of independently establishing new food consumption patterns after moving out of parental home. Changes in physical activity may be related to Covid-19 restrictions as it

may have been difficult for participants to fulfill their expectations due to the restrictions. Moreover, an increase in alcohol was observed which may be related to a decrease in parental monitoring, among others. As such, we found that parents play a significant role in the physical activity and alcohol use patterns of their offspring during the first semester. Altogether, the observed different trajectories of food consumption and physical activity as well as of alcohol consumption indicate that the focus of early college-based prevention and intervention efforts related to these behaviors might differ. Regarding food consumption and physical activity, the focus might be to reduce levels of unhealthy behaviors observed early in the first semester whereas regarding alcohol use, a main focus should be to prevent increases in drinking across the first semester and possibly beyond.

4.2 Study 2 – Predictors of coping with health-related expectation violations among university students

Background: University students are at high risk of developing unhealthy expectations about food consumption and physical activity during their time at university, which may lead to future adverse health outcomes (Hilger et al., 2017). When an individual's expectations are violated, they may react by altering or maintaining their expectations (Panitz et al., 2021). The Violated Expectations (ViolEx) Model proposes 3 ways of coping with expectation-disconfirming information (1) ignoring or downplaying the discrepancy (immunization), (2) increasing efforts to fulfill the expectations (assimilation), or (3) changing their expectations (accommodation; Panitz et al., 2021; Rief et al., 2015). Coping with expectation violations can be influenced by characteristics of an expectation disconfirming event such as valence, discrepancy magnitude, and controllability of the expectation disconfirming event (Pinquart et al., 2021). We investigated with an experimental study whether valence, discrepancy, and controllability of the expectation

disconfirming event predict coping with expectation violations (i.e., expectation maintenance or change).

Method: We implemented a 2 (valence of expectation violations: positive vs. negative) x 2 (discrepancy: larger vs smaller) x 2 (controllability: control vs no control) within-subjects design. A questionnaire containing a total of 16 vignettes was administered in which expectations about healthy food consumption and physical activity were violated (8 referred to food consumption and 8 referred to physical activity). In each vignette, characteristics of the expectation disconfirming event were manipulated to include different combinations of predictor levels, and participants could select one out of three response options representing either immunization, accommodation, or assimilation. To control possible sequence effects, participants were randomly assigned so that half received all the vignettes in one random sequence and the other half in the reverse sequence. The sample consisted of 297 university students (75.8% female; 22.9% male; 1.3% non-binary; $M_{age} = 23.76$, $SD = 4.42$).

Results: Regarding physical activity, participants showed significantly higher accommodation when being confronted with a better-than-expected event and showed significantly higher immunization when being confronted with a worse-than-expected event. Regarding food consumption and physical activity, individuals confronted with lower discrepancy showed significantly higher immunization; individuals responded to situations with control over the source of expectation disconfirmation by showing significantly higher assimilation; and individuals responded to situations without control over the source of expectation disconfirmation by showing significantly higher accommodation.

Discussion: Our results indicate that the size of discrepancy and having control over the disconfirming event are relevant for coping with expectations violations related to food

consumption and physical activity. Moreover, large discrepancies might inhibit learning and expectation change as they may lead to subtyping or to the perception of the expectation disconfirming event as an exception from the rule, and consequently, to the maintenance of general expectations as future situations are expected to be as they have previously been (Niv, 2019). As such, expectation violations can be used as part of interventions for changing unhealthy behaviors. Applying our findings regarding the optimal kind of expectation violations that foster healthy expectations could increase intervention effects for promoting healthy food consumption and physical activity. In addition, interventions could foster the perception/availability of control to increase the chance that participants try to overcome existing barriers to fulfill their healthy expectations (encourage assimilative behavior) rather than giving them up (accommodation).

4.3 Study 3 – Expectancy challenge interventions to reduce alcohol consumption among high school and college students: A meta-analysis

Background: Alcohol outcome expectations, or beliefs about the positive or negative effects of drinking, are a critical factor in the development of problematic alcohol use (Goldman et al., 1999). Expectancy challenge (EC) interventions aim to manipulate positive alcohol outcome expectations to reduce or prevent alcohol use among young people (Darkes & Goldman, 1993). The present meta-analysis investigated the effects of ECs at changing expectations and alcohol use among high school and college students, and moderating effects of study and individual characteristics on these changes.

Method: Relevant studies were retrieved from the electronic databases PsycInfo, ERIC, Medline, and PubMed. A total of 23 studies were included in the present meta-analysis using a random-effects model, resulting in a combined sample of 4,122 participants. Studies were included if they reported enough information for calculating the effects of EC interventions on alcohol

expectancy change and/or alcohol use among high school or college students, and if they randomized participants into an experimental condition or a control condition that did not receive an active intervention.

Results: ECs showed significant yet small effects at reducing alcohol consumption and general positive alcohol outcome expectations. Changes in social, tension reduction, liquid courage, and risk aggression expectations explained significant variance in change in alcohol use. Moderator analyses indicated that the effects of ECs at changing social, sexual, tension, and liquid courage expectations were stronger among college students compared to high school students. Additionally, more favorable effects (i.e., reduction of alcohol consumption and change of expectations regarding liquid courage and cognitive behavioral consequences) were observed for interventions delivered at a higher dose (number of sessions and session length).

Discussion: The findings of the present meta-analysis present encouraging trends suggesting that ECs serve to modestly reduce alcohol consumption (quantity and frequency) and to reduce positive alcohol outcome expectations among young individuals, particularly among emerging adults and college students, when delivered at a higher dose. Small effect sizes may represent an acceptable benefit–cost ratio considering the low average duration of ECs, and the few resources needed to implement them. Older participants and college students tend to have more positive expectations about the consequences of drinking than younger participants and high school students (Frank et al., 1999; Pinquart & Borgolte, 2022) and, therefore, may have had more possibility to show improvement. Furthermore, the observed changes in positive alcohol outcome expectations explained significant variance in change in alcohol use, which supports the assumption that ECs reduce alcohol use via changes of expectations. Further research investigating

under which circumstances and among which subgroups ECs are expected to produce greater effects is needed.

5. DISCUSSION

Through the present dissertation, knowledge concerning expectations, expectation violations, and factors influencing expectation maintenance or change in the context of health behaviors among emerging adults was broadened as well as regarding the use of expectation violations in an intervention aimed at promoting healthy behavior among adolescents and emerging adults.

Study 1 implemented a longitudinal design and demonstrated that, in part, health behaviors and related expectations are linked to the present state, to coping with expectation violations, to parental encouragement for behavior, and to living arrangement as change of expectations regarding physical activity and alcohol use was predicted by the initial respective behavior, ways of coping with expectation violation predicted change in expectations about physical activity, parental motivation for sedentary behavior and for alcohol use significantly predicted the respective current and expected behavior, and not living with parents predicted current and expected drinking behavior. These results contributed to the further understanding of the relationship between expectations, expectation violations, and health behaviors among emerging adults and added to the notion that individual and environmental factors influence an individual's behavior as well as expectations and expectation maintenance or change in this population. As such, Study 1 produced knowledge that can be relevant for health promotion strategies among first-semester students.

Study 2 experimentally demonstrated the connection between expectations about health behaviors and aspects of an expectation violation related to situational use of coping strategies,

which can prove useful for interventions among university students in general. In this study we found that valence, discrepancy magnitude, and controllability of the expectation disconfirming event predict coping with expectation violations. More specifically, we found that discrepancy size and having control over the disconfirming event are relevant for food consumption and physical activity as smaller discrepancies predicted immunization, having control over the expectation disconfirming event predicted assimilation, and uncontrollable disconfirming events predicted accommodation. Moreover, valence is relevant for physical activity as higher accommodation was observed following a positive valence and higher immunization was observed when experiencing a negative valence. Furthermore, results suggest that larger discrepancies might inhibit learning and expectation change. As such, the understanding of predictors regarding characteristics of expectation disconfirming events for the maintenance or change of expectations related to food consumption and physical activity was advanced and insights as to how to foster healthy behavior among university students were obtained.

Study 3 presents a practical example of applied knowledge on expectations and expectation violations to interventions aimed promoting healthy behavior among adolescents and emerging adults regarding one domain of behavior investigated in this dissertation, namely alcohol use. The study meta-analytically demonstrates that EC targeting high school and college students produce significant albeit small effects at modifying alcohol consumption and alcohol expectations in the desired direction and suggests several mediating and moderating effects of study and individual characteristics on these changes. First, change in expectations explained significant variance in change in alcohol use, illustrating the mediating role of expectation change in drinking reduction. Second, although the intervention was effective among both groups, the effect of EC at changing positive alcohol expectations was stronger among college students than among high school

students. Lastly, more favorable intervention effects were observed in interventions delivered at a higher (higher number of sessions with a longer duration) than at a lower dose. All in all, our meta-analysis updates existing knowledge about EC and further validates the practical importance of challenging health-behavior-related expectations (i.e., using expectation violations) through interventions to change behavior and expectations in a healthier direction among young people.

Fundamentally, Study 1 and Study 2 provided longitudinal and experimental evidence of integrating aspects of the ViolEx model (Rief et al., 2015) in the context of health behaviors among emerging adults. In addition, Study 3 also included evidence for adolescents in relation to expectation violations in a health behavior context and is associated with Studies 1 and 2 despite not being based on the ViolEx model and despite the fact that the included studies on EC did not apply the ViolEx Model. This model appears to be an appropriate fit for investigating health behaviors among young people as it helps to not only predict behavior and expectation change, but also to understand characteristics of an expectation violation that are likely to elicit desired behavior change which is relevant for intervention efforts. The first study assessed individual and environmental factors that influence behavior as well as expectation maintenance or change among first-semester university students, where the focus was on how these factors influence behavior and expectations, but also, partly, on the longitudinal influence of expectations on behavior. As such, Study 1 represents the first longitudinal investigation relating the coping process of the ViolEx Model to food consumption, physical activity, and alcohol use during the first year at university in which the implementation of the ViolEx model served to enhance the current understanding of the maintenance or change of physical-activity-related expectations indicating that individuals reporting to be active to fulfill their expectations are more likely to further

increase/maintain their expectations (assimilation) and those being more prone to ignoring and downplaying expectation violations showing less expectation change (immunization).

Especially for the second study, the ViolEx model is of importance, as the second study investigated characteristics of an expectation disconfirming event that predict change or maintenance of expectations (based on the processes of coping with expectation violations proposed by the ViolEx model) in the context of food consumption and physical activity among emerging adults, which has not been previously done. The ViolEx model provides information about whether expectation change or maintenance is likely to occur in the face of disconfirming evidence. Responding with accommodation towards expectation violation results in a change of expectations, which was observed after experiencing a better-than-expected event (i.e., positive valence; physical activity) and when individuals did not have control over the source of expectation disconfirmation (physical activity and food consumption). The usual processes keeping expectations high in case of disconfirming information are assimilation or immunization. Higher immunization was observed when experiencing a worse-than-expected event (physical activity) and when experiencing lower discrepancy (physical activity and food consumption). Higher assimilation was observed when individuals had control over the source of expectation disconfirmation (physical activity and food consumption). Interestingly, lower assimilation was observed when experiencing a larger discrepancy (physical activity), a result which was in the opposite direction of our hypothesis. We hoped to be able to explain this unexpected finding by taking into consideration theoretical viewpoints regarding whether larger discrepancies lead to greater or to lower expectation change (Roese & Sherman, 2007). Corresponding to the delta rule, in their work Rescorla and Wagner (1972) posit that larger discrepancies will produce larger expectation change as they provide more room for learning. This view is of relevance as the delta

rule is one of the most commonly applied learning rules which has been generally corroborated (Pinquart et al., 2021). Still, it might be that the alternative theoretical view suggesting that large discrepancies inhibit learning and expectation change (i.e., subtyping; Niv, 2019, Seta & Seta, 1993) may have been a more appropriate approach for our data than the delta rule. Consistently, experiments supporting the delta rule usually provided only the discrepancy information without additional situational cues that may distinguish the new situation from previous ones while our vignettes provided some contextual information that may have promoted subtyping (i.e., situations with larger discrepancy being perceived as an exception from the rule). When interpreting this result, it is also important to note that, despite being confronted with a large discrepancy, individuals still had the option to show assimilative behavior. Thus, expectation change (i.e., accommodation) in response to larger discrepancies may still be found if individuals do not have the chance to alter the situation (i.e., to show assimilative behavior). Nonetheless, it is possible that some of the predictors of coping with health-related expectation violations identified in Study 2 may not play a role if addressing expectations on other domains. For instance, the aforementioned availability of contextual information on vignettes would not play a role in simple learning experiments that only vary the size of association between a stimulus and a consequence (except for studies on context effects on associative learning; e.g., Bouton et al., 2019). Moreover, expectations may be less likely to change if associated with central aspects of the self-concept (e.g., achievement-related expectations if achievement is highly important; Henss & Pinquart, 2022). Another example involves the role of parental influences (Study 1) on their offspring's behaviors which may be more relevant regarding some topics than others (e.g., parental influences tend to be smaller related to youth leisure activities (e.g., clothing, music, hobbies) than related to health and safety issues (e.g., drinking); Wood et al., 2004). Therefore, while some predictors of

coping with expectation violations identified in Study 2 may be relevant across different domains (contents), it is also possible that there is a specificity to the topic of health behavior, and related factors may influence coping (e.g., health beliefs and attitudes). Further research would be needed to determine the generalizability of the study's findings to other domains. Lastly, the relative importance of eating healthy and being physically active may vary depending on characteristics of the individual as, for instance, some young people may prioritize their health over their academic performance, while others may prioritize academic success over their health (Stults-Kolehmainen & Sinha, 2014). As this is likely to play a role on students' engagement in healthy food consumption and physical activity, it would be practically relevant to examine the importance of these health behaviors for this population compared to succeeding at university in order to help students balance their health and academic goals rather than viewing them as competing priorities.

The third study focused on the practical relevance regarding the effects of expectation violation on changing alcohol use and related expectations among adolescents and emerging adults, which advanced the knowledge deriving from previous work that provided mixed results, only focused on college students, and did not report necessary results corresponding to mediating and moderating effects. Moreover, Study 3 created a bridge towards the possible advantage of applying the ViolEx model on interventions to promote healthy behavior among young people, which has not been previously done in this context. In this way the third study meta-analytically demonstrated the influence of expectations on young people's health behavior and the implication for health promotion efforts to further consider expectation-focused interventions for young people. It also investigated possible mediators and moderators, with expectation change as well as age and dose being important factors to consider when delivering health interventions to youth.

Although focused on food consumption and physical activity, results from Study 2 could inform EC interventions assessed in Study 3 to potentiate their effect at reducing alcohol consumption and challenging positive alcohol expectations among high school and college students. For instance, ECs could use the ViolEx model as a framework to induce expectation violations that are moderate in size in order to promote accommodative behavior so that change in (unhealthier) expectations occurs to match the unexpected experienced (healthier) outcome. In addition, results from Study 1 indicate that social ties are influential on young people's health-related expectations and actual behaviors. Thus, considering social sources of discrepant information could also be appropriate for the development of new interventions and for the enhancement of existing interventions (e.g., ECs) to promote healthy behaviors among young people. For example, EC interventions could involve social ties as sources of discrepant information about alcohol use to provide accurate information about the consequences associated with alcohol consumption and to help dispel common myths about alcohol use and its effects on health. Nonetheless, the relevance of social partners in shaping individuals' expectations and behaviors may vary depending on the topic of the expectation as the degree of influence may depend on the social tie's perceived credibility and expertise in that domain, as well as on the cultural and social context in which the expectations and behaviors are shaped (Petty & Cacioppo, 1986).

Overall, Studies 1, 2 and 3 could be regarded as addressing different aspects of a broader topic, which is expectations and expectation violations in the context of health behaviors among adolescents and emerging adults and how environmental and individual factors influence behavior, expectations, and coping with expectation violations among this population. In summary, results from these three studies may be applied to optimize available interventions or develop new

interventions informed by the ViolEx model which include discrepancies of a medium size to promote change of unhealthy expectations, involve the perception of control as well as social sources of discrepant information.

5.1 Limitations

A general difficulty when conducting research among young people is the overrepresentation of participants from WEIRD (Western, Educated, Industrialized, Rich, and Democratic) societies (Davey et al., 2022). This issue was faced in all the studies conducted for this doctoral thesis which does not necessarily indicate that the data is not representative of young people, but results must be interpreted with caution when basing our general understanding of young people on high school and college students from WEIRD societies (Davey et al., 2022). More specifically, young people who attend high school or college in WEIRD societies are outliers in some traits and therefore might have different expectations about their health behaviors than young people not attending high school or college and who are from non-WEIRD societies (Davey et al., 2022), for example, when considering their expectations about drinking. A suitable study illustrating this example showed the relationship between religious/spiritual belief and alcohol expectations as well as quantity of alcohol consumed among adolescents in Thailand, with practicing Buddhists expecting more negative and less positive outcomes from drinking and being less likely to drink than non-practicing Buddhists (Newman et al., 2006). Because of the underrepresentation of participants from non-WEIRD societies in our studies, we were not able to derive generalizable inferences from our results that apply to different cultural groups. Nonetheless, it is important to note that our longitudinal study was explicitly focused on first-semester university students and the goal was not to analyze change in health behaviors among German 18- or 19-year-olds in general. To contribute to the non-Western-centric understanding of

health behaviors and expectations among young people, we conducted a cross-sectional study among emerging adults in Colombia and found that parents play a significant role in young people's food consumption and drinking, and that the partner's drinking as well as time spent with peers are highly related to heavy drinking (Gesualdo et al., 2023). Moreover, we will conduct a cross-cultural study comparing cross-sectional data from Colombia and Germany.

Another general issue refers to the use of self-report measures. Some participants may have become aware of what was being tested, may been reluctant or ashamed to answer truthfully, or may have not be willing to answer and might have instead provided socially desirable responses (Furnham, 1986). Moreover, questionnaires bear the tendency for extreme positive, negative, or intermediate answers (Furnham, 1986), which may hinder the accuracy of responses. However, cognitive and situational factors do not threaten the validity of self-reports related to health behaviors (Brener et al., 2003), and we secured participant anonymity to reduce this extreme response bias at least in part.

