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ORIGINAL ARTICLE

# Orthorexic eating behaviors related to exercise addiction and internal motivations in a sample of university students

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## Abstract

**Purpose** This research explored the exercise tendencies and motivations of individuals varying in orthorexia symptomatology.
**Method** Participants were 411 university students, who completed the Eating Habits Questionnaire alongside measures of exercise activity and addiction in Study 1 (a modified version of the Leisure-Time Exercise Questionnaire, the Exercise Addiction Inventory, and the Compulsive Exercise Test) and various exercise motivations in Study 2 (the Behavioural Regulations in Exercise Questionnaire and the Exercise Motivations Inventory-2).
**Results** Orthorexia symptomatology was positively correlated with aerobic and strength-training exercise levels; all measures of exercise addiction; all measures of internal exercise motivation; and nearly all measures of exercise motivation for the purposes of psychological, social, health, and body improvement. Symptomatology was not significantly related to either measure that specifically assessed external motivation to exercise.
**Conclusion** Individuals high in orthorexia symptomatology are internally driven to exercise for the purposes of improving their physical and mental health, but these strong motivations also lead to exercise addiction characterized by a compulsive need to follow a rigid schedule of intensive exercise even in the face of injury, illness, or other problems.
**Level of evidence** Level V, descriptive cross-sectional study.

**Keywords** Orthorexia · Exercise activity · Exercise addiction · Exercise motivation

## Introduction

Both a social and political movement, "healthism" dictates that individuals take responsibility for avoiding risk factors that contribute to ill health and for partaking in behaviors that are instrumental for achieving optimal health, especially regular exercise and healthy eating [1–4]. In bioethics, healthism even encompasses the belief that healthy people are more valuable than their non-healthy counterparts, which may promote unacceptable discrimination. Many people have accordingly pursued and benefited from such a healthy lifestyle, decreasing their risk of such life-threatening diseases as cancer and cardiovascular disease [5] and enhancing their mental health and wellbeing [6] according to two thorough research reviews. However, for some, their healthy behaviors progress to extreme degrees and may consequently become unhealthy in the cases of exercise addiction [7–9] or orthorexia nervosa (ON) [10, 11].

### ON, obsessive-compulsiveness, and other eating disorders

ON refers to an obsessive fixation on eating healthy that includes compulsive behavior and accompanying mental preoccupation with restrictive dietary practices for the purpose of achieving optimum health [10, 11]. For individuals suffering from ON, these dietary restrictions usually begin simple (e.g., eliminating gluten) but progressively escalate to the extreme (e.g., eliminating gluten, sugar, non-organic foods, all processed foods, dairy, and so on), and violations of these restrictions give rise to strong feelings of shame and personal impurity. In cases of severe restrictions, malnutrition and related medical complications arise, despite the original intentions to pursue perfect health. Additionally, people suffering from ON may also experience impaired

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social functioning and quality of life as they avoid social gatherings that involve food, socially isolating themselves from family and friends, and experiencing corresponding feelings of depression and anxiety [10, 11].

Past research reveals that ON symptomatology and risk are greatest for people with the predisposing personality characteristics of perfectionism [12, 13] and obsessive–compulsive tendencies [12, 14–19]. These findings make sense when considering that individuals with ON are "obsessed" with maintaining the "perfect" diet [20]. Interestingly, these personality traits are likewise risk factors for other eating disorders including anorexia nervosa-restrictive type and avoidant/restrictive food intake disorder, both of which also involve dietary restrictions that may result in weight loss and nutritional deficiency [21–23]. The differences among these disorders concern the underlying reasoning for the restrictions. According to the American Psychiatric Association's Fifth Edition of the Diagnostic and Statistical Manual, patients with anorexia nervosa-restrictive type restrict their food intake because they have a distorted body image and an intense fear of gaining weight, and patients with avoidant/restrictive food intake disorder restrict their food as a result of underlying medical issues [24]. The latter simply have no appetite; they avoid certain foods based on sensory characteristics such as the smell of foods, typical of those with autism spectrum disorders with heightened sensory sensitivities; or they fear aversive consequences of eating such as vomiting or abdominal pain, typical of those with gastrointestinal disorders and other medical conditions [21, 23, 25, 26]. In contrast, people with ON restrict their diet for the purpose of achieving optimal health [10, 11].

