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Stéphanie Scoffier-Mériaux, Y Paquet, K. Corrion, F d'Arripe-Longueville

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French Development and Validation of the Self-Regulatory Eating Attitude in Sports Scale (SREASS)

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Running head: Self-Regulatory Eating Attitude in Sport

French Development and Validation of the Self-Regulatory Eating Attitude in Sports Scale
(SREASS)

S. Scoffier

11

Y. Paquet

Université de Nice Sophia Antipolis,

12

Laboratoire de Psychologie Appliquée

261 Route de Grenoble, BP 3259

13

EA 4298, Université de Reims

06205 Nice cedex 03, France

14

57 rue Pierre Taittinger

15

51096 Reims cedex, France

K. Corrion & F. d'Arripe-Longueville

Université de Nice Sophia Antipolis

261 Route de Grenoble, BP 3259

06205 Nice cedex 03, France

Corresponding author:

Stéphanie Scoffier

UFR STAPS – Université de Nice Sophia-Antipolis

261 Route de Grenoble, BP 3259

06205 Nice cedex 03, France

Phone: + 33 492 296 529

Fax: + 33 492 296 537

Email: scoffier@unice.fr

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3 1 French Development and Validation of the Self-Regulatory Eating Attitude in Sports Scale
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6 (SREASS)
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10 4
11 Abstract

12
13 5 In this study, the French Self-Regulatory Eating Attitude in Sports Scale (SREASS)
14
15 6 was developed and then validated. Five subscales measure the control of eating attitude in
16
17 7 contexts of: (a) food temptation, (b) negative affects, (c) social interaction, (d) lack of
18
19 8 compensatory strategy, and (e) lack of anticipation of consequences on performance. The
20
21 9 validation procedure required the participation of 527 student athletes and four successive
22
23 10 studies to develop and present a preliminary scale and assess the clarity of the items (study 1),
24
25 11 evaluate the factorial structure validity of the scale and test the invariance across gender
26
27 12 (study 2), assess the time stability (study 3), and assess the external validity of the instrument
28
29 13 (study 4). The present results provide preliminary evidence for the appropriateness of the
30
31 14 SREASS for French student athletes. Nevertheless, further evaluation of this instrument is
32
33 15 warranted to establish the robustness of the present findings.
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17 *Keywords:* self-regulation, eating disorders, sports, validation.

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3 1 French Development and Validation of the Self-Regulatory Eating Attitude in Sports Scale
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6 2 (SREASS)
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10 4 Introduction
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12 5 The concept of self-regulation has been explored in many fields of study. In social
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14 6 psychology, self-regulation refers to the capacity to control one's behavior or perform an
15
16 7 activity (Bandura, 1977; Bandura, 1982; Bandura, 1986; Bandura, 1997). This capacity is
17
18 8 thought to develop through the interplay of influences between an individual and his or her
19
20 9 social environment and implies personal standards and social and moral levels. Bandura
21
22 10 (1997) theorized that several factors determine individual self-regulation. The feeling of self-
23
24 11 efficacy particularly affects self-regulation. Self-efficacy can be defined as the individual's
25
26 12 conviction of being capable of organizing and carrying out the actions needed to accomplish a
27
28 13 task. McAuley (1992) and Dawson, Gyurcsik, Culos-Reed and Brawley (2001) reviewed the
29
30 14 psychosocial variables affected by self-regulation. They reported that self-regulation
31
32 15 influenced goal choices, activities, and persistence in the face of challenges and obstacles
33
34 16 (Bandura, 1986; Locke & Latham, 1990) and health-related behaviors. For example, self-
35
36 17 regulation was identified by Pehacek and Danaher (1979) as a predictor of smoking cessation
37
38 18 without relapse. It has also been linked to exercise and physical activities (Desharnais,
39
40 19 Bouillon & Godin, 1986; McAuley, 1992; McAuley & Mihalko, 1998), as well as weight loss
41
42 20 and nutrition (see Herman & Polivy, 2004, for a review). Because eating is essential for life,
43
44 21 it is considered to be particularly regulated (Herman & Polivi, 2004). The literature on social
45
46 22 cognitive theory (Bandura, 1982), the theory of reasoned action (Fishbein & Ajzein, 1975)
47
48 23 and the health belief model (Rosenstock, 1974) all indicate the influence of self-regulation
49
50 24 and self-regulatory efficacy, among numerous other factors, on eating attitudes. This
51
52 25 influence was corroborated by many of the studies cited in AbuSabha and Achterberg's

1 review of the literature (1997). For example, the capacity for self-regulation affects students'
2 control of fruit and vegetable consumption (Baranowski, Perry & Parcel, 1997).