Additional limitations should be considered when interpreting the results of Study 1. As data was collected during the Covid-19 pandemic, unusual circumstances and restrictions as well as limited available opportunities for typically observed risk behaviors among first-semester students were generally present (e.g., bars/pubs were closed at the time of data collection, limited contact with other students at university; Zusammen gegen Corona, 2020). Moreover, we were not able to test whether results specifically associated to the restrictions in place due to the pandemic. Therefore, results may not be representative of times before or after the Covid-19 pandemic and should be interpreted cautiously with regard to generalizability. Also, the data collection period for the first point of measurement was extended to ensure a larger sample size. As such, participants' behaviors and expectations may have already been influenced by individual and

environmental factors. Combining these limitations, the restrictions in place due to the Covid-19 pandemic may have influenced participants' behaviors and the aforementioned factors that are hypothesized to influence young people's health behaviors and expectations might not have been detected at an appropriate time.

Study 2 also presented some limitations. First, sequence effects were found regarding items presented in either the first or last vignette, which, in line with findings on serial learning (Alós-Ferrer et al., 2016), could indicate that additional trials of exposure to expectation violations may have been needed for participants to cease ignoring discrepant information (immunize) and change their expectation (accommodate). Moreover, although we attempted to reduce attention to the manipulation by varying the content of the vignettes, the vignettes may have been too similar, and participants may have become aware of the manipulated variables which could have led them to respond as they believed was expected. In addition, although participants had to answer based on their own perspective, responses could potentially differ when being personally confronted with these situations, as is common in vignette studies (Bicchieri et al., 2021; Silva et al., 2019). Although Study 3 increased the knowledge regarding the effects of EC interventions among high school and college students and updates the previous meta-analysis, some limitations must be considered. First, although our test power was appropriate to identify modest effect sizes, numbers of available studies including female samples as well as high school students was low, which limits interpretations about the moderating effects of individual characteristics on EC. In addition, only a small portion of studies assessed other relevant outcome variables related to expectations or provided necessary data to assess comparative EC effects between relevant subgroups, which further limited our investigation.

5.2 Future Research

The present thesis addressed some of the gaps regarding the understanding of expectations and expectation violations in the context of health behaviors among young people. Nonetheless, several questions remain unanswered while new questions appeared, both of which should be addressed in future studies.

Study 1 provided insights regarding first-semester university students' health behaviors, expectation change and factors that could influence the maintenance or change of behavior and expectations. Two behaviors that are commonly unhealthy during the first semester (i.e., food consumption and physical activity) became healthier overtime. As this result might, partly, be associated with limited opportunities to display unhealthy behavior, a future replication of the present study once all Covid-19 restrictions are lifted is needed in order to derive more generalizable inferences. We also found support regarding physical activity and alcohol use indicating the predictive effect of present health behavior on expectation change. As the predictive power of expectations may increase when they are based on more previous experiences (Panitz et al., 2021), future studies might also consider incorporating an assessment of previous experiences with a particular behavior. Moreover, although Study 1 represents the first assessment of health-behavior-related expectation maintenance or change during the first semester at university considering food consumption, physical activity, and alcohol use together, significant results were found regarding only one domain of behavior (i.e., physical activity). As individuals may need additional time to change their expectations (Panitz et al., 2021), future research could assess expectation maintenance or change throughout a longer period of time. In addition, as our focus was behavior and expectations during the first semester, our findings do not provide evidence concerning the university period entirely. Behavior and expectations may also evolve throughout different stages of the university period (Vadeboncoeur et al., 2015), and older students may hold

different expectations than younger students due to having had more experiences with the health behaviors investigated (Frank et al., 1999), making a more thorough assessment of different age groups necessary. Although this study was conducted specially to assess the vulnerable period for health behaviors represented by the transition to university, extensive longitudinal investigations regarding health-behavior-related expectation maintenance or change throughout different semesters and age groups are necessary to further understand this matter and to determine additional opportunities to prevent risk behaviors.

Interesting questions for future research can also be derived from Study 2. As previously stated, we found clear associations between characteristics of an expectation-disconfirming event (valence, discrepancy magnitude, controllability) and expectation maintenance or change regarding physical activity and food consumption. More information on the role of these predictors in relation to other health behaviors among young adults (e.g., alcohol use, risky sex) would help us to establish a greater degree of generalizability on this matter. In addition, considerable work is needed to examine further predictors of coping with expectation violations related to characteristics of the expectation disconfirming event (e.g., credibility of the disconfirming information). These progressions can broaden the understanding of how expectation maintenance or change can be influenced in different domains which would allow for more precise assumptions that would prove useful for interventions. Lastly, applying a more complex model that includes the role of control over an expectation-violating event for predicting how the size of discrepancy relates to accommodation could be theoretically relevant as the delta rule (Rescorla & Wagner, 1972) may mainly or exclusively be applied in uncontrollable situations.

As identified in Study 3, EC targeting high school and college students produce small effects at reducing alcohol consumption and changing alcohol expectancies. Several

recommendations for future research are given. First, the possibility of increasing the effect of EC warrants further investigation. One suggestion for future research is to analyze whether including additional intervention components to EC, such as goal-setting exercises and money/cost information, would potentiate the effects of EC on behavior and expectations, as Tanner-Smith and Lipsey (2015) posit that brief alcohol interventions targeting youth which include several intervention components are more likely to deliver stronger effects. Second, further work is certainly required to disentangle the complexities regarding the differential yet significant effects of EC among both high school and college students. Looking forward, further attempts to conduct additional EC among samples of high school students could prove quite beneficial to the literature as scarce investigations among this age group exist. This provides a suitable starting point for further research regarding factors that may influence the stronger effects among college students compared to high school students, as well as to determine relevant needs targeted at both populations. Furthermore, it would be important that future research investigates and confirms the effect of challenging expectations through interventions regarding other domains of health behaviors (i.e., food consumption and physical activity), which would be of particular significance succeeding the finding that change in expectations explained significant variance in change in drinking behavior. Demonstrating the same effect regarding food consumption and physical activity would have significant practical implications as it could facilitate the further development of effective expectation-focused interventions. Lastly, it would also be interesting to assess the coping strategies participants use in specific expectation-violating situations and how this, in turn, influences future expectations.

5.3 Conclusions

All in all, the research conducted for this doctoral thesis was able to further validate the practical importance of challenging health-behavior-related expectations through interventions targeting adolescents and emerging adults by demonstrating the mediating role of expectation change in behavior change. Furthermore, the findings of this dissertation present important insights to optimize health promotion interventions targeting young people as we were able to show the connection between expectations, expectation violations, and health behaviors among this population. First, interventions can benefit from implementing initial assessments of ways of coping with expectation violations as these can influence reactions to future expectation violations and affect intervention effects. Second, interventions should aim to reduce the consumption of unhealthy food and physical inactivity and prevent increases in alcohol use early during the first semester at university while also targeting related expectations, parental influence on physical activity and alcohol use, and alcohol use among first-semester students that moved out of the parental home. Third, applying our findings regarding the optimal kind of expectation violations that foster healthy expectations could increase intervention effects. Interventions that encourage assimilative behavior (i.e., foster the perception and availability of control) for coping with unforeseen events that prevent an expected healthy behavior would be favorable to foster healthy behaviors among young people.

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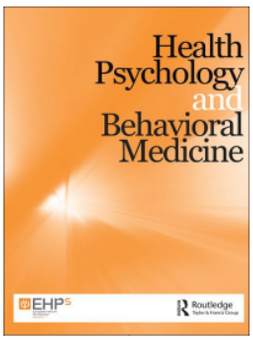
7. APPENDIX

7.1 Manuscripts of the three studies

7.1.1 Study 1 – Influences on change in expected and actual health behaviors among first-year university students



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RESEARCH ARTICLE

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Influences on change in expected and actual health behaviors among first-year university students

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ABSTRACT

Background: First-year students often adopt health risk behaviors during their first semester such as increased consumption of unhealthy food, decreased physical activity, and increased alcohol use. Expectations, social tie's efforts to motivate behavior, and coresidence with parents can influence said behaviors.

Aims: We assessed how students' health behaviors and expectations change over the first semester, and how the aforementioned factors influence the maintenance or change of behavior and expectations.

Methods: A longitudinal survey design was implemented. A total of $N = 163$ German first-year students (81% female; 18% male; 1% non-binary; $M_{age} = 21.20$, $SD = 2.66$) completed online questionnaires, including the NCHRBS and AUDIT, during the Covid-19 pandemic at the beginning (November 2020) and after the end (May 2021) of their first semester.

Results: Current and expected food consumption and physical activity became healthier over time. The current and expected number of drinks consumed per month increased. Change in expectations for physical activity, number of drinks and binge drinking were predicted by the initial respective behavior. The number of drinks and expected physical activity became unhealthier in relation to reported initial parental influence to drink and to be physically inactive. Moving out of the parental home predicted an increase in current and expected number of drinks and in current and expected binge drinking. These effects of moving out were not mediated by perceived parental or peer influence.

Conclusions: Interventions should target these behaviors and expectations during the first semester and address parental influence on physical activity and alcohol use.

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Food consumption; physical activity; alcohol; health behavior expectations; Covid-19

Previous studies have consistently demonstrated that a large percentage of first-year students adopt health deteriorating behaviors such as increased consumption of unhealthy food (i.e. low consumption of fruits, vegetables and dietary fiber and high consumption

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of saturated fats, sodium, and refined sugar; Maillet & Grouzet, 2021), decreased physical activity (Deng et al., 2021), and increased alcohol use as well as binge drinking, particularly during the first semester (Romm et al., 2020). It is well established that consuming healthy food as well as regular engagement in physical activity and limiting alcohol use serve as protective factors against conditions such as type 2 diabetes, cardiovascular diseases, and certain types of cancer (Hilger et al., 2017). A meta-analysis of weight gain in first-year university students found that most students gained weight during the first semester of the first year (Vadeboncoeur et al., 2015). Increased consumption of unhealthy food and decreased physical activity appear to be significantly correlated with the observed weight gain during the first semester (Deng et al., 2021). Furthermore, a large percentage of students consume critically high amounts of alcohol during their first semester (Riordan & Carey, 2019). While scant research exists investigating health behaviors of first-year German university students, some evidence exists indicating deficient consumption of healthy foods (Keller et al., 2008), insufficient physical activity (Diehl & Hilger, 2016; Keller et al., 2008), as well as risky alcohol consumption and binge drinking (Helmer et al., 2010; Keller et al., 2008) among this population.

Risky health behaviors have been linked to university students, and the college environment provides a context associated with engagement in said behaviors (Romm et al., 2020), which may influence students' behavioral expectations about their time at university. As such, the transition to university marks a vulnerable period for the development of health risk behaviors that will consequently negatively impact future health and personal outcomes (Maillet & Grouzet, 2021). As students' health behaviors are expected to worsen during their first semester, understanding factors that influence behavioral change is pivotal to battle risky behaviors and prevent undesirable health outcomes among students.

Influences on health behaviors

Expectations

The Theory of Planned Behavior (TPB; e.g. Bosnjak et al., 2020) and the ViolEx model (Rief et al., 2015) suggest that expectations are important determinants of future behavior. In TPB, the attitude component refers to the expected consequence of a behavior and the control component is usually measured via self-efficacy (the expectation of being able to show a particular behavior). For instance, individuals who believe that they can be active and who expect favorable outcomes from physical activity are more likely to adopt and maintain said behavior (Anderson et al., 2006). In the case of discrepancies between the present state and related expectations, individuals may change expectations in the direction of the present state or change the present state in the direction of the expected state (Rief et al., 2015). As such, expectations change can be fostered by past and present experiences and behavior. For instance, previous experiences with programs that promote healthy food consumption as well as physical activity influence future outcome expectations and future behavior (Herriot et al., 2008). Thus, it is plausible that expectations about future behavior influence alterations in behavior to match expectations, and that previous or current experiences reinforce expectations.

The Violated Expectations (ViolEx) Model proposes that, in the face of evidence disconfirming initial situation-specific expectations, maintenance or change of expectations

depends on the particular psychological process to cope with disconfirmed expectations occurring within an individual (Panitz et al., 2021). Three strategies for coping with expectation violation are specified in the ViolEx Model, namely: immunization, assimilation, and accommodation (Panitz et al., 2021). Immunization refers to the minimization of the impact of expectation-disconfirming evidence and has been associated with the persistence of expectation (Panitz et al., 2021). Assimilation occurs when an individual searches for or produces future expectation-confirming evidence and has been associated with persistence of expectations (Panitz et al., 2021). Accommodation occurs when individuals update their expectations in the direction of the experienced outcome, thus indicating expectation change (Panitz et al., 2021). These processes have not yet been applied in longitudinal research on expectations about health behaviors.

Discrepancies between expected and actual behavior also relate to the intention-behavior gap, a phenomenon where individuals intend to behave in a particular way but finally do not show the intended and expected behavior. Unexpected events or experiences could lead (amongst others) to said discrepancy. In the case where expectations refer to one's intended behavior, expectation violations and the gap between intention and final behavior tend to occur together. Nonetheless, expectations and expectation violations do not always refer to one's intended behavior. Furthermore, it has been demonstrated that changes in expectations may lead to behavior change. A meta-analysis examining the effects of expectancy challenge (EC) interventions among college students in the United States and Europe showed that a reduction of student's positive alcohol expectations achieved through participation in the EC was related to a significant decrease in positive alcohol expectations (Gesualdo & Pinquart, 2021).

Social tie's efforts to motivate behavior

The ViolEx model further posits that social influences can affect an individual's expectation updating (Panitz et al., 2021). Close social ties' (i.e. parents, romantic partner, peers) attempts to influence an individual's behavior may also play a significant role in health behavior (Kaseva et al., 2017) and expectation (Panitz et al., 2021) change. Information provided by social ties and their attempts to encourage behaviors may be mechanisms through which individuals adjust their behavior and health-behavior-related expectations (Legros & Cislaghi, 2020; Panitz et al., 2021). Nevertheless, little empirical research has addressed the role of social influences on change of health-behavior-related expectations.

Living with parents and health behavior change

According to the ViolEx model, characteristics of the environment (e.g. living arrangement) can influence an individual's expectations (Panitz et al., 2021). In line with this notion, Deliens et al. (2014) found that students perceive that living with their parents influences their expectations about their future behavior. Moving out of the parents' residence often facilitates health demoting opportunities as living with parents usually provides a structure that enables healthy behaviors and inhibits unhealthy behaviors (Jones et al., 1992). Living with parents increases the likelihood that students will consume more healthy foods (Maillet & Grouzet, 2021) and less alcohol (Jones et al., 1992) over time. Evidence for physical activity is mixed as some studies report that students who live

with their parents are more physically active than those who do not (Fan et al., 2019), whereas other studies report the opposite (Jones et al., 1992).

The present study

As several health behavior patterns are formed during the first year at university (Maillet & Grouzet, 2021), understanding risky health behavior determinants among students during this vulnerable period is fundamental for developing appropriate structured support to prevent adverse outcomes on future health. Although previous studies have demonstrated that expectations are likely to influence behavior (Rief et al., 2015), the role of expectations on health behavior change during the first year has not been extensively investigated in previous studies, and investigations concerning the maintenance or change of health-behavior-related expectations are limited and mostly refer to alcohol use. Moreover, the process that relates to the maintenance or change of health-behavior-related expectations has not been previously assessed among first-year students. Findings on this topic will inform future health promotion efforts on how to foster healthy expectations and behavior among first-year students. Furthermore, the influence of parents', partner's, and peers' attempts to motivate behavior on expectation maintenance or change has not been simultaneously addressed. Findings on this matter can highlight which social ties have stronger motivating influence on first-year students' health behaviors. Finally, the relationship between coresidence with parents and health-behavior-related expectation change as well as behavior change has not been broadly investigated in the existing literature, particularly regarding physical activity. Based on the VioleEx Model (Panitz et al., 2021), the present study addressed the aforementioned gaps by analyzing longitudinal data to investigate change in behaviors and in expectations.

We first assessed how first-year students' health behaviors (i.e. food consumption, physical activity, alcohol use) and respective expectations change over the first semester. Hypothesis 1 states that first-year students' health behaviors and expectations will become unhealthier throughout the first semester. Moreover, we assessed whether present health behaviors predict expectation change over time and whether present expectations predict change in health behaviors, thus leading to a decline of discrepancies between health behavior and related expectations. Hypothesis 2 assumes behavior change in the direction of the initial expectation. Hypothesis 3 proposes that behavior at the first point of measurement will predict change in expectations (expectations become more aligned with the actual behavior). In addition, we investigated whether coping with expectation disconfirmation relates to expectation change. Hypothesis 4 states that participants with higher initial accommodation scores will show more expectation change while participants with higher immunization and assimilation scores will present less expectation change. Furthermore, we investigated whether social ties' efforts to influence health behaviors are associated with change in health behaviors and related expectations. Hypothesis 5 posits that participants will change their behaviors and expectations to reflect their social ties' (parents', peers', romantic partner's) influence. Lastly, we investigated whether changes in health behaviors and expectations depend on whether students moved out of their parents' home. Hypothesis 6 proposes that participants who had moved out of their parents' home at the start of their study will present

stronger increases in unhealthy behavior and related expectations than participants who did not move out of their parents' home, and that this effect is, at least in part, mediated by differential influences of parents and peers. Peers might have a stronger influence than parents, particularly regarding alcohol use, if participants no longer live with their parents.

Methods

A longitudinal survey design was implemented. The study was approved by the Ethics Committee at the University of Marburg, Germany (file number 2020-79k). Data collection took place via online, anonymous questionnaires during the Covid-19 pandemic at two times of measurement, namely at the beginning (November 2020) and after the end (May 2021) of the first semester. Approximately 500 first-year students in Germany who were at least 18 years old (above the legal drinking age) were recruited via e-mails with a link directing them to the questionnaires. Out of the recruited participants, $n = 212$ responded at time 1 out of which $n = 166$ provided data at the 6-month follow-up. Incomplete questionnaires as well as outliers were excluded from the analysis.

Participants completed the questionnaires after reading study-related information and granting consent. Participants needed a maximum of 30 minutes to complete the questionnaires. University credit points or participation in a gift card raffle were offered as compensation.

Measures

Sociodemographic characteristics

Demographic questions were administered during both points of measurement and assessed gender (male, female, non-binary), age, and whether participant's hometown is in Germany or abroad (specific ethnic background was not assessed to prevent reidentification).