### ON and exercise behavior

Given their obsession with healthy eating, individuals with ON would likely pursue a healthy lifestyle in other domains, namely with respect to exercise. This prediction is supported by the findings from a qualitative study involving focus groups with personal trainers, all of whom also had nutritional advisory roles [27]. Based on their personal experiences and on their experiences with their clients, these personal trainers indicated that excessive exercise is one of the main characteristics of ON, and that people with ON need complete control of (and feel that they cannot deviate from) their strict dietary and exercise plans. Moreover, researchers found that out of a sample of 50 university students who were categorized as having ON, 44 were also classified in the "high" category with the International Physical Activity Questionnaire [28].

Regarding quantitative correlational research, three studies found significant positive correlations between ON symptomatology and frequency of physical activity, as measured by exercise hours per week among fitness center members [29], by exercise sessions per week among fitness center members [30], and by a Likert rating of sport activity (0 = do not engage in any sport … 4 = compete regularly) among university students [31]. Likewise, although the relationships did not reach statistical significance, three additional studies found positive correlations between ON symptomatology and frequency of physical activity, as measured by exercise hours per week among health care professionals involved in nutrition education [32], by exercise hours per week among university students [33], and by exercise sessions per week among university students [34]. Finally, in research investigating group differences, one study found that athletes (who participated in at least three 1.5-h exercise sessions per week for at least 3 years) had significantly greater ON symptomatology than sedentary controls [35]. Unfortunately, most of these studies used single-item measures of overall exercise activity that did not differentiate the type of activity or the presence of compulsive exercise behaviors.

The purpose of the current study is to expand upon this past research by exploring how ON symptomatology, in samples of university students, relates to levels of aerobic and strength-training activities, to exercise addiction and compulsion, and to different exercise motivations. Based on the high-ON individuals' pursuit of perfect health and their obsessive–compulsive personality tendencies, we hypothesized that the obsessions and compulsions associated with the healthy eating in ON would extend to obsessions and compulsions with exercise activities, and that these behaviors would largely be driven by internalized motivations to improve one's health.

## Study 1

### Method

#### Participants

Undergraduate students, who were at least 18 years old, were recruited from psychology courses at Texas State University, including Introduction to Psychology courses that require students complete a research requirement with participation in research studies as one option to fulfill that requirement, as well as other psychology courses for which students may earn a small amount of extra credit in exchange for their participation in research studies or other activities. From this pool of students, 228 (204 women, 24 men) participated in this study. Their ages ranged from 18 to 34 years ($M = 20.31$, $SD = 1.88$). Based on self-reported ethnicity, 38% were Caucasian, 38% were Hispanic or Latino, 14% were African American, 4% were Asian American, 5% were biracial or multiracial, and 1% were of another ethnicity. No data were excluded from the analyses.

### Materials and procedure

This study was approved by the Institutional Review Board of Texas State University. Upon giving informed consent, participants completed an anonymous online survey with a demographic questionnaire, the Eating Habits Questionnaire (EHQ) [18], the Exercise Addiction Inventory (EAI) [36], and the Compulsive Exercise Test (CET) [37].

ON symptomatology was assessed with the EHQ [18], a 21-item measure that includes items about healthy eating behaviors (e.g., "I prepare food in the most healthful way"), the problems associated with healthy eating (e.g., "My healthy eating is a significant source of stress in my relationships"), and feeling positively about healthy eating (e.g., "I feel in control when I eat healthy"). The EHQ has excellent reliability with Cronbach's alpha of 0.90 [13] and test–retest coefficient of 0.78 [18]. The creators of this measure also demonstrated the validity of the EHQ, finding its scores positively correlated with higher levels of both disordered eating behaviors and obsessive–compulsive tendencies, consistent with past research that found these same correlations but with a different measure of ON symptomatology [12, 14–17, 19, 35, 38, 39].