3 Another important predictor of eating attitude is locus of control (AbuSabha &
4 Achterberg, 1997). The theory of locus of control refers to where individuals expect control
5 over events to be located; that is, whether they believe they are themselves the source of the
6 control of reinforcement (Rotter, 1966; 1975). Several studies (e.g., Caggiula & Watson,
7 1992; Saturnino-Springer & Bogue, 1994) examined the respective relationships among
8 eating or weight-control behaviors, the locus of control in health-related behaviors, and the
9 self-regulation of eating attitude. Although the conclusions are diverse because of differences
10 in the study variables, contexts and subjects, some authors (e.g., Bandura, 1977; 1997) saw
11 the link between locus of control and self-regulation as evident. Bandura assumed that an
12 external locus of control (by luck or the influence of a significant other) would diminish self-
13 regulation.

14 The literature indicates two principal tools to measure the capacity for self-regulation
15 of eating attitudes: the *Eating Self-Efficacy Scale* (ESES) of Glynn and Ruderman (1986),
16 which is composed of 25 items loaded on two factors: negative affects and socially acceptable
17 circumstances, and the *Eating Disorder Recovery Self-Efficacy Questionnaire* (EDRSQ) of
18 Pinto and colleagues (Pinto, Guarda, Heinberg, & DiClemente, 2006; Pinto, Heinberg,
19 Coughlin, Fava, & Guarda, 2008), which is composed of 23 items loaded on two factors:
20 normative self-regulation of eating attitude and the feeling of self-efficacy concerning self-
21 image. Both tools have certain limits. They measure the self-regulation of eating behavior but
22 only take into account two factors, which seem to overlook the richness of Bandura's
23 conception (1986; 1997). Also, these tools were developed to measure the self-regulation of
24 eating attitude in daily living contexts and only exist in English. Moreover, the EDRSQ is
25 specifically designed for individuals with eating disorders, like anorexia and bulimia nervosa,

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3 1 and does not really pertain to those with subclinical pathology or those at elevated risk.
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5 2 Finally, these tools have never been adapted for athletes.
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8 3 Indeed, thinness is assumed to confer a competitive advantage in certain sports and the
9
10 4 risk of developing eating disorders is higher in them (Petrie & Greenleaf, 2007): this is
11
12 5 particularly so in sports (a) in which low body weight contributes to speed and movement
13
14 6 efficiency (e.g., ski jumping, marathons, endurance races), (b) with weight categories
15
16 7 (e.g., judo, taekwondo), and (c) with aesthetic criteria requiring a high level of self-knowledge
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18 8 and a specific morphology (e.g., artistic ice-skating, gymnastics) (Reels & Gill, 1996;
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20 9 Smolak, Murnen & Ruble, 2000; Sherman & Thompson, 2009; Sundgot-Borgen & Torstveit,
21
22 10 2004). Athletes are under high pressure from the sport achievement context itself. Some must
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24 11 conform to an ideal body weight in order to achieve an aesthetically pleasing appearance,
25
26 12 whereas others need to maintain low body weight or remain in a specific weight category in
27
28 13 order to attain performance excellence; hence, weight in both cases may be essential to
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30 14 success (Sherman & Thompson, 2009).
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36 15 The sports context is moreover characterized by specific socialization agents like the
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38 16 coach (Sundgot & Borgen, 1994) and norms of excellence and accomplishment not found in
39
40 17 ordinary life (Beals & Malnore, 1995; Sherman & Thompson, 2009; Scoffier, Maïano &
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42 18 d'Arripe-Longueville, *in press*). The tools generally used in sports psychology studies are (a)
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44 19 the *Eating Attitude Test* of Garner, Olmsted, Bohr and Garfinkel (1982), which measures the
45
46 20 attitudes and behaviors associated with eating disorders and was validated by Leichner,
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48 21 Steiger, Puentes-Neuman, Perreault and Gottheil (1994) in a population of French-speakers,
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50 22 and (b) the *Eating Disorder Inventory* of Garner Olmsted and Polivy (1983), which assesses
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52 23 disturbances in eating behavior. No instrument to our knowledge, however, measures the self-
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54 24 regulation of eating attitude in athletes. Given the particularly high stakes and intense social
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56 25 pressures of this context, instruments developed for daily living seem limited, and a validated
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3 1 tool for athletes seems needed to better understand the eating disorders in this population and
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6 2 to develop effective strategies for prevention.

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8 3 The aim of this study was to develop and validate in French a scale to measure the
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10 4 self-regulation of eating attitude in sports: the *Self-Regulation of Eating Attitude in Sports*
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12 5 *Scale* (SREASS). Four complementary studies were required to follow Vallerand's
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14 6 transcultural validation procedure (1989) and the contemporary invariance measurement
15
16 7 literature (e.g., Gregorich, 2006). Validity was successively assessed by exploratory factor
17
18 8 analysis during the development of the preliminary version (study 1) and by confirmatory
19
20 9 factor analysis and partial invariance testing across gender (study 2). The reliability of the
21
22 10 scale was assessed by examining the internal consistency of the scales and the stability over
23
24 11 time (study 3). Last, construct validity of the concept of self-regulation of eating attitude in
25
26 12 sports was tested with external variables: locus of control and eating attitudes (study 4).