Partner status and residence

In addition, we assessed whether participants have a partner or not and whether they moved out of their parents' home or not to attend university for hypothesis testing.

Food consumption

The seven-item National College Health Risk Behavior Survey (NCHRBS; Douglas et al., 1997) was administered at both points of measurement to investigate how many times a day in the past month participants consumed unhealthy food. Two additional items following the NCHRBS's format designed for our study were also included to assess further food often consumed by students (i.e. pizza as well as sweets and chocolate). All nine items included a Likert scale response format of 0 times a day, 1 time a day, 2 times a day, and 3 or more times a day. Higher scores represented higher levels of unhealthy eating. The scale showed acceptable reliability for our data with a Cronbach's coefficient of $\alpha = .60$ for the first point of measurement and of $\alpha = .67$ for the second point of measurement. Additionally, rephrased versions of the nine items were also administered at both points of measurement to assess expected food consumption (e.g. on average,

during this semester, how often per day do you expect to eat fruits?). Expected food consumption items showed acceptable consistency of $\alpha = .70$ for the first measurement and of $\alpha = .77$ for the second measurement.

Physical activity

Four items of the NCHRBS's physical activity scale (Douglas et al., 1997) were administered at both points of measurement to assess how many times a week in the last month participants performed physical activity (i.e. cardio, strengthening, stretching, and walking or cycling). The items included a Likert scale response format ranging from 0 to 7 times a week. Scores were reversed so that higher scores denoted higher levels of physical inactivity. The NCHRBS physical activity scale has shown excellent test-retest reliability and validity indices similar to other self-report physical activity questions (Dinger, 2003). The scale has also been used successfully in empirical research among university students of various backgrounds to assess physical activity among college students (e.g. Ajibade, 2011). For our study, the scale showed an acceptable internal consistency of $\alpha = .76$ for the first point of measurement and of $\alpha = .78$ for the second point of measurement. Furthermore, rephrased versions of the four items were also administered at both points of measurement to assesses expected physical activity (e.g. on average, during this semester, how many days a week do you expect to walk or ride a bike for at least 30 minutes?). Expected physical activity items showed consistency of $\alpha = .76$ for the first and of $\alpha = .77$ for the second measurement.

Alcohol use

Three items from the Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993) were adapted to assess drinking behavior and were administered at both points of measurement. The first (i.e. how many days during the past month did the participant consume alcohol) and second (i.e. how many standard drinks did a participant drink on a drinking occasion) items had a free input response format and both results were multiplied to calculate the number of drinks consumed by participants in a month. The third item assessed binge drinking by asking how often participants drink five (for males), four (for females) or more standard drinks in a drinking occasion (National Institute on Alcohol Abuse and Alcoholism, 2012), with a Likert scale response format ranging from never, less than monthly, monthly, to weekly. As there are no established practices to assess binge drinking among sexual minority groups, the male threshold was used to assess binge episodes in non-binary individuals based on findings suggesting that a higher proportion of non-binary individuals are assigned a male sex at birth in comparison to binary individuals (Todd et al., 2019). Rephrased versions of the three items were also administered at both measurements to assesses expected drinking behavior (e.g. how many days per month do you expect to consume alcohol during this semester?).

Coping with expectation violations

To assess individual differences in coping with disconfirmed expectations, the ViolEx-Questionnaire (Pietzsch et al., 2020) was administered at the first point of measurement. The twenty-six-item questionnaire consists of three scales, each of which assessed an individual coping strategy (i.e. accommodation, assimilation, and immunization). The assimilation scale (e.g. I am actively committed to ensuring that my expectations come true) consisted

of 10 items, while the accommodation (e.g. I adjust my expectations when a situation requires it) and immunization scales (e.g. If I experience something that doesn't fit my expectations well, then I see this as an exception) consisted of 8 items each. Items addressed the extent to which a statement applied to an individual with a four-point rating scale ranging from 1 = strongly disagree to 4 = strongly agree. Higher scores denoted higher use of a particular strategy. Cronbach's alpha was excellent for the assimilation $\alpha = .87$, the accommodation $\alpha = .85$, and the immunization scale $\alpha = .86$.

Social ties' efforts to encourage health risk behaviors

Nine items inquiring about social ties' efforts to motivate health demoting behaviors were developed and were administered at the first point of measurement (see supplementary material S1). Single items assessed how often each social tie motivates the participant to eat unhealthy food, to be physically inactive, and to consume alcohol (e.g. how often do your peers encourage you to consume unhealthy foods?). Motivation deriving from the parental dyad and the peer group was assessed (i.e. three items for parents and three items for peers). Participants who initially stated that they have a partner completed three additional questions. Responses ranged from 4 = very often to 1 = never, and higher scores denoted more frequent encouragement for unhealthy behaviors.

Statistical analysis

IBM SPSS Statistics version 27 and Lisrel 8.8 were used for data analysis. A power analysis specified a minimum sample size of $N = 108$ to identify small effects with 80% power at an alpha level of .05. A self-generated code by participants was used to link corresponding surveys of both points of measurement. To test for systematic loss to follow-up, participants who were lost and who stayed in the study were compared regarding demographics and outcome variables. Categorical variables were analyzed with Chi^2 tests and continuous data with *t*-tests. Normality tests were conducted. Listwise deletion was used for handling missing data. An Alpha level of 5% was implemented to identify significant results. The first hypothesis was tested using ANOVAs with repeated measures including the means of current and expected behaviors, respectively, at both time points. Structural equation models were implemented to test the second and third hypotheses. The fourth and fifth hypotheses were tested using linear regressions with behavior and expectations at the second point of measurement as outcome variables, and initial behavior and expectations as well as scores in the ViolEx questionnaire and social ties' influence on health behaviors as predictors. The sixth hypothesis was tested using regression analyzes (health behaviors and expectations), as well as to assess whether moving out of the parental home predicts change in health behaviors and expectations, as well as using structural equation models for testing mediating effects. Age and sex were included as covariates in all analyzes.

Results

Sociodemographic characteristics

A total of $N = 208$ first-year students agreed to participate in our study. From those, $n =$ 166 participants completed the questionnaires at both points of measurement out of

which $n = 3$ were excluded from our analysis as outliers due to reported extreme drinking scores. The final sample consisted of $N = 163$ first-year students (81% female; 18% male; $M_{age} = 21.20$, $SD = 2.66$) out of which $n = 155$ (95%) reported that their hometown is in Germany, $n = 66$ (41%) reported having a partner, and $n = 125$ (77%) moved out of their parents' home. As participants had already been, on average, $M = 25.98$ ($SD = 10.45$) days in the first semester at the first data collection point, the first assessment referred to the first days at university and the longitudinal study assessed change in health behaviors and expectations during the first semester (i.e. we did not assess changes from pre-college time to time at college). Participants who dropped out did not significantly differ to the remaining participants regarding demographic variables and initial health behaviors (see supplementary material S2). Bivariate correlations between all model variables are provided in the supplementary material (S3). No significant effects of age and sex were found in hypothesis testing.

Longitudinal behavior/expectation change

Consumption of healthy food, participation in physical activity, and the number of drinks consumed per month increased over time (see Table 1). As the number of drinks per month was based on information about the number of days they consumed alcohol and the mean number of drinks per day, we also checked whether both numbers changed. Only the former number increased. In addition, no significant changes were found regarding current level of binge drinking. Furthermore, expected consumption of healthy food, expected participation in physical activity, and expected number of drinks increased during the first semester. Expectations about future binge drinking did not change significantly.

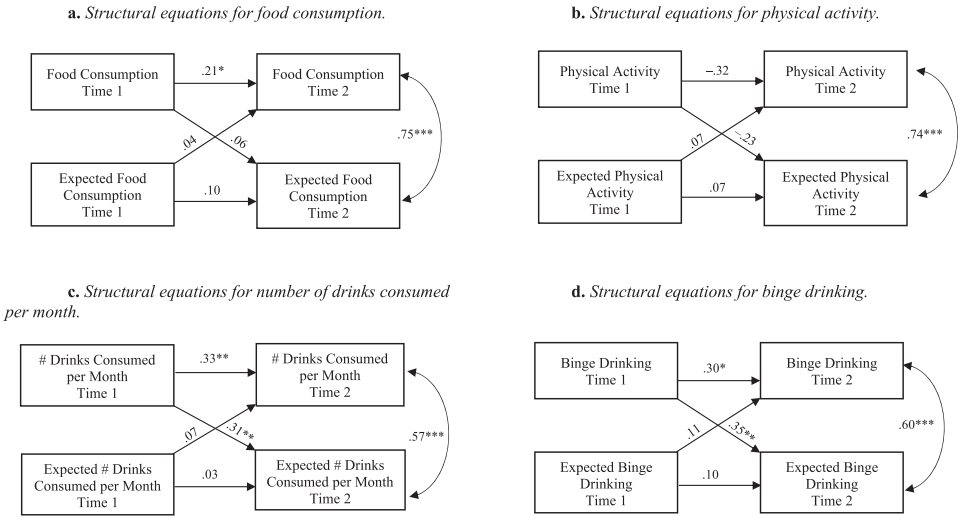
Longitudinal interplay of behavior and expectations

Cross-lagged (autoregressive) panel models were computed that assess whether initial expectations predict change in related health behavior and whether initial behavior

Table 1. Change in Health-Related Expectations and Behavior Between Time 1 and Time 2.

	M_1	SD_1	M_2	SD_2	F	df	p
Behavior							
FC	19.63	2.76	15.72	2.57	229.22	162	<.01
PA	22.85	5.79	13.88	5.96	149.82	162	<.01
ND	11.00	14.44	25.03	27.68	47.75	162	<.01
Frequency AU	3.98	4.54	10.09	8.87	84.27	162	<.01
Quantity AU	2.40	2.69	2.15	1.85	1.37	162	.25
BD	2.01	.94	1.97	.90	.21	162	.65
Expectation							
FC	19.23	2.72	15.50	2.63	184.69	162	<.01
PA	21.34	5.68	15.91	5.84	57.76	162	<.01
ND	11.01	13.15	22.51	30.68	22.85	162	<.01
Frequency AU	3.93	3.87	8.37	8.67	47.20	162	<.01
Quantity AU	2.34	2.58	2.16	1.87	.71	162	.40
BD	1.90	.93	1.89	.85	.64	162	.94

Note. $N = 163$. FC = food consumption; PA = physical activity; ND = number of drinks consumed per month; BD = binge drinking; AU = alcohol use; M_1 = mean score at time 1; SD_1 = standard deviation at time 1; F = test of change in health behavior and health-related expectations between both times of measurement; df = degrees of freedom.



Note. Standardized coefficients are shown. * $p < .05$, ** $p < .01$, *** $p < .001$.

Figure 1. (a) Structural equations for food consumption. (b) Structural equations for physical activity. (c) Structural equations for number of drinks consumed per month. (d) Structural equations for binge drinking. *Note.* Standardized coefficients are shown. * $p < .05$, ** $p < .01$, *** $p < .001$.

predicts expectation change over time. As shown in Figure 1(a–d), food consumption, number of drinks consumed per month, and binge drinking showed some correlational stability. In contrast, we found a non-significant negative association between reported physical activity at the first and second point of measurement. Associations between expectations at the first and second point of measurement were not significant, while reported present and expected future activities were concurrently correlated. Furthermore, initial expectations about food consumption, physical activity, number of drinks consumed per month, and binge drinking did not predict change in the respective behavior. Change in expected numbers of drinks and in binge drinking were predicted by the initial levels of these behaviors. In contrast, higher initial physical passivity predicted a stronger *decline* in the related expectation over time, and initial food consumption did not predict change in the related expectation over time.

Coping with expectation violations

Higher immunization predicted less change in expectations about physical activity, and higher assimilation significantly predicted greater increases in expectations about future physical activity (see Table 2). However, participants with higher initial accommodation did not show greater expectation change.

Social ties' influence on behavior/expectation change

Initial perceived parental attempts to promote alcohol use and physical inactivity predicted an increase of this behavior and expectation, respectively, over time (see Table 3). No significant results were found regarding partners and peers.

Table 2. Associations of coping with expectation disconfirmation with students' change in expected health behavior (regression analysis).

	Expected food consumption (T_2)			Expected physical activity (T_2)			Expected # of drinks consumed monthly (T_2)			Expected binge drinking (T_2)		
	B	*SE B*	β	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
HB at T_1	.15	.08	.15	−.25	.08	−.24[b]	.46	.18	.20[a]	.35	.07	.38[b]
Immunization	−.06	.05	−.11	−.27	.12	−.21[a]	−.29	.62	−.04	−.03	.02	−.13
Assimilation	.07	.05	.13	.22	.10	.19[a]	−.35	.53	−.06	−.01	.01	−.04
Accommodation	.02	.05	.04	.06	.10	.05	.01	.55	.01	−.01	.01	−.01
R^2		.04			.11[b]			.05			.17[b]	

Note. $N = 163$. HB = health behavior. T_1/T_2 = first/second point of measurement. *B* = unstandardized regression coefficient. *SE* = standard error. *β* = standardized regression coefficient. HB at T_1 corresponds to the behavior represented in each column. [a]$p < .05$, [b]$p < .01$.

Living with parents and behavior/expectation change

Moving out predicted a significant increase in current and expected number of drinks as well as in current and expected binge drinking (Table 4). Moving out did not predict change in current or expected consumption of unhealthy food and physical inactivity. However, the effect of moving out was not mediated by pereceived parental and peer influences (*t*-scores of indirect effects ranged from −1.38 to 1.09, n.s.).

Discussion

Based on the ViolEx Model (Panitz et al., 2021), the present study investigated how reported health behaviors and expectations of first-year students change over their first semester, how the interplay between expectations and behavior relates longitudinally, and whether coping with expectation disconfirmation, social tie's efforts to motivate

Table 3. Associations of social tie's efforts to motivate unhealthy behaviors with students' change in current and expected health behavior (regression analysis).

	Current food consumption (T_2)			Current physical activity (T_2)			Current # of drinks consumed monthly (T_2)			Current binge drinking (T_2)		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
HB at T_1	.28	.11	.31[a]	−.24	.14	−.21	.68	.20	.38[b]	.20	.13	.21
Parents' Influence UB	−.13	.54	−.03	3.19	1.65	.25	14.69	6.29	.29[a]	.26	.29	.13
Partner's Influence UB	−.22	.46	−.06	.01	1.30	.01	−3.06	3.89	−.11	.22	.18	.19
Peers' Influence UB	−.09	.46	−.03	.37	1.56	.03	−6.24	3.37	−.24	−.20	.16	−.19
R^2		.11			.10			.33[b]			.13	
	Expected food consumption (T_2)			Expected physical activity (T_2)			Expected # of drinks consumed monthly (T_2)			Expected binge drinking (T_2)		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Expected HB at T_1	.19	.12	.19	−.25	.14	−.21	.15	.28	.07	.14	.12	.15
Parents' Influence UB	.45	.57	.10	3.29	1.52	.28[a]	14.89	9.21	.24	.39	.26	.22
Partner's Influence UB	−.72	.49	−.19	−.60	1.22	−.07	−1.78	5.75	−.05	.17	.16	.16
Peers' Influence UB	−.47	.49	−.13	1.39	1.45	.13	−4.65	5.01	−.14	−.12	.14	−.13
R^2		.11			.13			.07			.09	

Note. $N = 163$. HB = health behavior. T_1/T_2 = first/second point of measurement. *B* = unstandardized regression coefficient. *SE* = standard error. *β* = standardized regression coefficient. UB = unhealthy behavior. HB at T_1 corresponds to the behavior represented in each column. Social tie's influence for unhealthy behavior refers to the corresponding participant behavior. [a]$p < .05$, [b]$p < .01$.

Table 4. Associations of having moved out of the parental home with students' change in current and expected health behavior (regression analysis).

	Current food consumption (T_2)			Current physical activity (T_2)			Current # of drinks consumed monthly (T_2)			Current binge drinking (T_2)		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
HB at T_1	.22	.07	.24[b]	−.27	.08	−.27[b]	.70	.13	.37[b]	.36	.07	.37[b]
Moved Out of Parents' Home	−.08	.45	−.01	−.12	1.04	−.01	17.06	4.42	.27[b]	.45	.15	.22[b]
R^2		.06[a]			.07[b]			.22[b]			.19[b]	
	Expected food consumption (T_2)			Expected physical activity (T_2)			Expected # of drinks consumed monthly (T_2)			Expected binge drinking (T_2)		
	B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Expected HB at T_1	.13	.08	.14	−.26	.08	−.26[b]	.44	.18	.19[a]	.33	.07	.37[b]
Moved Out of Parents' Home	−.37	.47	−.06	−.84	1.02	−.06	15.76	5.29	.23[b]	.35	.14	.18[a]
R^2		.02			.07[b]			.10[b]			.17[b]	

Note. $N = 163$. HB = health behavior. T_1/T_2 = first/second point of measurement. *B* = unstandardized regression coefficient. *SE* = standard error. *β* = standardized regression coefficient. HB at T_1 corresponds to the behavior represented in each column. Moving out of the parental home was represented as a dummy variable.
[a]$p < .05$, [b]$p < .01$.

behavior, and moving out of the parental home relate to change in current and expected health behaviors. The first hypothesis, which assumed that first-year students' health behaviors and expectations would become more negative throughout their first semester, was partially supported. Mean scores for current and expected number of drinks consumed per month increased while current and expected food consumption as well as current and expected physical activity became healthier over time. Findings regarding change in food consumption support the notion that high consumption of unhealthy food among first-year students appears to predominantly occur early in the first semester (i.e. within the first four months; Vadeboncoeur et al., 2015), highlighting the relevance of early prevention efforts. We speculate that these changes may occur as part of the process of independently establishing food consumption patterns (e.g. learning to prepare meals). Regarding change in physical activity, during the first measurement in November 2020, some participants may have been less physically active due closed fitness studios in Germany as per Covid-19 regulations (Zusammen gegen Corona, 2020) and limited opportunities for outdoor exercise due to cold weather. Thus, the observed increase in physical activity over time might be based on reopened fitness studios and more suitable weather conditions for outdoor exercise during the time of the second measurement in May 2021. The negative correlation between physical activity at the first and second measurement indicates that the initially most inactive students showed the strongest increase over time. Participants who were initially physically active despite closed fitness studios and bad weather were probably less affected by later change of these external conditions and therefore may have shown a different pattern of change in physical activity over time. Findings regarding change in alcohol use corroborate pre-pandemic reports (e.g. Prince et al., 2019) and suggest that, also during the Covid-19 pandemic, students' alcohol use increased as they had opportunities to consume alcohol either alone or with others at places not affected by restrictions (e.g. dormitories, parks). Prince et al. (2019) found that students who reported greater alcohol use during the first semester showed greater escalation of drinking during the following

years at university and greater Alcohol Use Disorder symptoms a year post graduation. Thus, reaching students early in their university career is an important protective strategy against post-university health risk behaviors.