Aerobic exercise activity was assessed with two items asking for the estimated number of hours spent during a typical 7-day period on "strenuous aerobic exercises with the heart beating very rapidly (e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)" and on "moderate aerobic exercises with the heart beating fast but not exhausting (e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)." These two items were added for a composite score representing aerobic exercise activity. Note that these items are modified versions of the items from the widely used Godin Leisure-Time Exercise Questionnaire [40]. Whereas the latter measure asks for how many times the participant does these two activities for more than 15 min during a typical 7-day period, the current study asked for how many total hours the participant spends on these activities during that same period. This modification was made for the purpose of assessing extreme amounts of exercise that may be associated with exercise addiction. For example, a "healthy" exerciser may complete five 30-min aerobic sessions per week (5 on Godin measure; 2.5 total hours), whereas an "addicted" exerciser may complete five 3-h aerobic sessions per week (5 on Godin measure; 15 total hours).

Strength-training exercise activity was assessed with an item asking for the estimated number of hours spent during a typical 7-day period on "weight-training exercises (e.g., using weight machines, manipulating free weights like barbells or kettlebells, manipulating your own weight as in push-ups or chin-ups)."

Exercise addiction was assessed with the EAI [36] and two subscales of the CET [37]. The EAI includes six items assessing exercise addiction behavior and risk (e.g., "Exercise is the most important thing in my life"). The EAI has excellent reliability and validity, having Cronbach's alpha of 0.84 and being strongly correlated with two other measures of exercise addiction: the Obligatory Exercise Questionnaire [41] and the Exercise Dependence Scale [42]. The CET Rule-Driven Behavior subscale includes eight items assessing the compulsive need to exercise (e.g., "I feel extremely guilty if I miss an exercise session"), and the CET Exercise Rigidity subscale includes three items assessing the compulsive need to structure exercise activities (e.g., "I follow a set routine for my exercise sessions (e.g., walk or run the same route, particular exercises, same amount of time, and so on)"). These CET subscales have good reliability and validity, having Cronbach's alphas of 0.88 and 0.73, respectively, and being strongly correlated with the Commitment to Exercise Scale [43] ($r = 0.70$ and 0.51, respectively).

### Statistical analyses

Pearson correlation analyses were used to assess the relationships between EHQ and the following exercise variables: aerobic exercise (hours per week), strength-training exercise (hours per week), EAI score, CET Rule-Driven Behavior score, and CET Exercise Rigidity score. These analyses were conducted on the data for all participants combined, and then separately for women and men for informational purposes, given the gender norms of emphasizing a thin body shape (that may partly be achieved through aerobic exercises) in women and a muscular build (that may partly be achieved through strength-training exercises) in men.

## Results and discussion

As shown in Table 1, the correlation analyses revealed significant positive relationships ($p < .05$) between EHQ score and all exercise variables: aerobic exercise, strength-training exercise, EAI score, CET rule-driven behavior score, and CET exercise rigidity score. Additionally, with one exception, all of these relationships were significant for women and men when analyzed separately. The exception was that for men, EHQ was not significantly correlated with aerobic exercise ($r = 0.08$). This and the following finding are consistent with the aforementioned gender norms: higher EHQ scores were related to relatively greater strength-training exercise in men ($r = 0.63$) than in women ($r = 0.37$).

The results from Study 1 reveal positive correlations between obsessions with healthy eating and obsessions with exercise activity, whereby higher scores on ON

**Table 1** Correlation coefficients for relationships between orthorexia (EHQ score) and exercise activities and addiction

| | All ($n=228$) | Women ($n=204$) | Men ($n=24$) |
|---|---|---|---|
| Aerobic exercise | 0.22*** | 0.27*** | 0.08 |
| Strength training | 0.41*** | 0.37*** | 0.63*** |
| EAI | 0.37*** | 0.35*** | 0.46* |
| CET rule driven | 0.41*** | 0.41*** | 0.40* |
| CET exercise rigidity | 0.42*** | 0.41*** | 0.55** |

*$p<.05$

**$p<.01$

***$p<.001$

symptomatology are associated with greater time spent on both aerobic and strength-training exercises, as well as higher scores on measures of exercise addiction and compulsion. Study 2 explored the relationships between ON symptomatology and different types of motivations to exercise.