While the second hypothesis on statistical effects of expectations on change in health behavior was not supported, we found partial support for predictive effects of the present health behavior on expectation change (Hypothesis 3) as initial physical activity predicted change in physical activity expectations, and initial alcohol use predicted change in alcohol-related expectations. Due to persistent Covid-19 restrictions (Zusammen gegen Corona, 2020), we speculate that it might have been difficult for participants to fulfill some of their expectations. Also, expectations may have been less realistic at the start of the first semester as many conditions were difficult to foresee. The predictive power of expectations may increase the more they are based on previous experiences. Our findings also indicate that previous experiences with alcohol can inform change in expectations so that differences between expected and actual consumption become smaller over time.

The present study represents the first longitudinal investigation relating the coping process of the ViolEx Model to health behaviors. We found partial support for the fourth hypothesis as ways of coping with expectation violation predicted change in expectations about physical activity, with those reporting to be active to fulfill their expectations being more likely to further increase their expectations and those who are more prone to ignoring and downplaying expectation-inconsistent information showing less expectation change. As such, the implementation of the ViolEx model has served to enhance our current understanding of the maintenance or change of physical-activity-related expectations, and, consistent with Panitz et al. (2021), findings suggest that individuals with higher assimilation and higher immunization would show less expectation change (Panitz et al., 2021). We speculate that coping processes may be more predictive of expectation change when also considering the direction of experienced expectation violation (i.e. whether reality is worse or better than expected; Panitz et al., 2021), and when testing how respondents cope with a specific expectation violation (i.e. specific event) rather than assessing coping in a general way. Interventions could benefit from assessing student's ways of coping with expectation violations and their current and expected physical activity levels to deliver tailored support based on knowledge on how they would cope if their expectations are disconfirmed. Although the present study addressed the gap in the literature concerning the maintenance or change of health-behavior-related expectations during the first year at university and found significant results regarding one domain (i.e. physical activity), future research should consider further investigating this topic as results may provide relevant support for interventions aimed at promoting healthy behavior.

The fifth hypothesis assumed that participants would change their behaviors and expectations to reflect their social ties' influence based on reports suggesting that close social ties can affect an individual's behavior (Legros & Cislaghi, 2020) and expectations (Panitz et al., 2021). This hypothesis was partially supported as perceived initial parental attempts to inhibit physical activity and to promote alcohol use predicted increases over time in expected physical inactivity and in the number of drinks consumed by students per month. Our results indicate that parents play a significant role in their offspring's physical activity and alcohol use patterns during the first semester at university, which

corroborates previous reports (Kaseva et al., 2017). As we did not specifically assess methods of motivating used by social ties, we can only speculate that parents may have conveyed permissiveness for and acceptance of unhealthy behaviors which first-year students may have interpreted as encouragements to behave and to expect to behave in unhealthy manners (Calhoun et al., 2018). Future studies should investigate what methods to encourage behavior are applied by social ties and how do these relate to changes in health behaviors. Still, significant results were not found regarding the influence of partners and peers on health behaviors. As the number of participants who reported having a romantic partner was low, additional statistical power might provide significant results. Regarding peers, participants could have had limited opportunities for joint health-related activities due to Covid-19 restrictions (Zusammen gegen Corona, 2020) which might have inhibited associations with perceived peer attempts to influence their behavior. Moreover, the transition to university is often characterized by instabilities in the peer network which reduces the predictive power of initial peer relations (Riordan & Carey, 2019).

Lastly, we hypothesized that housing would have an effect on participant's behaviors and expectations and that this effect would be mediated by parental and peer attempts to influence participant's behaviors. We found that moving out predicted a significant increase in current and expected alcohol use. Yet, statistical effects of leaving the parental home on changes in current and expected food consumption and physical activity were not found. We speculate that differences between living in the parental home and independent living might have been reduced in times of Covid-19 pandemic as students spent less time at the university town as most courses were conducted online. The effect of housing on alcohol use was not mediated by perceived parental and peer attempts to promote alcohol use. Thus, other processes may explain the observed statistical effect of housing on alcohol use, such as decline of parental monitoring after moving out (White et al., 2020) or influences of close friends, rather than of peers in general (Walther et al., 2017).

The current study presented several limitations. First, data was collected during the Covid-19 pandemic which presented unusual circumstances and restrictions (e.g. bars/pubs were closed at time of data collection, limited contact with other students at university) that reduced opportunities for some typically reported risk behaviors after the transition to university. As such, our results may not be applicable during times before and after the Covid-19 pandemic. We plan to follow-up on this limitation by repeating the study after Covid-19 restrictions are completely lifted. Second, females were overrepresented in our sample which could have affected our results. Future studies should include a more balanced gender distribution as well as a larger subject pool. Third, late data collection for the first point of measurement could have impacted the results as participants may have already been influenced by their peers and the university environment and their recall of past expectations and behaviors may have shifted to be more in-line with current behaviors and expectations. Lastly, we focused on investigating behavior changes during the first semester only as it is a crucial period for the development of unhealthy behaviors. Accordingly, our findings do not provide evidence about health behavior changes throughout the full university period. Future investigations could try to replicate our research among students of more advanced semesters to determine additional opportunities to prevent risk behaviors. Notwithstanding these

limitations, our findings present important insights to improve health interventions for first-year students.

The observed different trajectories of food consumption and physical activity as well as of alcohol consumption indicate that the focus of early interventions related to these behaviors might differ. Regarding food consumption and physical activity, the focus might be to reduce levels of unhealthy behaviors observed early in the first semester whereas regarding alcohol use, a main focus should be to prevent increases in drinking. Reports from a systematic review and meta-analysis suggest the following intervention strategies to prevent unhealthy food consumption and physical inactivity among university students: addressing food consumption and physical activity separately, targeting self-efficacy, providing higher vigilance, encouragement, and support through frequent professional contact, and delivering feedback on student's progress rather than simply providing educational resources (Plotnikoff et al., 2015). Moreover, based on findings of a meta-analysis investigating the efficacy of alcohol interventions for first-year college students (Scott-Sheldon et al., 2014), interventions should combine several of the following intervention components to reduce alcohol intake and related problems among individuals: personalized feedback on consumption, problems, or risks, strategies to moderate drinking, challenges to alcohol-expectancies, and establishment of alcohol-related goals and limits. Lastly, interventions should address parental influence on physical activity and alcohol use as well as alcohol use among students that moved out of the parental home.

Ethics statement

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and was approved by an Institutional Review Board/Ethics committee. See details under Methods.

The study received an exemption from an Institutional Review Board/Ethics committee; See details under Methods.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Supplementary Material

S1. *Social Ties' Efforts to Encourage Health Risk Behaviors (Self-Developed Items).*

1. How often do your peers encourage you to consume unhealthy foods?
   - Very often
   - Often
   - Seldom
   - Never
2. How often do your peers encourage you to drink a lot of alcohol?
   - Very often
   - Often
   - Seldom
   - Never
3. How often do your peers encourage you to not be physically active?
   - Very often
   - Often
   - Seldom
   - Never
4. How often do your parents encourage you to consume unhealthy foods?
   - Very often
   - Often
   - Seldom
   - Never
5. How often do your parents encourage you to drink a lot of alcohol?
   - Very often
   - Often
   - Seldom
   - Never
6. How often do your parents encourage you to not be physically active?
   - Very often
   - Often
   - Seldom
   - Never
7. How often does your romantic partner encourages you to consume unhealthy foods?[1]
   - Very often
   - Often
   - Seldom
   - Never
8. How often does your romantic partner encourages you to drink a lot of alcohol? [1]
   - Very often
   - Often
   - Seldom
   - Never
9. How often does your romantic partner encourage you to not be physically active? [1]
   - Very often
   - Often
   - Seldom
   - Never

Supplementary Material

S2. ***Comparison of Completers and Dropouts.***

	Completers		*Drop-Outs*				
	M_1	SD_1	M_1	SD_1	*t*	*df*	*p*
Demographics							
Age	20.71	2.68	20.47	2.58	–.62	206	.54
Sex	1.83	.41	1.87	.41	.48	206	.64
Hometown	1.05	.22	1.00	.01	–1.32	206	.19
Behavior							
FC	19.64	2.59	19.63	2.76	–.03	206	.97
PA	24.42	5.86	22.85	5.79	–1.61	206	.11
ND	9.78	15.31	11.00	14.44	.50	206	.62
BD	1.89	.91	2.01	.94	.75	206	.46

Note. FC = food consumption; *PA* = physical activity; *ND* = number of drinks consumed per month; *BD* = binge drinking; M_1 = mean score at time 1; SD_1 = standard deviation at time 1; *t* = test of between-group differences; *df* = degrees of freedom.

S3. ***Bivariate Correlations Between All Model Variables.***

	M (SD)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Behavior																	
1. FC-1	19.63 (2.72)	1.00	.14*	0.05	0.10	.24**	-0.07	0.00	-0.05	.62**	-0.07	-0.01	-0.02	0.12	-0.08	-0.04	-0.08
2. PA-1	23.19 (5.83)	.14*	1.00	-0.03	0.06	-0.15	-.27**	0.01	0.04	-0.03	.78**	-0.03	-0.03	-0.15	-.29**	0.05	-0.01
3. ND-1	10.74 (14.61)	0.05	-0.03	1.00	.69**	0.04	0.12	.38**	.29**	.23**	0.00	.76**	.53**	0.13	0.12	.29**	.34**
4. BD-1	1.98 (.93)	0.10	0.06	.69**	1.00	0.13	0.06	.36**	.38**	.16*	-0.01	.56**	.77**	0.14	0.04	.34**	.43**
5. FC-2	15.72 (2.57)	.24**	-0.15	0.04	0.13	1.00	0.13	0.08	0.15	.17*	-0.15	0.00	0.11	.79**	0.11	0.08	0.08
6. PA-2	13.88 (5.96)	-0.07	-.27**	0.12	0.06	0.13	1.00	0.13	0.14	0.02	-.18*	0.13	0.10	.16*	.81**	.17*	0.09
7. ND-2	25.03 (27.68)	0.00	0.01	.38**	.36**	0.08	0.13	1.00	.66**	0.12	0.03	.32**	.35**	0.09	0.12	.68**	.65**
8. BD-2	1.97 (.90)	-0.05	0.04	.23**	.38**	0.15	0.14	.66**	1.00	-0.05	0.04	.27**	.34**	0.09	0.05	.54**	.77**
Expectation																	
9. FC-1	19.23 (2.72)	.62**	-0.03	.23**	.16*	.17*	0.02	0.12	-0.05	1.00	0.05	.16*	0.09	0.14	0.05	0.01	0.07
10. PA-1	21.34 (5.68)	-0.07	.78**	0.00	-0.01	-0.15	-.18*	0.03	0.04	0.05	1.00	-0.01	-0.05	-0.14	-.25**	0.05	0.00
11. ND-1	11.01 (13.15)	-0.01	-0.03	.76**	.56**	0.00	0.13	.32**	.27**	.16*	-0.01	1.00	.56**	0.06	0.14	.21**	.27**
12. BD-1	1.90 (.93)	-0.02	-0.03	.53**	.77**	0.11	0.10	.35**	.34**	0.09	-0.05	.56**	1.00	0.12	0.11	.26**	.38**
13. FC-2	15.50 (2.63)	0.12	-0.15	0.13	0.14	.79**	.16*	0.09	0.09	0.14	-0.14	0.06	0.12	1.00	.27**	0.05	.16*
14. PA-2	15.91 (5.84)	-0.08	-.29**	0.12	0.04	0.11	.81**	0.12	0.05	0.05	-.25**	0.14	0.11	.27**	1.00	0.10	0.14
15. ND-2	22.51 (30.68)	-0.04	0.05	.29**	.34**	0.08	.17*	.68**	.54**	0.01	0.05	.21**	.26**	0.05	0.10	1.00	.56**
16. BD-2	1.89 (.85)	-0.08	-0.01	.34**	.43**	0.08	0.09	.65**	.77**	0.07	0.00	.27**	.38**	.16*	0.14	.56**	1.00

Note. FC = food consumption; *PA* = physical activity; *ND* = number of drinks consumed per month; *BD* = binge drinking; *-1* = time 1; *-2* = time 2; *M* = mean score; *SD* = standard deviation.

* $p < .05$

** $p < .01$

7.1.2 Study 2 – Predictors of Coping with health-related expectation violations among university students

Predictors of Coping with Health-related Expectation Violations among University Students

Chrys Gesualdo, MSc
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Objectives: Individuals often experience expectation violations related to the consumption of healthy food and physical activity and they may cope with expectation-disconfirming information by (1) ignoring the discrepancy (immunization), (2) increasing efforts to fulfill them (assimilation), or (3) changing their expectations (accommodation). We investigated whether valence, discrepancy magnitude, and controllability of the expectation disconfirming event predicted coping with expectation violations. **Methods:** A 2 (valence: positive vs negative) x 2 (discrepancy: larger vs smaller) x 2 (controllability: control vs no control) experimental design was implemented. Overall, we presented 297 university students with vignettes describing expectation violations and present different combinations of predictor levels. **Results:** Regarding physical activity, participants showed significantly higher accommodation when experiencing a better-than-expected event and showed significantly higher immunization when experiencing a worse-than-expected event. Regarding food consumption and physical activity, individuals experiencing lower discrepancy showed significantly higher immunization; individuals with control over the source of expectation disconfirmation showed significantly higher assimilation; and individuals without control over the source of expectation disconfirmation showed significantly higher accommodation. **Conclusions:** To promote the maintenance of healthy expectations, despite expectation violations, interventions could foster the perception of control as well as assimilative behavior.

Key words: food consumption; physical activity; expectation violations; coping

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University students often develop unhealthy food consumption[1] and physical activity patterns throughout the university period.[2] These behaviors may impact future health outcomes, thereby putting university students at risk for health conditions such as obesity, cardiovascular diseases, malignant tumors, and diabetes.[3] Studies report that university students often gain a significant amount of weight, which has been correlated with increased unhealthy food consumption and sedentary behavioral patterns.[4] Therefore, it is imperative to improve understanding of factors that can either inhibit or promote unhealthy behaviors among students to optimize interventions aimed at promoting healthy living. For this, universities are critical settings for decreasing the prevalence of chronic diseases among future adult populations.

PERSONAL EXPECTATIONS

Previous literature consistently describes expectations or subjective appraisals of the probability of forthcoming occurrences[5] as predictors of future behavior.[6] Expectations are particularly noteworthy cognitions as they can guide individuals to engage in healthy or unhealthy behaviors that may ultimately affect their present and future well-being.[7] In a study among college freshmen, Werner et al.[8] found that holding positive alcohol expectations significantly predicted future alcohol use. Additionally, Anderson et al.[9] reported that individuals who expected positive results from performing physical activity showed a higher probability of being physically active.

When an individual's expectations are confirmed or violated based on novel evidence, individuals can react by altering or conserving their original

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expectations. The Violated Expectations (ViolEx) Model proposes 3 ways of coping with the disconfirmation of situation-specific expectations–*immunization*, *assimilation*, and *accommodation*.[6,10] Immunization refers to minimizing the impact of expectation-disconfirming evidence by ignoring or downplaying its importance. Assimilation refers to increased efforts to fulfill one's expectations (ie, search for or produce future expectation-confirming evidence). Whereas the 2 former processes contribute to the persistence of expectations, accommodation refers to change in expectations to match the experienced outcome.

The ViolEx Model provides a framework in various disciplines for understanding how expectations develop and how they change or persist despite disconfirming evidence.[11] For instance, the model has been applied in clinical psychology to explain the maintenance of symptoms because of expectation-confirming assimilative behavior, and by immunizing against the experienced unexpected absence of feared negative consequences of avoided behaviors.[7] Furthermore, the model has been found to predict persistence versus change of students' achievement expectations after worse-than expected achievements.[11]

Characteristics of the Disconfirming Event as Predictors of Coping

Recognizing conditions that promote or inhibit the use of the coping strategies proposed by the ViolEx Model can help predict expectation maintenance or change in response to expectation violation. Coping with expectation violations can be influenced by certain characteristics of an expectation disconfirming event such valence, discrepancy size, and controllability of the disconfirming information or event.[11] The role of these factors has not been analyzed extensively in the context of violated health-related expectations.

Valence of the disconfirming event. Vast evidence indicates a higher probability of expectation change in response to better-than-expected outcomes as opposed to worse-than-expected outcomes.[12] This effect has been referred to as optimistic reinforcement learning.[13] A higher probability of immunizing against worse-than-expected rather than better-than expected outcomes has been demonstrated as individuals tend to question the credibility of negative disconfirming information and to label it as an exception.[14]

Discrepancy size of the disconfirming event. Several researchers argue that the magnitude of the discrepancy of the expectation violation predicts expectation maintenance versus change. Corresponding to the delta rule, Recorla et al.[15] posit that larger discrepancies produce larger expectation change as they provide more room for learning. Nonetheless, other researchers suggest that moderate discrepancies may produce the strongest expectation change as highly discrepant events might be regarded as atypical and exception from the rule (subtyping), while smaller discrepancies are likely to be ignored.[16,17]

Controllability of the disconfirming event. Evidently, some level of control over an event is needed for influencing its occurrence. Previous studies suggest that, in the case of controllable disconfirming situations, individuals are more likely to increase efforts to fulfill their expectations.[18] In the face of uncontrollable disconfirming sources, individuals are more likely to update their expectations in response to expectation violation.[18]

The Present Study

As university students are at high risk of developing unhealthy expectations about food consumption and physical activity during their time at university,[1,2] understanding predictors of maintenance or change of these expectations is important to promote healthy behavior among university students and prevent adverse health outcomes. Our study searches for evidence regarding characteristics of expectation disconfirming events that predict coping with expectation violations in a health behavior context. Previous studies demonstrate that characteristics of expectation disconfirming events predict the maintenance or change of expectations, although these characteristics have been rarely empirically related to the processes of coping with expectation violation as proposed by the ViolEx Model.[11] In addition, the related research has not yet addressed coping with expectation violations associated with health behaviors, such as food consumption and physical activity. Findings on predictors of expectation maintenance or change can advise health promotion interventions on adjusting dysfunctional expectations that contribute to persistent unhealthy behaviors, thus, fostering

healthy food consumption and physical activity patterns and related expectations among university students. Moreover, applying these findings could potentiate the effects of interventions.[19]

We investigated how 3 characteristics of the expectation disconfirming event (ie, valence, discrepancy magnitude, and controllability of the expectation disconfirming event) predict coping with expectation violations (ie, accommodation, assimilation, immunization). The first hypothesis states that individuals experiencing a positive valence of expectation violation will react with higher accommodation to expectation-disconfirming information compared to individuals experiencing negative valence of expectation violation. The second hypothesis assumes that individuals experiencing a negative valence of expectation violation will react to expectation-disconfirming information with higher immunization compared to individuals experiencing positive valence of expectation violation in order to avoid negative feelings related to disappointment.[12] The third hypothesis suggests that individuals experiencing larger discrepancy will react with higher accommodation to expectation-disconfirming information compared to individuals experiencing smaller discrepancy, and the fourth hypothesis states that individuals experiencing smaller discrepancy will react with higher immunization to expectation-disconfirming information compared to individuals experiencing larger discrepancy. The third and fourth hypotheses are based on numerous findings supporting the delta rule that suggest that larger expectation violations are likely to lead to stronger expectation change.[15] To keep them realistic, we worked with moderate discrepancies rather than with extreme discrepancies that may provoke subtyping; we anticipated a linear association of the size of discrepancy with accommodation and immunization, and therefore, adhered to the delta rule. Furthermore, based on evidence suggesting a higher likelihood of individuals becoming active to fulfill their expectations in the case of control as opposed to no control over the expectation disconfirming event,[18] the fifth hypothesis assumes that if individuals have control over the source of expectation disconfirmation they will react with higher assimilation to expectation-disconfirming information than individuals who do not have control over the source of expectation disconfirmation. Finally, the sixth hypothesis proposes that if individuals do not have control over the source of expectation disconfirmation they will react with higher accommodation to expectation-disconfirming information than individuals who have control over the source of expectation disconfirmation.

METHODS

We implemented a 2 (valence of expectation-violating event: positive vs negative) x 2 (discrepancy magnitude of expectation-violating event: larger vs smaller) x 2 (controllability of expectation-violating event: control vs no control) within-subjects design. University students who were at least 18 years old were recruited via e-mail lists and were sent an invitation containing a direct link to an online questionnaire. All responses were anonymous, and participants consented to participate. As compensation, students could participate in a gift card raffle or obtain course credit.

Measures

Sociodemographic characteristics. Demographic questions assessed sex (male, female, non-binary), age, and whether the hometown was in Germany or abroad (specific ethnic background was not assessed to prevent reidentification of participants).

Coping with expectation violations. We assessed our outcome variable through a self-developed questionnaire containing stories in which expectations about healthy food consumption and physical activity were violated. In each story, characteristics of the expectation disconfirming event were manipulated according to a 2 (positive vs negative valence) x 2 (smaller vs larger discrepancy) x 2 (high vs low controllability) plan. A total of 16 stories were included, out of which 8 referred to food consumption and 8 referred to physical activity. For each story, participants had to choose one out of 3 response options, representing immunization (ignoring/downplaying the expectation violation), accommodation (expectation change) or assimilation (trying to fulfill the expectation despite initial violation). Separate dependent variables were built for food consumption and physical activity to test the robustness of the results across both kinds of health behaviors. We used a counting variable

to sum the numbers of chosen immunization, accommodation, and assimilation responses for each level of the 3 independent variables, ranging from 0 (ie, not choosing a specific coping style in any of the 4 possible stories assessing a specific coping strategy) to 4 (ie, choosing a specific coping style in all of the 4 possible stories assessing a specific coping strategy). Appendix 1 presents 2 exemplary stories per domain.

To control for a possible effect of the sequences of the presented stories, half of the participants received them in one random sequence and the other half in the reverse sequence. Participants were randomly assigned to one of these sequences (all participants received all the vignettes).

Familiarity of situations. To validate the vignettes, we administered self-developed questions to assesses whether the situations presented in the stories were like previous situations experienced by participants with a Likert scale response format from 1 "very similar" to 5 "not similar at all."

Importance of consumption of healthy food and physical activity. To validate the vignettes, we administered self-developed questions for assessing the perceived significance of consuming healthy food and of being physically active with a response format ranging from 1 "very important" to 5 "not important at all."

Data Analysis

We used SPSS version 27 (IBM Corp, Armonk, NY) for data analysis. Based on an *a priori* power analysis, a minimum of 111 participants was required to obtain .95 power to detect a medium effect size of .25 at the standard .05 alpha error probability. We tested our hypotheses using repeated measures ANCOVAs, comparing the corresponding outcome variable in response to the corresponding predictor variable while including the sequence of presentation of the stories as the between-subjects factor. Analyses for food consumption and for physical activity were computed separately. Appendix 2 provides a list of all used variables.

RESULTS

Demographic and Individual Characteristics

The sample consisted of 297 university students (75.8% female, 22.9% male, 1.3% non-binary; M_{age}=23.76, SD=4.42), of which 63 (21.2%) reported that their hometown was outside of Germany.

The presented stories were, on average, perceived as familiar (M=2.77 (SD=1.30) for food consumption; M=3.02 (SD=1.31) for physical activity) and relevant (M=1.76 (SD=.76) for food consumption; M=2.03 (SD=1.03) for physical activity), which supports the validity of the stories. Paired-samples t-tests demonstrated that consumption of healthy food (M=1.76, SD=.76) was perceived as more important than physical activity (M=2.03, SD=1.01: t(296)=-4.83, p<.001), and that participants had more familiarity with expectation violations related to consumption of healthy food (M=8.97, SD=2.97) than related to physical activity (M=9.83, SD=3.58; t(296)=-3.79, p<.001).

Predictors of Coping with Expectation Violations

Table 1 presents the results for all hypotheses. The first hypothesis was only supported regarding physical activity as participants responded with significantly higher accommodation when experiencing a better-than-expected event compared to experiencing a worse-than-expected activity-related event. In line with the second hypothesis, we found that participants responded with higher immunization when experiencing a worse-than-expected event related to physical activity compared to experiencing positive valence of expectation violation. Nevertheless, the second hypothesis was not supported regarding food consumption.

The third hypothesis was not supported because experiencing larger discrepancy was not associated with significantly higher accommodation scores than experiencing smaller discrepancy. For physical activity, higher discrepancy was even associated with less accommodation. Consistent with the fourth hypothesis, we found for both kinds of health behavior that experiencing smaller discrepancy was related to significantly higher immunization to expectation-disconfirming information.

The fifth hypothesis was supported regarding food consumption and physical activity because having control over the source of expectation disconfirmation was associated with significantly higher assimilation scores than having no control over the source of expectation disconfirmation.

The sixth hypothesis was supported regarding food consumption and physical activity as situations without control over the source of expectation disconfirmation were associated with significantly higher accommodation scores than situations with control over the source of expectation disconfirmation.

Furthermore, we checked whether the sequence of the presented items affected the report of coping with expectation violations. We found sequence effects indicating that respondents were more likely to react with immunization if a story on expectation violation was presented first rather than last (F scores ranging from 3.88 to 20.87 and p ranging from .05 to<.001). However, this sequence effect is unlikely to affect hypothesis testing as half of the participants received the stories in one sequence and the others received them in reverse sequence (thereby leading to the same mean rank of each story in the total sample).

Table 1

Effects of Predictor Variables on Coping with Expectation Violation per Health Behavior

HB[a]	Group 1	$Mean_1$	SD_1	Group 2	$Mean_2$	SD_2	df	F	p
Effect of valence on accommodation									
FC[b]	*PV*[d]	.83	1.03	*NV*[e]	.86	1.22	1	.10	.75
PA[c]	*PV*	1.50	1.30	*NV*	.87	.88	1	73.98	< .001
Effect of valence on immunization									
FC	*PV*	1.85	1.27	*NV*	1.84	1.37	1	.08	.77
PA	*PV*	1.20	1.07	*NV*	2.35	1.16	1	182.86	< .001
Effect of discrepancy on accommodation									
FC	*HD*[f]	.80	.99	*LD*[g]	.89	1.14	1	2.43	.12
PA	*HD*	1.10	1.02	*LD*	1.27	1.10	1	8.47	.004
Effect of discrepancy on immunization									
FC	*HD*	1.45	1.09	*LD*	2.24	1.24	1	131.39	< .001
PA	*HD*	1.48	.95	*LD*	2.07	1.07	1	84.65	< .001
Effect of control on assimilation									
FC	*C*[h]	1.14	.96	*NC*[i]	.72	.85	1	342.83	< .001
PA	*C*	1.14	.96	*NC*	.93	.88	1	10.67	.001
Effect of control on accommodation									
FC	*C*	.60	.94	*NC*	.88	1.11	1	44.09	<.001
PA	*C*	.96	.97	*NC*	1.41	1.25	1	39.52	<.001

Note.
[a] HB denotes health behavior.
[b] FC denotes food consumption.
[c] PA denotes physical activity.
[d] PV denotes positive valence.
[e] NV denotes negative valence.
[f] HD denotes high discrepancy.
[g] LD denotes low discrepancy.
[h] C denotes control.
[i] NC denotes no control.

DISCUSSION

In this study, we investigated predictors of coping with expectation violations related to 3 characteristics of an expectation disconfirming event (ie, valence, discrepancy magnitude, and controllability) in the health behavior context (ie, food consumption and physical activity). Three of the 6 hypotheses were completely confirmed, 2 were confirmed in part, and one hypothesis was not confirmed. We start with a short discussion of the confirmed hypotheses, followed by a more detailed discussion of inconsistent findings.

Results for the fourth hypothesis align with findings by Seta et al.[17] and suggest that in the case of food consumption and physical activity, smaller discrepancies predict immunization to cope with expectation violations. Moreover, results for the fifth and sixth hypotheses corroborate previous findings suggesting a higher likelihood of individuals becoming active to fulfill their expectations if they have control as opposed to no control over the expectation disconfirming event, and higher likelihood of expectations change following expectation violation in the face of uncontrollable disconfirming events.[18] Our results indicate that that the size of discrepancy and having

control over the disconfirming event are relevant for health behaviors such as food consumption and physical activity.

The first and second hypotheses were supported regarding physical activity but not regarding food consumption. Possibly, the manipulation of the independent variable (ie, valence) may have been more successful in the stories referring to physical activity than to food consumption as the levels of valence presented in the food consumption vignettes (eg, price difference of buying a salad of 30 cents vs 80 cents) may not have been large enough to produce different responses compared to the levels of valence presented in the physical activity vignettes (eg, running for 2 hours instead of 1 hour or running for 40 minutes instead of 2 hours). As more statistically significant results were found regarding physical activity than food consumption, the higher perceived importance of healthy eating and the higher familiarity with expectation violations related to food consumption rather than physical activity might have inhibited the effects of the manipulation of the presented situations. Thus, participants already may have developed a general way of coping with food-consumption-related expectation violations (eg, whether it is worth to check another store) that may have affected their reactions to the presented stories and therefore, may have reduced the effects of the experimental manipulation within the stories.

Interestingly, the third hypothesis was not confirmed, and regarding physical activity, we found even statistically significant results in the opposite direction of our hypothesis (ie, higher discrepancy was associated with less accommodation). Several researchers suggest that high discrepancies may lead to subtyping and to the perception of the expectation disconfirming event as exception from the rule, and therefore, to the maintenance of general expectations as future situations are expected to be as they have previously been.[16,17] Thus, large discrepancies might inhibit learning and expectation change. This alternative theoretical view may have been more appropriate for our data than Rescorla and Wagner's[15] delta rule. Moreover, despite stories presenting higher discrepancy, half of them included the option to show assimilative behavior (ie, becoming active to fulfill one's expectation at least in part). Higher accommodation (ie, expectation change) in response to larger discrepancies may be found mainly if individuals have no chance to alter the situation (eg, getting an unexpected injury that permanently prevents from doing an expected kind of sports). Thus, the third hypothesis might have been confirmed if the stories only referred to situations that did not leave any option to show assimilative behavior.

We end the discussion with a few comments on the observed effect of the sequence of the presented stories. When participants were first exposed to a story presenting an expectation violation, they were more likely to immunize against discrepant information. However, participants were more likely to change their expectation (ie, accommodate) after further exposure to stories presenting expectation violations as it may have become more difficult to ignore discrepant information. Thus, in line with research on serial learning,[20] some participants may have needed more than one trial of exposure to expectation violations to realize it may be difficult to continue ignoring discrepant information and decide to change their expectation.

Limitations and Conclusions

Our findings should be interpreted in light of potential limitations. First, some sequence effects were found regarding items presented in either the first or last story (depending on the sequence completed). In addition, due to the similarity of the presented stories, participants may have become more aware of the variables that were manipulated and may have more strongly responded accordingly thereafter. Varying the story contents (eg, buying different kinds of food, success vs failure with preparing a meal, etc) not only would reduce the attention for the manipulation of the independent variables, but also would bring in additional sources of variation that could confound effects of the independent variables (if a particular story content is presented together with a particular combination of the independent variables). Using a between-subject design and presenting only one story to each individual would solve these problems, although it would be challenging to recruit a much larger sample that would be needed for such a design. In addition, repeated confrontation with expectation violations is common in daily life. Second, our study focused on investigating disconfirmation of expectations about only 2 healthy behaviors. For

testing the generalizability of our results, future studies could assess coping with expectation violations related to other healthy (eg, getting enough sleep) and unhealthy (eg, substance use) behaviors. Despite these limitations, our findings provide novel evidence regarding characteristics of expectation disconfirming events that predict coping with expectation violations in a health behavior context.

Future studies should consider assessing predictors of coping with expectation violations in a health behavior context in a more naturalistic setting by confronting individuals with broken expectations in real life situations–for instance–with virtual-reality-based studies. Moreover, future research could assess the role of these predictors in relationship to other health behaviors among young adults (eg, alcohol use, sexual risk-taking) and other age groups and/or examine further predictors of coping with expectation violations related to characteristics of the expectation disconfirming event (eg, credibility of the disconfirming information), and to broader situational and personality characteristics (eg, prior coping with the disconfirming information; positive and negative affectivity.[11] Furthermore, empirical research is needed to assess under which conditions effects of the size of discrepancies follow the delta rule[15] and under which conditions large discrepancies do not lead to expectation change. A more complex model that includes the role of control over an expectation-violating event for predicting how the size of discrepancy relates to accommodation might be theoretically relevant, as the delta rule[15] mainly or exclusively may be applied in uncontrollable situations.

Applying our findings can potentiate the effects of health promotion interventions related to food consumption and physical activity among university students. First, interventions may benefit from assessing participants' initial ways of coping with expectation violations as these may influence their reaction to future expectation violations and the effects of interventions. Second, our findings indicate that, even in the case of larger expectation violations, individuals can maintain expectations about the consumption of healthy food and physical activity if, to some degree, they have the perception of control (ie, see the chance to still achieve their expectations). Correspondingly, interventions that encourage assimilative behavior for coping with unforeseen events that prevent an expected healthy behavior would be favorable to fostering healthy eating and physical activity. As such, interventions could foster the perception and availability of control to increase the probability that individuals will try to overcome barriers to fulfill their healthy expectations (ie, assimilation) rather than giving them up (ie, accommodation). Fostering control could include activities that allow participants to overcome unexpected barriers (eg, writing daily health goals, committing to realizing them, and marking them as completed). Lastly, as confronting individuals with expectation violations about alcohol use through Alcohol Expectancy Challenges is effective at changing unhealthy expectations and behavior,[21] expectation violations also could play a role in interventions aimed at promoting healthy behaviors. Applying our findings regarding the optimal kind of expectation violations that foster healthy expectations could increase intervention effects for promoting healthy food consumption and physical activity.

Human Subjects Approval Statement

Ethical approval was granted by the ethical board of the Psychology Department at Philipps-University of Marburg, approval number 2021-78k.

Conflict of Interest Disclosure Statement

All authors have no conflict of interest to disclose.

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APPENDIX 1
Exemplary Stories

Story related to food consumption (combination of independent variables: valence=positive, discrepancy=higher, controllability=higher): I went to the supermarket to buy one salad for 1 euro because I expect to eat it with a friend in the evening. When I arrived at the supermarket, I found out that the price of the salads was reduced by 80%, and I can buy five salads for the price of one. I can decide how many salads to buy. I would react by:
a) Buying the one salad I expected to buy (assimilation)
b) Thinking that it doesn't matter how much the salads cost as long as I get the one salad that I expected to buy (accommodation)
c) Changing my expectation to buy only one piece of salad as I can get more for the price of one (immunization)

Story related to physical activity (combination of independent variables: valence=negative, discrepancy=higher, controllability=lower): I started to wake up early because I expect to run in the morning for two hours. When I woke up, I read my emails and realized that I can only run for forty minutes instead of two hours because I confused the time of my lecture. Since this lecture is important for me and I cannot miss it, I cannot decide to run for more than forty minutes. I would react by:
a) Planning to run after the lecture to run for two hours as I expected to (assimilation)
b) Thinking that it does not matter how long I run as long as I get to run (accommodation)
c) Changing my expectation of running for two hours to running for a shorter time (immunization)

APPENDIX 2
Variables

- **Sex:** (1) Male (2) Female (3) Non-binary
- **Age**
- **Hometown:** (1) In Germany (2) Abroad
- **Order of vignettes:** (1) Order 1 (2) Reversed order
- **Food consumption vignette familiarity:** Average of all four items assessing whether the situations presented in the food consumption stories were like previous situations experienced by participants.
- **Physical activity vignette familiarity:** Average of all four items assessing whether the situations presented in the physical activity stories were like previous situations experienced by participants.
- **Importance of consumption of healthy food:** Sum of items assessing perceived significance of consuming healthy food.
- **Importance of physical activity:** Sum of items assessing perceived significance of being physically active.
- **Numbers of choosing accommodation, assimilation, and immunization depending on kind of health behavior (food consumption, physical activity) and characteristics of the expectation violation:**

		Food consumption		Physical activity	
Control over expectation confirmation	High	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization
	Low	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization
Size of discrepancy between expectation and event	High	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization
	Low	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization
Valence of expectation violation	Positive (better than expected)	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization
	Negative (worse than expected)	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization	Accommodation Assimilation Immunization

7.1.3 Study 3 – Expectancy challenge interventions to reduce alcohol consumption among high school and college students: A meta-analysis

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Expectancy Challenge Interventions to Reduce Alcohol Consumption Among High School and College Students: A Meta-Analysis

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Objective: Alcohol expectancies are a critical factor in the development of problematic alcohol use. Expectancy challenge (EC) interventions aim to manipulate positive alcohol expectancies to reduce or prevent alcohol use among young people. The present meta-analysis investigated the effects of ECs at changing expectations and alcohol use among high school and college students, and moderating effects of study and individual characteristics on these changes. ***Method:*** A total of 23 EC studies (N = 4,122; mean age = 19.0; 57% males) was included as they reported enough information to calculate effect sizes, had a control condition that did not receive an active intervention, and were presented as of August 1, 2020. Two independent coders coded relevant variables and calculated effect sizes at posttest using a random-effects model. ***Results:*** ECs showed significant yet small effects at modifying alcohol consumption and alcohol expectancies in the desired direction (g's ranged from −.18 to −.42). Changes in social, tension, liquid courage, and risk aggression expectancies explained significant variance in change in alcohol use. The effects of ECs at changing social, sexual, tension, and liquid courage expectancies were stronger among college students compared to high school students. More favorable results were observed for interventions delivered at a higher dose. ***Conclusions:*** ECs targeting high school and college students produce small effects at reducing alcohol use and changing alcohol expectancies. Future efforts are needed to determine under which circumstances and among which subgroups ECs are expected to produce greater effects.