## Study 2

### Method

#### Participants

As done for Study 1, undergraduate students, who were at least 18 years old, were recruited from psychology courses at Texas State University. From this pool of students, 183 (156 women, 27 men) participated in this study. Their ages ranged from 18 to 52 years ($M=22.19$, $SD=4.66$). Based on self-reported ethnicity, 36% were Caucasian, 39% were Hispanic or Latino, 14% were African American, 3% were Asian American, 7% were biracial or multiracial, and 1% were of another ethnicity. No data were excluded from the analyses.

#### Materials and procedure

This study was approved by the Institutional Review Board of Texas State University. Upon giving informed consent, participants completed an anonymous online survey with a demographic questionnaire, the EHQ [18] that was also used in Study 1, the Behavioural Regulations in Exercise Questionnaire (BREQ) [44], and the Exercise Motivations Inventory-2 (EMI-2) [45].

The BREQ [44] is a 15-item measure that provides scores on four subscales: External Regulation (four items; e.g., "I exercise because other people say I should"), Introjected Regulation (three items; e.g., "I feel guilty when I don't exercise"), Identified Regulation (four items; e.g., "I value the benefits of exercise"), and Intrinsic Regulation (four items; e.g., "I exercise because it's fun"). These subscales have good reliability with Cronbach's alpha values ranging from 0.76 to 0.90 for the different subscales [44], and later research [46] supported the measure's validity by showing that the relationships between these subscales and the psychological needs satisfaction variables are consistent with self-determination theory [47].

The EMI-2 [45] is a 51-item measure that provides scores on 14 subscales. Four subscales concern motivation to exercise for the purpose of psychological improvement: Stress Management (four items; e.g., "to reduce tension"), Revitalization (three items; e.g., "because I find exercise invigorating"), Enjoyment (four items; e.g., "because I find exercise satisfying"), and Challenge (four items; e.g., "to give me personal challenges to face"). Three subscales concern motivation to exercise for the purpose of social improvement: Affiliation (four items; e.g., "to spend time with friends"), Competition (four items; e.g., "because I enjoy physical competition"), and Social Recognition (four items; e.g., "to show my worth to others"). Three subscales concern motivation to exercise for the purpose of health improvement: Health Pressures (three items; e.g., "because my doctor told me to exercise"), Ill-Health Avoidance (three items; e.g., "to prevent health problems"), and Positive Health (three items; e.g., "to maintain good health"). Finally, four subscales concern motivation to exercise for the purpose of body improvement: Weight Management (four items; e.g., "to lose weight"), Appearance (four items; e.g., "to look more attractive"), Strength and Endurance (four items; e.g., "to build up my strength"), and Nimbleness (three items; e.g., "to stay/become more agile"). These subscales have good reliability with a mean Cronbach's alpha of 0.87; all values exceeded 0.82 with the exception of 0.69 for the Health Pressures subscale [45].

#### Statistical analyses

Pearson correlation analyses were used to assess the relationships between EHQ and the following exercise motivation variables: the four subscales from the BREQ and the 14 subscales from the EMI-2. As done for Study 1, these analyses were conducted on the data for all participants combined, and then separately for women and men for informational purposes.

### Results and discussion

As shown in Table 2, the correlation analyses revealed significant positive relationships ($p<.05$) between EHQ score and all forms of internal motivation to exercise (BREQ Intrinsic, BREQ Identified, and BREQ Introjected subscales), all forms of psychological-improvement motivations

**Table 2** Correlation coefficients for relationships between orthorexia (EHQ score) and different motivations to exercise