Public Health Significance
This meta-analysis suggests that EC interventions modestly reduce alcohol use among college and high school students, and that ECs that target college students and that are delivered at a higher dose can produce more favorable effects.

Keywords: alcohol, meta-analysis, expectancy challenge, college students, high school students

Supplemental materials: https://doi.org/10.1037/adb0000732.supp

Despite trends suggesting declines in alcohol consumption rates among young people (Jackson et al., 2017), alcohol remains the most frequently consumed and abused substance among high school (Johnston et al., 2014) and college (Schilling et al., 2017) students. Findings indicate that college students consume higher alcohol volumes than non-college-attending young adults; largely explained by demographic characteristics and exposure to a campus environment increasing the likelihood of drinking (White & Hingson, 2013). Moreover, a high percentage of high school students reportedly drink alcohol (Miller et al., 2007). Alcohol consumption among high school and college students has been consistently linked to a cluster of adverse consequences such as higher risk of future alcohol dependence (Miller et al., 2007), poor academic performance (DuRant et al., 1999; Wechsler et al., 2002), risky sexual behavior (Hingson et al., 2009), and delinquency (Hingson et al., 2009).

Alcohol-Related Expectancies

In response to the evident burden of alcohol use among the student population, scholars have investigated the influence of alcohol expectancies, or beliefs about the positive or negative effects of alcohol, as a critical factor in the development of problematic alcohol use (Goldman et al., 1999). Alcohol expectancies exist at early ages prior to the initial drinking experience (Dunn & Goldman, 1996), predict onset of drinking (Stacy, 1997), and mediate the influence of precursor factors on alcohol consumption (Darkes & Goldman, 1998). Positive drinking expectancies (e.g., regarding sociability, sexual arousal, and tension reduction) may also motivate an individual to maintain drinking behavior (Wechsler & Nelson, 2008). Alcohol expectancies can increase the likelihood of alcohol consumption among adolescents (Copeland et al., 2014) and college students (Derby, 2011). In contrast, negative alcohol expectancies (e.g., impeded cognitive, social, or motor skills) can prevent, reduce, or end the occurrence of heavy drinking (Jones, 2004). Thereby, a decrease in positive expectations and increase in negative

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expectancies may be mechanisms through which drinking behavior can be prevented or reduced. Mixed findings exist regarding sex differences, with a set of results indicating that males report higher levels of positive expectancies than females (Wood et al., 1996), whereas another study found no significant differences (Carey, 1995).

Alcohol Expectancy Challenge Interventions

The association between problematic alcohol use and alcohol expectancies has led to the development of expectancy challenge (EC) interventions aimed at manipulating positive expectancies to prevent or reduce alcohol use among young individuals (Darkes & Goldman, 1993). ECs were designated by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) as suggested interventions to decrease problematic alcohol use among college students (National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2002). Darkes and Goldman (1993) implemented the first extensive EC procedure targeting heavy-drinking college students without a preceding history of alcohol dependency. The EC was delivered in three separate sessions and involved a bar lab setting where groups of students were served beverages and were told that the beverages would either contain alcohol or not. Participants engaged in learning experiences and in social activities and were asked to identify who, including themselves, had consumed alcohol. This judgment was based on the observations of behavioral changes (e.g., social facilitation) expected to occur after drinking alcohol. Participant's expectations were challenged as they were subsequently presented with correct information regarding who had consumed alcohol, which reflected that their judgments were no more accurate than if they were to respond randomly. Participants' inability to accurately identify drinkers is hypothesized to alter their expectations and to help them better differentiate between experiences lived due to expectations about drinking than to the actual pharmacological effects of alcohol. Compared to a traditional information and an assessment-only condition, EC participants showed significantly stronger decreases in alcohol use.

Succeeding applications of EC interventions have incorporated changes to the protocol proposed by Darkes and Goldman (1993) such as variations in dose and in delivery. Furthermore, to address concerns regarding the number of sessions, the administration of alcohol, and the need of a bar lab in traditional EC interventions (Wiers & Kummeling, 2004), researchers have modified these characteristics resulting in a single-session intervention delivered in a typical classroom setting (Cruz & Dunn, 2003). This evolution has facilitated the expansion of the intervention and has allowed for its application among high school and elementary school students—a favorable progression as alcohol expectations are often formed during childhood (Cruz & Dunn, 2003). Moreover, evidence supports the association between exposure to alcohol-related media depicting positive experiences associated with alcohol consumption and the formation of alcohol expectancies, leading to actual alcohol consumption (Stacy et al., 2004). To approach this matter, the EC Alcohol Literacy Curriculum (ECALC) was validated for use with high school and college students placing a strong focus on increasing media literacy to train subjects to more accurately determine the validity of alcohol advertisement and to defy positive media portrayals of alcohol use (Sivasithamparam, 2008). Further developments in the delivery of ECs led to the use of recorder narrations to deliver scripted information, which guarantees cost-effectiveness and consistency of delivery, and facilitates distribution of the intervention (Dunn et al., 2019).

Mixed findings exist in regard to the effects of EC interventions at reducing alcohol use and at modifying alcohol expectations among adolescents and young adults. Drawing from a mixed-gender sample of high school students, Cruz (2007) found a significantly stronger decrease in alcohol consumption and changes in alcohol expectancies among higher drinking male EC participants compared to participants in the traditional information and assessment only conditions. However, results among mixed-gender groups of college students are inconclusive (Labbe & Maisto, 2011). Dietz (2016) reported a significant decrease in positive expectancies among high school students with drinking experience in the EC condition, and a significantly stronger decrease in alcohol consumption among females in the EC condition compared to the control condition. Furthermore, studies have demonstrated a stronger decline in alcohol use following the successful modification of expectations resulting from participation EC interventions compared to traditional information and assessment-only conditions among moderate to heavy-drinking male (Darkes & Goldman, 1993, 1998) and female (Lau-Barraco & Dunn, 2008) college students. Yet, other studies did not find significantly stronger changes in drinking or expectations among male (Keillor et al., 1999) nor female (Wiers & Kummeling, 2004) college students participating in ECs compared to those in control conditions. Moreover, evidence supports the effects of ECs at reducing alcohol use and positive alcohol expectancies among males, yet, studies applying EC interventions to women-only groups have not found consistent intervention effects and research on this gender group remains scarce. Thus, a gap in the literature on EC interventions exists concerning the effects of the intervention on females.

A meta-analysis investigating alcohol interventions for mandated college students found that interventions challenging alcohol expectancies reduced drinking frequency (Carey et al., 2016). However, when adjusted for multiple univariate testing, this association was not significant ($p = .43$). An earlier meta-analysis exclusively evaluating EC interventions included 14 studies and reported a significant overall effect of EC interventions at reducing positive alcohol expectations and the quantity and frequency of heavy drinking among a college population; however, effect sizes were small (d's ranged from 0.23 to 0.28; Scott-Sheldon et al., 2012).

The Present Meta-Analysis

Earlier efforts to investigate the effects of interventions challenging alcohol expectancies have provided mixed evidence for their effects at modifying alcohol use and expectancies among college students (Carey et al., 2016; Scott-Sheldon et al., 2012). Also, they are limited to samples of college students despite findings suggesting that adolescence is a critical period to challenge alcohol expectancies (Dietz, 2016). An earlier systematic analysis of ECs only reported moderating effects of gender (Labbe & Maisto, 2011), and a previous meta-analysis investigated moderating effects of study and individual characteristics on the effects of ECs among college students found only moderating effects of age (Scott-Sheldon et al., 2012). Additional moderating effects of study and individual characteristics could exist but may have not been identified due to the small sample of included studies. It is crucial to thoroughly understand which intervention and participant characteristics moderate

the effects of these interventions because they define under which circumstances ECs are more likely to promote desired outcomes. The present meta-analysis addressed these gaps by investigating changes in expectations and in alcohol use among high school and college students and moderating effects of study characteristics on these changes, that is, dose (number of sessions and session length), methodological quality of studies, training on media literacy, delivery format (experimental bar vs. no experimental bar), and of individual factors (age, sex, ethnic minority status, and college vs. high school students).

Drawing on the aforementioned findings, we first hypothesized that EC interventions would be effective at reducing alcohol use and positive alcohol expectancies among the general high school and college student population. Second, as expectancies are critical predictors of alcohol use (Jones et al., 2001), we investigated the mediation role of expectancy change in drinking reduction and expected that change in expectancies predicts change in alcohol consumption. Furthermore, we investigated whether intervention characteristics and individual factors had a moderating effect on the size of change in alcohol consumption and in alcohol expectations. Accordingly, our third hypothesis anticipated that younger participants and high school students would exhibit better outcomes from EC interventions than older participants and college students due to the lower likelihood of holding exceptionally strong positive alcohol expectancies during earlier stages of alcohol use (Dietz, 2016); existing evidence suggests that drinking behavior becomes more stable with age making it more difficult to change (White & Jackson, 2004), and promising outcomes reported for this younger age group (Sivasithamparam, 2011). Fourth, we hypothesized that EC interventions would show more favorable results when delivered to groups with a high percentage of male participants as males display more positive alcohol expectancies than females (Jones et al., 2001), tend to drink more than females (Darkes & Goldman, 1993), and previous ECs targeting this group format has presented superior outcomes than in mixed and female-only groups (Labbe & Maisto, 2011). Fifth, we hypothesized that EC interventions delivered at a higher dose would show more favorable results as longer interventions allow for more opportunities to challenge alcohol use and expectancies compared to shorter interventions (Gottfredson & Wilson, 2003). Sixth, due to the influence of media sources on youth decision making and on the formation of positive alcohol expectancies (Dunn et al., 2019), we expected EC interventions to be more effective when they included a media literacy component. Furthermore, we investigated whether the methodological quality of the studies had any moderating effects. We also explored whether an experimental bar delivery format and a non-experimental-bar delivery format lead to different effects. Superior positive effects of a non-experimental-bar format may support this delivery format's faculty to facilitate the implementation of EC interventions and to reach a larger number of subjects without the need of administering alcohol to participants (Sivasithamparam, 2011). Finally, we explored whether the percentage of members of ethnic minority groups had moderating effects on changes in alcohol consumption and expectancies.

Method

Literature Search

Relevant studies were retrieved from the electronic databases PsycInfo, ERIC, Medline, and PubMed through a systematic search using the following terms: (expectancy challenge) AND (young adults OR students OR adolescent) AND (alcohol expectanc*). Additional studies were identified by checking the reference section of literature from the electronic databases. Studies were included if they

1. Reported enough information for calculating the effects of EC interventions on alcohol expectancy change and/or alcohol use among high school or college students.
2. Randomized participants into an experimental condition or a control condition that did not receive an active intervention.
3. Were published or presented before August 1, 2020.

We excluded studies that

1. Did not use an EC intervention.
2. Did not assess EC effects on alcohol consumption or related expectancies.

When a study met the inclusion criteria but provided insufficient information to calculate effect sizes, we sought to obtain the additional information by contacting the authors. Studies that also included other alcohol interventions (e.g., Brief Motivational Intervention [BMI]) were only included if the study had an EC-only group that could be compared to an assessment only control group. To minimize the possibility of publication bias (Rosenthal, 1979), we included several unpublished articles that were identified by the literature search described above.

A total of 245 articles were identified using the listed search terms. After screening the results and assessing them for eligibility, 222 articles were excluded. A total of 23 studies were included in the present meta-analysis (see Figure 1) resulting in a combined sample of 4,122 participants. All included studies are listed in the References section and marked with an asterisk.

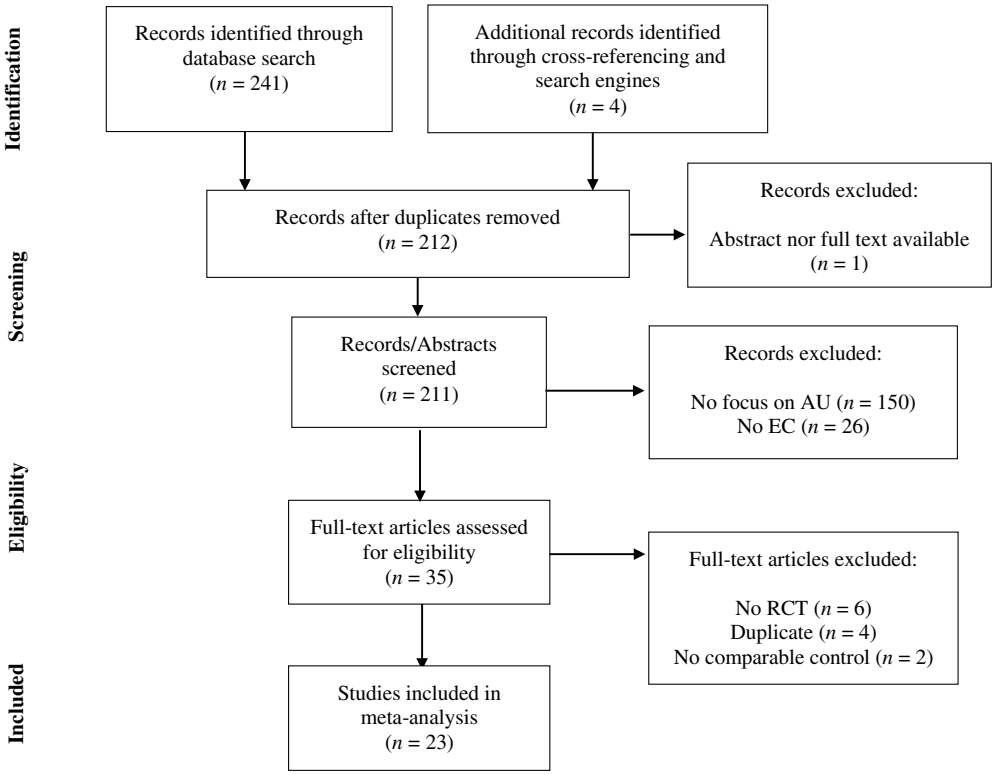
Coding Procedures

Variables were coded based on three potential mediating categories as follows:

1. Study characteristics (i.e., publication status, methodological quality, and sample size).
2. Intervention characteristics (i.e., dose, components, delivery format, interval between intervention and outcome assessment, and instruments used).
3. Sociodemographic characteristics (i.e., age, sex, ethnic minority status, and population).

The methodological quality of the studies was assessed using the National Institutes of Health Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (National Institutes of Health [NIH], 2014) which included 14 items (e.g., was the study described as randomized control trial?) and scores could vary from 0 to 14. Effect sizes (d) were calculated for changes in alcohol use and changes in alcohol expectancies by computing the difference between change in the intervention condition and the control condition, divided by the pooled standard deviation at pretest

Figure 1
PRISMA Flow Diagram



Note. AU = alcohol use; EC = expectancy challenge; RCT = randomized control trial.

(Cohen, 1988). As studies used different measures for assessing alcohol use and alcohol expectancies, we conceptualized changes in alcohol consumption as changes in the quantity of drinks consumed over time and frequency of drinking occasions for evidence shows that alcohol expectancies are associated with quantity and frequency of drinking among adolescents (Fromme & D'Amico, 2000) and college students (Carey, 1995). For studies that reported results on alcohol consumption quantity and frequency of drinking occasions separately, a mean effect size combining both effect sizes was calculated. In addition, alcohol expectancies were coded separately for change in general expectancies (i.e., global expectancies) and in domain-specific expectancies (e.g., sexual enhancement, social enhancement, tension reduction, liquid courage, cognitive consequences, risk aggression, and negative self-perception). Effects sizes were calculated separately for groups with different drinking patterns, different demographic characteristics (e.g., age and sex), and having more than one EC group. In the absence of mean scores, *F* scores were utilized to calculate effect sizes (Lipsey & Wilson, 2001). Negative effect sizes reflect changes in the desired direction (i.e., decrease of positive alcohol expectancies, increase of negative alcohol expectancies, and decrease in quantity and frequency of drinking) in the EC condition. Studies were screened and coded by two independent coders. The first author coded 100% of the studies, while a graduate student coded a random sample of 44% of the studies. Discrepancies regarding variable coding were solved through discussions between the two coders. Interrater reliability was high (80%).

Outcomes

Only variables for which at least nine effect sizes were available were included to identify a small effect size of $g = .20$ with a test power of 80%, as indicated by the Power Calculator Tool (Harrer et al., 2019). These outcome variables include the following: alcohol consumption, global alcohol expectancies (i.e., total positive expectancy scores), sexual enhancement expectancies (e.g., "I would be a better lover"), sociability expectancies (e.g., "I would be outgoing"), tension reduction expectancies (e.g. "My body would feel relaxed"), liquid courage expectancies (e.g., "I would feel brave"), cognitive consequences expectancies (e.g., "I would have difficulty thinking" or "I would think faster"), risk aggression expectancies (e.g., "I would act aggressively"), and negative self-perception expectancies (e.g., "I would feel self-critical").