| | All ($n=183$) | Women ($n=156$) | Men ($n=27$) |
|---|---|---|---|
| BREQ: external vs. internal motivation | | | |
| External regulation | 0.08 | 0.14 | −0.22 |
| Introjected regulation | 0.36*** | 0.40*** | 0.16 |
| Identified regulation | 0.53*** | 0.51*** | 0.67*** |
| Intrinsic regulation | 0.44*** | 0.44*** | 0.38* |
| EMI-2: motivation for psychological improvement | | | |
| Stress management | 0.32*** | 0.29*** | 0.53** |
| Revitalization | 0.38*** | 0.36*** | 0.51** |
| Enjoyment | 0.41*** | 0.40*** | 0.44* |
| Challenge | 0.41*** | 0.40*** | 0.43* |
| EMI-2: motivation for social improvement | | | |
| Social recognition | 0.31*** | 0.29*** | 0.25 |
| Affiliation | 0.18* | 0.17* | 0.15 |
| Competition | 0.28*** | 0.28*** | 0.11 |
| EMI-2: motivation for health improvement | | | |
| Health pressures | 0.14 | 0.10 | 0.35 |
| Ill-health avoidance | 0.22** | 0.20* | 0.43* |
| Positive health | 0.37*** | 0.34*** | 0.60*** |
| EMI-2: motivation for body improvement | | | |
| Weight management | 0.08 | 0.17* | −0.13 |
| Appearance | 0.25*** | 0.25** | 0.37 |
| Strength and endurance | 0.26*** | 0.22** | 0.45* |
| Nimbleness | 0.26*** | 0.25** | 0.40* |

*$p<.05$
**$p<.01$
***$p<.001$

(EMI-2 Stress Management, EMI-2 Revitalization, EMI-2 Enjoyment, and EMI-2 Challenge subscales), all forms of social-improvement motivations (EMI-2 Social Recognition, EMI-2 Affiliation, and EMI-2 Competition subscales), three forms of body improvement motivations (EMI-2 Strength and Endurance, EMI-2 Nimbleness, and EMI-2 Physical Appearance subscales), and two forms of health-improvement motivations (EMI-2 Ill-Health Avoidance and EMI-2 Positive Health subscales). EHQ score was not significantly related to external motivation (BREQ Extrinsic subscale and EMI-2 Health Pressures subscale) or to the EMI-2 Weight Management subscale.

When the data for women were analyzed separately, the one exception to the results above was that EHQ score was significantly correlated with the EMI-2 Weight Management subscale, consistent with gender norms emphasizing thinness in women. When the data for men were analyzed separately, five exceptions to the results above were found. With men, EHQ score was not significantly correlated with the BREQ Introjected subscale, the EMI-2 Appearance subscale, or any form of social-improvement motivations (EMI-2 Social Recognition, EMI-2 Affiliation, and EMI-2 Competition subscales). As noted below, however, the small sample size of male participants may not offer adequate power to detect these relationships that may possibly exist in the greater population.

## General discussion

### Explanation and implications of findings

This research investigated how ON symptomatology, in samples of university students, relates to exercise activity levels, to exercise addiction and compulsion, and to different exercise motivations. Regarding exercise levels, as hypothesized, greater ON symptomatology was associated with more time spent on both aerobic and strength-training exercises, although the correlation with aerobic exercise was relatively weak in magnitude ($r=0.22$). This finding is consistent with past research that found ON risk to be positively related to exercise and sport activity [27–31, 35]. Also, the ON relationship with strength-training exercises was stronger for men, whereas the ON relationship with aerobic exercises was significant for women but not for men. These findings support the gender ideologies concerning health that are portrayed in the media, such that men's health magazines present images of very muscular models [48], and this muscularity is promoted more in men's than women's health magazines [49]. In contrast, women's health magazines present images of very thin models [50], and this thinness is promoted more in women's than men's health magazines [49].

Regarding exercise addiction, as hypothesized, greater ON symptomatology was associated with greater levels of exercise addiction and compulsion, which is consistent with the results of one other study finding a significant relationship between ON and exercise addiction in a sample of fitness center members in Germany [29]. Considering the positive relationship between ON risk and general obsessive–compulsive tendencies [12, 14–19], the obsessions with healthy eating that are associated with ON would logically extend to obsessions with exercise. Moreover, high-ON individuals possess strong degrees of perfectionism [12, 13], which is a risk factor for exercise addiction [51]. It is worth noting that exercise addiction is likewise characteristic of patients with both anorexia and bulimia [52]. The previously mentioned shared personality characteristics of perfectionism and obsessive–compulsive tendencies may contribute to this association. However, the ultimate exercise goals vary

across the different eating disorders: weight loss or prevention of weight gain drives the exercise behaviors of those with anorexia and bulimia, whereas optimal health drives the exercise behaviors of those with ON.