Statistical Analysis

Data analysis was conducted using the *Comprehensive Meta-Analysis* software (Borenstein et al., 2009). Most studies did not report follow-up results, and none of the outcome variables analyzed presented nine or more effect sizes at follow-up. Therefore, only posttest outcomes were included in our analysis. All effect sizes were transformed to Hedge's *g*. Results of $g = .20$ were interpreted as small, of $g = .50$ as medium, and of $g = .80$ as large (Cohen, 1988). Outliers presenting more than two standard deviations (*SD*s) away from the mean were corrected to the value at two *SD*s.

Weighted mean effect sizes and 95% confidence intervals (CIs) were calculated using a random-effects model (Lipsey & Wilson, 2001). The significance of the mean was tested by dividing the weighted mean effect size by the standard error of the mean. Trim-and-fill analysis was computed for correcting potential publication bias (Shi & Lin, 2019). To test homogeneity between effect sizes, we computed Q scores and I^2 indices. Inverse variance weighted regressions were used to calculate moderator analysis for continuous variables and inverse variance weighted one-way ANOVAs were used for categorical variables (Lipsey & Wilson, 2001).

Results

Sample and Study Characteristics

Characteristics of each included study are reported in Table S1 on the electronic supplementary material. Concerning the $k = 23$ studies included in our analysis, 57% were published in an academic journal while 43% were dissertations. Studies were conducted between 1993 and 2018 ($M = 2005$). The methodological quality score of studies ranged from 6 to 13 points, with 9.61 being the median score. One study targeted participants who were either nondrinkers or who had limited drinking experiences, 8 studies targeted participants who were heavy drinkers (without current or past history of any other intervention to treat problematic alcohol use), while 13 studies targeted participants who were moderate to heavy drinkers. The mean age of the $n = 4{,}122$ participants was $M = 19$ years ($SD = 2.32$). Moreover, 57% were males, 78% were college students, and 80% were White. Seven ECs delivered in a bar lab setting served participants either an alcoholic beverage or a placebo beverage. Studies with and without a bar lab setting provided education about alcohol expectancies and about the effects of alcohol, and integrated discussions about existing expectancies and their sources to challenge them. Moreover, 8 interventions included a media literacy component. The number of sessions ranged from 1 to 4 ($M = 1.87$, $SD = .97$) and the duration of each session ranged from 35 to 105 min ($M = 59.35$, $SD = 20.41$). Typically, interventions consisted of one session (47.80%), followed by three (26.10%), two (21.70%), and four (4.30%) sessions. The average interval between the intervention and posttest was of 34.91 days. Sessions were typically delivered to groups (22 studies) as opposed to individuals.

Effects of EC Interventions

Weighted mean effect sizes of all outcome variables at posttest are shown in Table 1. Overall, EC interventions showed positive effects at reducing alcohol consumption and general positive alcohol expectancies among participants in the experimental condition as opposed to those in the control condition. However, the effects were small, particularly for alcohol consumption. Moreover, EC participants also showed significant changes in the desired direction on sexual, social, tension reduction, liquid courage, and risk aggression expectancies. Nevertheless, effect sizes were also small (Cohen, 1988). Accordingly, our first hypothesis was predominantly supported, yet effect sizes were small. Furthermore, the effects for alcohol consumption and for global, sexual, risk aggression, cognitive consequences, and self-perception expectancies were heterogeneous, indicating variability between the included studies. Our second hypothesis was partially supported as changes in social, tension, liquid courage, and risk aggression expectancies explained significant variance of change in alcohol use (see Table 2).

Trim-and-fill analysis added effect sizes of possible missing studies on five out of nine outcome variables (see Table S2 on the electronic supplementary material). The corrected effect sizes differed only slightly from the original effect sizes with results showing variability in size (i.e., larger than the original effect size in some cases, and smaller in other cases), indicating no consistent evidence of publication bias. Change in cognitive consequences expectancies became significant indicating a stronger increase in the intervention group on this domain.

Analysis of Moderator Effects

Moderator analysis was conducted to investigate whether intervention characteristics and individual factors had a moderating effect on the intervention's effect on change in behavior and in

Table 1
Mean Effect Sizes of Outcome Variables

Outcome	k	g	95%	CI	Z	Q
Alcohol consumption	30	−.17	−.26	−.09	−3.89[c]	36.49
Global alcohol expectancies	10	−.35	−.59	−.11	−2.88[b]	7.79
Sexual expectancies	19	−.32	−.42	−.21	−5.92[c]	24.39
Social expectancies	17	−.42	−.53	−.31	−7.75[c]	33.51[a]
Tension expectancies	18	−.37	−.47	−.26	−6.96[c]	28.63[a]
Liquid courage expectancies	12	−.38	−.49	−.26	−6.43[c]	42.45[c]
Cognitive consequences	14	.10	−.06	.27	1.24	23.20[a]
Risk aggression expectancies	13	−.24	−.35	−.13	−4.30[c]	13.99
Self-perception expectancies	12	−.11	−.22	.00	−1.90	7.84

Note. k = number of effect sizes included in the analysis; g = weighted mean effect size; 95% CI = lower and upper limits of the 95% confidence interval; Z = test for significance of g; Q = test for homogeneity of effect sizes.
Negative effect sizes reflect changes in the desired direction (i.e., decrease of alcohol consumption and positive alcohol expectancies, and increase of negative expectancies).
[a] $p < .05$. [b] $p < .01$. [c] $p < .001$.

Table 2
Association of Expectancy Change with Change in Alcohol Consumption

Expectancy	*k*	β	*B*	95%	CI	*Z*	R^2
Global alcohol Expectancies	8	.32	.20	−.41	.82	.65	.10
Sexual expectancies	16	−.23	−.23	−.72	.26	−.91	.05
Social expectancies	14	−.43	−.59	−1.14	−.03	−2.10[a]	.18
Tension expectancies	14	−.42	−.49	−.97	−.01	−2.01[a]	.18
Liquid courage expectancies	10	−.58	−.98	−1.54	−.41	−3.38[b]	.34
Cognitive consequences	12	.40	.54	−.02	1.10	1.89	.16
Risk aggression expectancies	11	−.66	−.69	−1.25	−.13	−2.40[a]	.44
Self-perception expectancies	10	−.27	−.21	−.77	.35	−.74	.07

Note. *k* = number of effect sizes included in the analysis; β = standardized regression coefficient; *B* = unstandardized regression coefficient; 95% CI = lower and upper limits of the 95% confidence interval; *Z* = test for significance of *B*; R^2 = explained variance.
[a] $p < .05$. [b] $p < .01$.

alcohol expectations. Results for continuous variables are shown in Table 3, and results for categorical variables are shown in Table 4.

Age and Population

High school and college students showed significant decreases in alcohol consumption and global expectancies. Moreover, older participants showed significant positive effects in regard to social expectancies. In contrast to high school students, college students also showed significant intervention effects on sexual, social, tension, liquid courage, cognitive, risk aggression, and self-perception expectancies. Intervention effects were significantly higher in college students than in high school students with regard to sexual, social, tension, and liquid courage expectancies (see Table 3 and Table 4). As college students received, on average, a higher dose, we tested whether differences in dose explained the different effects of college versus high school students. Yet, meta-regressions showed that the higher effect sizes in college students remained significant after controlling for dose (*p* ranged from .01 to .04 and β ranged from −1.56 to .57).

Sex

Contrasting our hypothesis, findings did not reveal significant moderating effects of sex (see Table 3).

Dose

Interventions delivered at a higher dose showed significantly stronger effects at reducing alcohol consumption and changing liquid courage expectancies and cognitive behavioral consequences expectancies. Thus, there was some support for our hypothesis on more desirable results for interventions delivered at a higher dose (see Table 3).

Media Literacy

Contrary to our hypothesis, no significant moderating effects of inclusion of a media literacy component were found (see Table 4).

Methodological Quality

Study quality was a significant moderator only for liquid courage expectancies, where intervention effects were higher among studies with a higher methodological quality. Follow-up analysis revealed that this moderating effect was based on the dropout rate ($Q_{\text{Between}} = 13.67$; $p < .01$), indicating stronger effects in the case of smaller dropout rates ($k = 3$, $g = -.60$, $z = -7.11$, $p < .01$ vs. $k = 9$, $g = -.17$, $z = -2.11$, $p = .04$).

Exploratory Analysis

The experimental bar and the nonbar formats showed significant effects at reducing alcohol consumption and social expectancies. The bar format also showed positive effects in regard to global and cognitive consequences expectancies, whereas the nonbar format showed positive effects for sexual, tension, and risk aggression expectancies. No significant moderating effect of either format was found (see Table 4). As population and delivery format were moderately correlated ($r = -.35$), we tested whether significant effects of population persisted after controlling for delivery format. All moderating effects of population persisted after including delivery format as a second predictor.

In regard to ethnic minority status, inconsistent moderating effects were found for two dimensions. Namely, changes in liquid courage expectancies were stronger in samples with more members of ethnic minority groups, while the opposite was true for cognitive consequences expectancies (see Table 3).

Discussion

The present meta-analysis investigated the effects of EC intervention at changing expectations and alcohol use among high school and college students and the moderating effects of study and individual characteristics on these changes. Our findings indicate that EC interventions produce effects at reducing alcohol consumption quantity and frequency and positive alcohol expectancies, and at increasing negative alcohol expectancies in the experimental condition as opposed to participants in the control condition. Still, the magnitude of effect sizes was very small to small (Hedges *g* ranging from −.11 to −.38). Our results corroborate those of a previous meta-analysis reporting that ECs succeeded at reducing

Table 3
Association of Continuous Personal and Study Characteristics with Change in Outcome Variables

Predictor	Alcohol consumption		Global alcohol expectancies		Sexual expectancies		Social expectancies		Tension expectancies		Liquid courage expectancies		Cognitive consequences expectancies		Risk aggression expectancies		Self-perception expectancies	
	k	β	*k*	β	*k*	β	*k*	β	*k*	β	*k*	β	*k*	β	*k*	β	*k*	β
Age	30	−.19	10	.61	19	−.25	17	−.42[a]	18	−.17	12	−.27	14	.22	13	−.16	12	.02
% Male	30	−.34	10	.11	19	.21	17	.23	18	.07	12	.13	14	−.34	13	.29	12	−.43
Dose	30	−.36[a]	10	−.39	19	−.22	17	−.31	18	−.23	12	−.68[c]	14	−.45[a]	13	−.24	12	−.06
Quality	30	−.19	10	.30	19	−.15	17	−.05	18	−.18	12	−.33[a]	14	.25	13	−.28	12	−.48
% Ethnic minority	30	.29	10	−.55	19	−.11	17	.13	18	.12	12	−.35[a]	14	.68[b]	13	−.40	12	−.23

Note. *k* = number of effect sizes; β = standardized regression coefficient.
[a] $p < .05$. [b] $p < .01$. [c] $p < .001$.

positive alcohol expectations and the quantity and frequency of heavy drinking, yet effect sizes were also small (Scott-Sheldon et al., 2012). As Scott-Sheldon et al.'s (2012) earlier meta-analysis solely focused on EC interventions for college students, our findings that EC interventions also appear to be, in part, successful among high school students provide novel insights in the meta-analytic investigation of EC interventions. The magnitude of effect sizes found in our meta-analysis is consistent with those reported in other brief interventions against alcohol use and EC interventions (Carey et al., 2016; Tanner-Smith & Lipsey, 2015). A potential explanation as to why ECs delivered significant but small effects may be that brief alcohol interventions are typically intended to provide participants with resources to modify their consumption patterns but, due to their short nature, are not intended to provide a thorough treatment for participants who already exhibit problematic alcohol use nor to implement robust techniques to prevent alcohol consumption among participants without problematic alcohol use (Tanner-Smith & Lipsey, 2015). Small effect sizes may represent an acceptable benefit–cost ratio in light of the low average duration of these interventions, and the few resources needed to implement them. Furthermore, changes in social, tension, liquid courage, and risk aggression expectancies explained significant variance in change in alcohol use. This supports the basic assumption that EC interventions reduce alcohol use via changes of expectancies. More significant statistical effects of domain-specific expectancy change on change in alcohol consumption may be found if more studies become available that increase test power. Consistent evidence for possible publication bias was not found, which could be related to our inclusion of several unpublished studies. The surprising increase of pro-alcohol cognitive behavioral consequences expectancies that appeared in the trim-and-fill analysis could be related to the fact that some individual studies found increases while other found decreases, so that adding some of the former studies led to a significant mean effect. Additional research is needed to determine under which conditions cognitive consequences expectancies change in one or the other direction.

Few moderating effects of study and individual characteristics were observed. In regard to age and target population, results showed that older participants and college students presented more desirable outcomes from EC interventions in regard to social expectancies. College students also showed stronger decreases in sexual, tension, and liquid courage expectancies than high school students. On a similar note, Scott-Sheldon et al. (2012) posit that EC interventions were more efficient at increasing general negative alcohol expectancies among older college students. A possible explanation to our findings could be that older participants and college students tend to have more positive expectations about the consequences of drinking alcohol than younger participants and high school students (Frank et al., 1999) and, therefore, have more possibility to show improvement. Furthermore, the stronger effects in college students compared to high school student may be based on differences in aspects of the intervention. However, the higher dose received by college students did not explain the stronger effects on this population. Nonetheless, this effect might have been based on differences between both groups in other aspects of the intervention. Finally, studies with college students used different questionnaires than studies with high school students, and these questionnaires may show different sensitivity for change. The role of these factors should be empirically tested. Nonetheless, high school and college

Table 4
Association of Categorical Personal and Study Characteristics with Change in Outcome Variables

	Alcohol consumption						Global alcohol expectancies						Sexual expectancies					
Moderator	*k*	*g*	95% CI		*Z*	*Q*	*k*	*g*	95% CI		*Z*	*Q*	*k*	*g*	95% CI		*Z*	*Q*
Media						1.46						1.60						.66
Yes	13	−.13	−.24	−.02	−2.34[a]	17.01	1	.11	−.64	.85	.28	.00	10	−.35	−.48	−.22	−5.36[c]	16.83
No	17	−.24	−.38	−.10	−3.33[c]	19.02	9	−.40	−.65	−.15	−3.13[b]	6.19	9	−.25	−.44	−.07	−2.64[b]	6.91
Population						.37						3.07						6.64[a]
HSS	6	−.24	−.48	−.00	−1.98[a]	6.27	1	−1.05	−.23	−2.51	−2.25[a]	.00	4	.05	−.25	.35	.33	2.53
CS	24	−.16	−.25	−.07	−3.40[c]	29.86	9	−.28	−.53	−.04	−2.52[a]	4.72	15	−.37	−.48		−.26	−6.45[c]	15.22
Delivery						3.74						.04						.00
Bar	8	−.37	−.58	−.15	−3.37[c]	9.30	6	−.33	−.62	−.04	−2.23[a]	2.17	2	−.32	−.71		.08	−1.58	.84
No Bar	22	−.13	−.22	−.04	−2.78[b]	23.45	4	−.38	−.79	.03	−1.83	5.59	17	−.32	−.43		−.21	−5.70[c]	23.55

	Social expectancies						Tension expectancies						Liquid courage expectancies					
Moderator	*k*	*g*	95% CI		*Z*	*Q*	*k*	*g*	95% CI		*Z*	*Q*	*k*	*g*	95% CI		*Z*	*Q*
Media						2.45						.57						1.34
Yes	9	−.36	−.49	−.23	−5.48[c]	23.44[b]	9	−.39	−.52	−.26	−5.93[c]	19.31[a]	9	−.41	−.54	−.28	−6.23[c]	34.21[c]
No	8	−.54	−.73	−.36	−5.70[c]	7.60	9	−.31	−.48	−.13	−3.48[b]	6.16	3	−.25	−.49	−.00	−1.97[a]	6.91[a]
Population						12.34[c]						6.99[a]						15.09[b]
HSS	6	−.08	−.29	.15	−.63	11.51[a]	7	−.11	−.32	−.10	−1.02	7.12	5	.05	−.19	.29	.40	2.87
CS	11	−.52	−.64	−.40	−8.49[c]	9.66	11	−.44	−.57	−.32	−7.26[c]	11.93	7	−.50	−.63	−.37	−7.50[c]	24.49[a]
Delivery						.47						.38						0.00
Bar	2	−.55	−.95	−.15	−2.72[a]	.01	3	−.26	−.59	−.06	−1.58	25.37[a]	0					
No Bar	15	−.41	−.52	−.30	−7.29[c]	33.03[b]	15	−.37	−.48	−.26	−6.68[c]	26.01	12	−.38	−.49	−.26	−6.43[c]	42.45[c]

	Cognitive consequences expectancies						Risk aggression expectancies						Self-perception expectancies					
Moderator	*k*	*g*	95% CI		*Z*	*Q*	*k*	*g*	95% CI		*Z*	*Q*	*k*	*g*	95% CI		*Z*	*Q*
Media						2.79						.40						1.66
Yes	9	.24	.07	.11	3.71[c]	11.70	9	−.26	−.39	−.13	−4.01[a]	10.89	9	−1.15	−.28	−.02	−2.28[a]	6.14
No	5	.03	.11	−.19	.26	8.70	4	−.18	−.39	.03	−1.67	2.70	3	.03	−.21	.28	.26	.05
Population						2.68						3.64						.52
HSS	6	.03	−.19	.25	.24	6.67	5	−.03	−.27	.21	−.24	.26	5	−.03	−.27	.21	−.24	2.55
CS	8	.24	.11	.37	3.70[c]	13.85	8	−.29	−.42	−.17	−4.70[c]	10.09	7	−.13	−.26	−.00	−2.02[a]	4.77
Delivery						2.64						.00						0.00
Bar	1	−.58	−1.51	.35	−1.22	.00	1	−.25	−.69	.18	−1.15	.00	0					
No Bar	13	.20	.09	.31	3.50[c]	20.56	12	−.23	−.35	−.13	−4.14[c]	13.99	12	−.38	−.49	−.26	−6.43[c]	42.45[c]

Note. *k* = number of effect sizes included in the analysis; *g* = weighted mean effect size; 95% CI = lower and upper limits of the 95% confidence interval; *Z* = test for significance of *g*; *Q* = test for homogeneity of effect sizes; *media* = media literacy component; *population* = high school or college students; *HSS* = high school students; *CS* = college students; *delivery* = format of intervention delivery (i.e., bar lab or no bar setting).
[a] $p < .05$. [b] $p < .01$. [c] $p < .001$.

students showed significant decreases in alcohol consumption and global expectancies.

Furthermore, we expected ECs to deliver more positive effects when delivered to males. Results revealed no significant moderating effects of gender, which may indicate that ECs produce equivalent effects for male and female participants. Our findings contrast those of a previous review indicating that ECs targeting male groups produce more effects at reducing alcohol expectancies and consumption (Labbe & Maisto, 2011). An explanation to the lack of moderating effects of gender could be that male and female drinking patterns have become more similar (National Institute on Alcohol Abuse and Alcoholism [NIAAA], 2015), which leads to similar room for improvement in men and women. Alternatively, even when young men drink more and have more positive expectancies about alcohol use, and could, therefore, change more than women, some factors may prevent their stronger improvement, such as greater social acceptance of male drinking (Gebara et al., 2013), and greater influence of peers (Borsari & Carey, 2001) which can diminish the effects of adult-led interventions. It is worth noting that gender variance among the studies was restricted, with 40% male-only samples and 20% female-only samples. More studies with female-only samples could facilitate the detection of significant gender moderating effects.

In line with our hypothesis, EC interventions delivered at a higher dose showed significantly higher effects at reducing alcohol consumption, liquid courage expectancies, and changing cognitive behavioral consequences expectancies. Scott-Sheldon et al. (2012) previously reported no moderating effects of dose on the effects of EC interventions. The differential findings from this previous meta-analysis could be related to the higher number of studies included in our analysis rather than to a nonexistent moderating effect of intervention dose. Our findings propose insights in favor of longer EC interventions, which could provide prolonged opportunities to reduce alcohol use and to target alcohol expectancies among high school and college students (Jones et al., 2001). For instance, Tanner-Smith and Lipsey (2015) suggest that brief alcohol interventions (i.e., roughly five total intervention hours—compared to the average duration of 1 hr of the EC interventions in the present meta-analysis) have been associated with long-term reduced alcohol consumption and associated problems in these populations.

Furthermore, contrary to our hypothesis, no significant moderating effects of inclusion of a media literacy component were found. However, test power was limited as most studies did not integrate a media literacy component. Based on findings suggesting that the media is an important source of the formation of positive alcohol expectancies (Boucher, 2012), additional implementations of EC interventions with a media literacy component are needed to infer its actual moderating effect in these interventions.

Concerning moderating effects of methodological study quality, effects on most outcomes did not vary by study quality indicating that these results are robust in regard to methodological quality. The lower intervention effects in studies with higher dropout rates could indicate that ECs with high dropout rates were less motivating to participate in and to change one's expectancies. To directly test this assumption, studies should measure perceived relevance and relate this to changes in alcohol consumption and expectancies. Scott-Sheldon et al.'s (2012) previous meta-analysis did not investigate moderating effects of methodological quality of studies on the outcomes of EC interventions. Thus, our results present novel findings relevant for college and high school students.

Furthermore, we conducted exploratory analysis to identify whether an experimental bar delivery format and a non-experimental-bar delivery format moderate the effect size of intervention effects. Both delivery methods showed positive effects at decreasing alcohol consumption and social expectancies though more evidence for change in domain-specific expectancies was available for no-lab ECs. A bar lab setting restricts the implementation of EC interventions as well as its application in clinical settings (Corbin et al., 2001). Also, the use of a bar lab setting prevents the applicability of these interventions among younger populations who are legally not yet old enough to consume alcohol. Nevertheless, we can infer that directly challenging alcohol expectancies in a bar lab and a nonbar setting produces effects at decreasing alcohol consumption and social expectancies. Thus, ECs delivered in experimental bar settings can be suitable for participants who are in the legal age for drinking. Likewise, a nonbar delivery format can produce effects among younger populations not yet in the legal drinking age.

Finally, given the contradictory moderating effects of ethnic minority status, further research is needed for identifying the factors that explain this moderating effect of ethnicity.

Limitations and Conclusions

The current meta-analysis represents an important step of additive value to understanding the effects of EC interventions among high school and college students. Nevertheless, our findings should be interpreted in light of potential limitations. First, although we had sufficient test power to identify small overall effects, the number of studies was limited for some subgroups, such as female-only samples and high school students. This restricted the elaboration of reliable inferences concerning the moderating effects of these study and individual characteristics on ECs. Accordingly, further moderating effects may appear once more studies become available. It is worth noting that additional outcome variables were not included in our meta-analysis as not enough studies reported relevant information on these variables (e.g., arousal expectancies, sedation expectancies, and personalities expectancies). Likewise, the comparisons of effects of ECs on some relevant subgroups (e.g., high drinking vs. low drinking participants) were not investigated as not enough studies reported outcomes among these subgroups. Nevertheless, the present meta-analysis updates the meta-analysis by Scott-Sheldon et al. (2012), which included 14 studies with samples of college students. Our inclusion of high school students allowed for a larger sample of 23 studies. Second, most ECs included in our analysis were executed in Western countries among White subjects. Future research on ECs should include more diverse and underrepresented samples to determine generalizable effects of ECs on different ethnic groups. Third, long-term effects of EC interventions could not be investigated as most studies did not include follow-up assessments. Future investigations would benefit from incorporating supplementary follow-up periods to detect long-term effects of ECs. Finally, studies only administered self-report measures, and some participants may have been reluctant or ashamed to answer truthfully or may have not be willing to answer and might have instead provided socially desirable responses. Nevertheless, research suggests that alcohol related self-report

measures can be regarded as accurate for light to moderate drinkers (Northcote & Livingston, 2011).

Despite these limitations, our findings present significant implications for practice and future research. In terms of effects, our findings suggest that EC interventions targeting high school and college students produce modest effects at reducing alcohol consumption and changing alcohol expectancies. However, effect sizes were small, and more efforts are needed to increase the effects of these interventions. Based on data suggesting that brief alcohol interventions for young people may be more effective when they include goal-setting exercises and money/cost information about drinking as components (Tanner-Smith & Lipsey, 2015), ECs may benefit from including such components as an additional strategy to potentiate their effect on alcohol consumption and expectations. Nonetheless, research is needed to examine further components, that, in combination with EC interventions, could be associated with larger effects across different populations of young people. In addition, it would be beneficial to identify more sources of heterogeneity to improve the size of effects. In regard to age and target group, evidence suggests that adolescence may be a critical age range to target alcohol expectancies as these tend to form during this period, and many individuals have their first experiences with alcohol as adolescents (Dietz, 2016). However, our results showed significant better effects of ECs among older participants and college students for alcohol use and all expectancy domains. Nevertheless, results also indicated that alcohol use and global expectancies also decreased among high school students. An important step for future research is to conduct additional EC interventions among samples of younger participants and high school students, as scarce investigations exist for EC interventions among this age group, making it difficult to build accurate inferences. Future research should also identify sources of higher effects in college as opposed to high school students. Finally, an important step for the future implementation of EC intervention is to revise its protocol by conducting additional analyses to identify further relevant needs in each target population, leading focus groups to reevaluate the design, and collecting feedback to make relevant modifications (McKleroy et al., 2006).

In summary, this meta-analysis summarizing the effects of EC interventions among high school and college students presents encouraging trends suggesting that these interventions serve to modestly reduce alcohol consumption and change alcohol expectancies among young individuals, particularly among older participants and college students, when delivered at a higher dose. Further research investigating under which circumstances and among which subgroups these interventions are expected to produce greater effects is needed.

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Table S1

Descriptive Information of Each Included Study

Study	Sample Characteristics	Study Characteristics				Effect Sizes (*g*)	Study Quality
		Control Group(s)	Dose		Measures		
			Sessions	Duration			
Corbin et al. (2001)	*N* = 62 (30); *A* = 29% 50% F; 87% W *M* age = 20; CS	AO	3	60	AEQ; TLFB; DDQ; Drinking/Expectancy chart	E = –.57 Se = –.63 So = –.80 T = –.79	11
Cruz (2007)	*N* = 259 (130); *A* = 11% 53% F; 72% W *M* age = 14; HSS	AO, AE	1	45	TLFB; MMBEQ	A = .18, –.83	9
Darkes & Goldman (1993)	*N* = 54 (36); *A* = 32% 0% F; 95% W *M* age = 21; CS	AO, AE	3	75	ECQ; AEQ; TLFB; Drinking/ Expectancy chart	A = –.85 E = –.47	12
Darkes & Goldman (1998)	*N* = 50 (15); *A* = 19% 0% F; 87% W *M* age = 20; CS	AO	3	105	ECQ; AEQ; AEI; TLFB; Drinking/Expectancy/ Drinking Reaction/Daily Activities charts	A = –.65, –.62 Se = –.44, –.67	11
Dietz (2016)	*N* = 180 (76); *A* = 40% 57% F; 62% W *M* age = 18; HSS	AO	1	35	TLFB; CEOA	A = –.18 So = .28 T = .20 L = .15 C = –.05 R = –.02 S = –.15	8

Study	Sample Characteristics	Study Characteristics				Effect Sizes (*g*)	Study Quality
		Control Group(s)	Dose		Measures		
			Sessions	Duration			
Fried (2010)	*N* = 318 (159); *A* = 33% 51% F; 83% W *M* age = 20; CS	AO	1	50	TLFB; CEOA	A = –.28, –.47 Se = –.30, –.26 So = –.52, –.26 T = –.52 –.38 L = –.19, –.28 C = –.02, .14 R = –.17, –.08 S = –.27, .13	8
Fried & Dunn (2012)	*N* = 209 (124); *A* = 11% 0% F; 79% W *M* age = 20; CS	AO	1	50	TLFB; CEOA	A = –.51 Se = –.42 So = –.41 T = –.36 L = –.32 C = –.01 R = –.11 S = –.24	10
Hunt (2004)	*N* = 158 (104); *A* = 0% 0% F; 64% W *M* age = 21; CS	AO	1	35	AEC; TLFB	A = .07, .01 Se = –.11, –.11	12
Jones et al. (1995)	*N* = 90 (60); *A* = 10% 46% F; 90% W *M* age = 19; CS	AO	2	35	AEQ; QFV	A = .14, .10	7
Keillor et al. (1999)	*N* = 25 (12); *A* = 24% 0% F; 90% W *M* age = 19; CS	AO	2	90	AEQ; ECQ; TLFB	A = .20 E = .22 Se = .17 So = –.19	10
Lau-Barraco & Dunn (2008)	*N* = 178 (114); *A* = 9% 57% F; 87% W *M* age = 20; CS	AO, AE	1	105	TLFB; AEQ	A = –.27 E = –.26 Se = –.23 So = –.56 T = –.24	13

Study	Sample Characteristics	Study Characteristics				Effect Sizes (*g*)	Study Quality
		Control Group(s)	Dose		Measures		
			Sessions	Duration			
Musher-Eizenman & Kulick (2003)	*N* = 37 (19); *A* = 23% 100% F; 95% W *M* age = 19; CS	AO	3	60	AEQ-A; Drinking/Daily Activity chart	A = –.05 E = –.76 Se = –.72 So = –.51 T = –.51 C = –.58	11
Portelli (2018)	*N* = 119 (53); *A* = 32% 48% F; 99% W *M* age = 14; HSS	AO	3	45	TLFB; AEQ-A	A = –.13 So = –.60 T = –.61 C = –.41	11
Schreiner (2010)	*N* = 407 (198); *A* = 49% 70% F; 69% W *M* age = 20; CS	AO	1	55	TLFB; CEOA	A = –.46, .01 Se = –.34, –.09 So = –.53, –.75 T = –.32, –.29 L = –.48, –.27 C = .34, .13 R = –.31, –.13 S = –.01, .05	6
Schreiner (2014)	*N* = 865 (432); *A* = 13% 61% F; 63% W *M* age = 18; CS	AO	1	55	TLFB; CEOA	A = –.02, –.01 Se = –.58 So = –.59 T = –.63 L = –.81 C = .44 R = –.49 S = –.23	10
Sivasithamparam (2008)	*N* = 120 (48); *A* = 5% 68% F; 71% W *M* age = 18; CS	AO	1	50	TLFB; CEOA	A = –.32 Se = .19 So = .06 T = .13 L = .34 C = –.20 R = .19 S = .02	7

Study	Sample Characteristics	Study Characteristics				Effect Sizes (*g*)	Study Quality
		Control Group(s)	Dose		Measures		
			Sessions	Duration			
Sivasithamparam (2011)	*N* = 364 (215); *A* = 76% 51% F; 66% W *M* age = 16; HSS	AO	1	50	TLFB; CEOA	A = –.60, .10 Se = –.25, –.03, –.03, .36 So = –.05, –.49, –.40, .32 T = –.18, –.11, –.42, .12 L = –.20, –.04, –.38, .29 C = .51, .34, .04, –.04 R = –.06, –.08, .17, –.05 S = .38, –.08, –.30, –.03	10
Stanick (1996)	*N* = 56 (28); *A* = 5% 100% F; 97% W *M* age = 20; CS	AO	2	60	AEQ; ECQ; TLFB	A = .26 E = .11	8
van de Luitgaarden et al. (2007)	*N* = 234 (163); *A* = 22% 0% F; 100% W *M* age = 18; CS	AO	1	50	Drinking Diary & Questionnaire; VAS	A = –.08	7
Wiers & Kummeling (2004)	*N* = 25 (16); *A* = 55% 56% F; 100% W *M* age = 21; CS	AO	3	60	ECQ; VAV; TLFB; Drinking Diary	A = .16, .67 E = –.89, .10	11
Wiers et al. (2005)	*N* = 92 (49); *A* = 4% 50% F; 88% W *M* age = 21; CS	AO	2	60	TLFB; Drinking diary; VAS; IAT	A = –.82 E = –.22 T = –.20	13
Wood et al. (2007)	*N* = 168 (89); *A* = 18% 53% F; 90% W *M* age = 21; CS	AO, BMI	2	90	TLFB; ECQ; CEOA	A = –.61	12
Wooten (1996)	*N* = 52 (25); *A* = 64% 51% F; 62% W *M* age = 14; HSS	AO	4	45	ECQ; AEQ-A; TLFB; DSQ	E = –1.05 T = –.27	6

Note. N = sample size (intervention condition); *A* = attrition; *F* = female; *W* = white; *CS* = sample of college students; *HSS* = sample of high school students; *AO* = assessment only; *AE* = alcohol education; *BMI* = Brief Motivational Intervention (Miller & Rollnick, 2002); *Dose* = total number of sessions and minutes per session; *AEQ* = Alcohol Expectancy Questionnaire (Brown et al., 1987); *TLFB* = Timeline Followback Interview (Sobell & Sobell, 1990); *DDQ* = Daily Drinking Questionnaire (Collins et al., 1985); *MMBEQ* = Memory-Model Based Expectancy Measure (Dunn & Goldman, 1996); *ECQ* = Expectancy Context Questionnaire (Darkes & Goldman, 1993); *AEI* = Alcohol Expectancy Inventory (Rather et al., 1992); *CEOA* = Comprehensive Effects of Alcohol (Fromme et al., 1993); *AEC* = Alcohol Expectancy Circumplex (Rather & Goldman, 1994); *QFV* = Quantity-Frequency-Variability Index (Cahalan et al., 1967); *AEQ-A* = Alcohol Expectancy Questionnaire Adolescent Form (Christiansen et al., 1982); *VAS* = Visual Analogue Scale of Arousal-Sedation Expectancies (Wiers et al., 2002); *VAV* = Vragenlijst Alcohol Verwachtingen (Wiers et al., 1997); *IAT* = Implicit Association Test (Greenwald et al., 1998); *DSQ* = Drinking Styles Questionnaire (Smith et al., 1995); *E* = global expectancies; *Se* = sexual expectancies*; So* = social expectancies; *T* = tension expectancies; *A* = alcohol consumption; *L* = liquid courage expectancies; *C* = cognitive behavioral consequences expectancies; *R* = risk aggression expectancies; *S* = self-perception expectancies; *g* = corrected effect size (for studies with several subgroups, effect sizes per outcome variable for all subgroups are included).

Table S2

Trim-and-Fill Analysis of Publication Bias Per Outcome Variable

Outcome	k_+	g	95% CI		Z	Q
Alcohol Consumption	0	–.20	–.31	–.09	–3.70[c]	36.56
Global Alcohol Expectancies	0	–.35	–.59	–.11	–2.88[b]	7.79
Sexual Expectancies	6	–.39	–.53	–.23	–5.04[c]	46.54[b]
Social Expectancies	1	–.35	–.51	–.17	–3.99[c]	35.82[b]
Tension Expectancies	0	–.30	–.44	–.16	–4.23[c]	26.04
Liquid Courage Expectancies	0	–.20	–.45	.04	–1.61	42.17
Cognitive Consequences	6	.29	.12	.46	3.31[c]	50.80[c]
Risk Aggression Expectancies	7	–.32	–.44	–.19	–4.90[c]	20.15
Self-Perception Expectancies	5	–.20	–.32	–.08	–3.33[c]	20.15

Note. k_+ = number of effect sizes added by the trim-and-fill-analysis; g = weighted mean effect size; *95% CI* = lower and upper limits of the 95% confidence interval*;* Z = test for significance of g; Q = test for homogeneity of effect sizes.

Negative effect sizes reflect changes in the desired direction (i.e., decrease of alcohol consumption and positive alcohol expectancies, and increase of negative expectancies).

[a] $p < .05$, [b] $p < .01$, [c] $p < .001$

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7.2 Curriculum Vitae

Pages 121-122 (CV) contain personal data. They are therefore not part of the online publication.

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7.3 Erklärung

Ich versichere, dass ich meine Dissertation

Health Behaviors Among Adolescents and Emerging Adults –
Expectations and Expectation Violations

Selbständig und ohne unerlaubte Hilfe angefertigt und mich dabei keiner anderen als der von mir ausdrücklich bezeichneten Quellen und Hilfen bedient habe. Die Dissertation wurde in der jetzigen oder einer ähnlichen Form noch bei keiner anderen Hochschule eingereicht und hat noch keinen sonstigen Prüfungszwecken gedient.

Marburg, 9. Mai 2023

Chrys Gesualdo