Regarding exercise motivations, as hypothesized, greater ON symptomatology was associated with greater levels of all forms of internal exercise motivation: introjected regulation (i.e., exercising because of internal pressures to exercise and guilt over missed sessions), identified regulation (i.e., exercising because the person values the benefits of exercise), and intrinsic regulation (i.e., exercising because the person naturally enjoys exercise activities). Symptomatology was not related to external motivations (i.e., exercising because other people, including doctors and loved ones, told the person to do so). These findings are consistent with past research that found risk for exercise addiction to be greatest for people who are internally rather than externally motivated to exercise [53]. Interestingly, of the 18 motivation variables assessed, identified regulation exhibited the strongest association with ON symptomatology, such that individuals with higher levels of ON symptomatology are more motivated to exercise to reap the benefits of exercise.

As to which types of benefits are deemed important, the current research found that greater ON symptomatology was associated with greater levels of motivation for the purpose of improvements in physical health (i.e., exercising to achieve positive health and avoid ill health), in fitness that is relevant to physical health (i.e., exercising to achieve strength, endurance, nimbleness, and low body fat), in psychological health (i.e., exercising for stress management, revitalization, enjoyment, and challenge), and in social relationships (i.e., exercising to spend time with others, compete, and be recognized for accomplishments with exercise). Given that high-ON individuals' eating habits are guided by the goal of achieving optimal physical health [10, 11], it makes sense that this same goal would guide their exercising habits. Unrelated, the ON relationships with social motivations to exercise are consistent with past research that found ON symptomatology to be positively correlated with both perfectionism and narcissism [13], such that high-ON individuals feel the need to compete and be superior to others, not only with their eating habits but also with their exercise behaviors.

### Limitations and directions for future research

Further research is needed to explore the psychological-improvement motivations associated with ON symptomatology. Does the pursuit of optimal physical health extend to the pursuit of optimal psychological health? Beyond exercise, a healthy diet also offers a variety of positive psychological health effects, including but not limited to a lower incidence of depression and anxiety [54, 55] and improved cognitive function [56, 57]. Future studies should investigate whether the eating habits (including supplement use) of high-ON individuals are guided at least partially by the goal of improving psychological health, and whether high-ON individuals partake in other behaviors that enhance psychological health besides their eating and exercise behaviors, such as mindfulness meditation that is likewise effective at reducing depression and anxiety [58, 59] and at improving cognition [60, 61].

Future research should also replicate the current studies to overcome their limitations, particularly concerning the convenience samples that were used. The current research was conducted only with undergraduate students at a single university in the southern United States. Although this university is ethnically diverse, the samples may not account for existing regional variations, such as trends that contribute to differing rates of obesity in different geographical areas. Furthermore, men were underrepresented in the current research, with only 24 men in Study 1 and 27 men in Study 2. Additionally, athletes were not excluded from our samples of university students. Future research should investigate ON and exercise addiction separately for competitive athletes, given that excessive exercise and micromanaging nutrients are essential components of their training regimes. Finally, future research should investigate the ON-exercise relationships across a greater age range that includes adolescents who are starting to experience increasing peer and media pressures to have the perfect body, as well as older adults who are starting either to experience declines in physical health or to seriously think about and fear their own mortality.

## Conclusions

In spite of the aforementioned limitations, the current research provides valuable insight into the relationships between ON and exercise behaviors of university students. Namely, the results of this research show that greater obsessions about healthy eating, a trait of ON, are indeed associated with greater exercise activities and obsessions, including time and devotion to both aerobic and strength-training exercises, as well as a compulsive need to follow a rigid schedule of regular exercise even in the face of injury, illness, or other problems. Healthcare professionals, including nutrition and mental health counselors, need to be aware that ON is associated with exercise addiction. In cases of recovery from ON, if patients feel that they are losing control of their eating behaviors during treatment, they may try to compensate through even greater levels of excessive exercise activities. Although internally motivated by the goal of achieving perfect physical and mental health, such extreme

behaviors may have the opposite effect, resulting in injury or illness.

## Compliance with ethical standards

**Conflict of interest** The authors declare no conflict of interest.

**Ethical approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed consent** Informed consent was obtained from all individual participants included in the studies.

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