13 Method

14 Overview

15 Validity was successively assessed by exploratory factor analysis during the development
16 of the preliminary version (study 1) and by confirmatory factor analysis and partial invariance
17 testing across gender (study 2). The reliability of the scale was assessed by examining the
18 internal consistency of the scales and the stability over time (study 3). Last, construct validity
19 of the concept of self-regulation of eating attitude in sports was tested with external variables:
20 locus of control and eating attitudes (study 4).

21 A total sample of 527 French voluntary student athletes, 285 males and 242 females
22 ($M_{age} = 22.12$ years; $SD = 3.70$ years), enrolled in a University of Sports Sciences, took part
23 in the study. This population of athletes practiced regularly ($M = 5.78$ hours per week, SD
24 $= 3.45$) and had an average of seven years of experience ($M = 7.35$; $SD = 1.80$) in their sport.
25 The student athletes practiced three sport types: individual sport ($N = 204$), combat sport ($N =$

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3 1 133), and collective sport ($N = 190$). The participants were all French and the majority was
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5 2 Caucasian. They completed the questionnaires on-line, at home. They chose the most
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7 3 convenient moment and completion did not take more than 10 minutes. They were informed
8
9 4 beforehand that they were not obligated to respond and that their anonymity would be
10
11 5 respected. They were also informed that this was not a test (i.e., there were no right and
12
13 6 wrong answers) and that all responses would remain strictly confidential and only serve
14
15 7 research purposes. Consent was obtained from all athletes prior to performing the study.
16
17 8 Because human subjects were involved in our study, the ethics committee of the University
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19 9 scientific board was consulted and approved our methods. Four studies were carried out to
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21 10 validate the SREASS, according to Vallerand's (1989) procedure.
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26 27 11 *Study 1: Development of a Preliminary Version of the SREASS*

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29 12 *Participants.* In the first study, which aimed at developing a preliminary version of the
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31 13 SREASS in French, the sample was composed of 20 student volunteers for the clarity
32
33 14 analyses and 160 student volunteers who regularly practiced sports: 75 males and 85 females
34
35 15 between 18 and 25 years old ($M_{age} = 23.00$ years; $SD = 6.47$ years).
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39 16 *Procedure.* A committee of experts (i.e., researchers in the field of social psychology
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41 17 applied to sport) was asked to generate a series of items to evaluate self-regulation of eating
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43 18 attitude in sport by referring to the literature. The major sources were Petrie and Greenleaf's
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45 19 review of the literature (2007) on the factors influencing eating disorders in sport and the
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47 20 ESES of Glynn and Ruderman (1986) and the EDRSQ of Pinto et al. (2006; 2008), which
48
49 21 both contain items to measure the self-regulation of eating attitude in daily living. Finally,
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51 22 semi-directive interviews were held with high-level athletes, who reported their perceptions
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53 23 concerning the typical contexts and situations that influence their capacity for regulating
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55 24 eating attitude (Marsollier, 2007). The participants responded on 6-point Likert-type scales,
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57 25 ranging from (1) "not at all capable" to (6) "completely capable".
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6 2*Study 2: Factorial Structure of the SREASS*

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8 3 *Participants and procedure.* In the second study, the objective was to confirm the
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10 4 factor structure of the instrument developed in the first study in a different population using
11
12 5 confirmatory factor analysis (CFA) and to test the invariance of the factorial structure. The
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14 6 population consisted of 181 student volunteers ($M_{age} = 23.50$ years; $SD = 3.42$ years) with 98
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16 7 males and 83 females. The questionnaires were completed either at the beginning or the end
17
18 8 of sessions, depending on the student's availability. Questionnaire completion was carried out
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20 9 under standardized conditions (i.e., isolation, paper, pencil, and prohibition to communicate)
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22 10 and did not exceed more than 10 minutes.
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27 11 *Data analyses:* We conducted several analyses in this study. First, we performed CFA
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29 12 on the SREASS with AMOS 7.0 software (Arbuckle, 2006). Second, we analyzed the
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31 13 invariance across gender. Measure invariance was assumed if the items had the same meaning
32
33 14 for all members of the population. To account for differences in the groups (i.e., gender), or
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35 15 patterns in the relationships among variables, we used the multi-group comparison technique
36
37 16 of AMOS 7.0, which consisted of testing the factorial invariance across several groups. To do
38
39 17 so, certain aspects of the factorial structure of these models needed to be constrained; that is,
40
41 18 maintained invariant. Factorial invariance tests through gender categories were performed on
42
43 19 the best CFA model and in the sequential order recommended by Gregorich (2006): (a)
44
45 20 *dimensional* (i.e., no invariance), (b) *metric* (i.e., equal loadings), (c) *strong* (i.e., equal
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47 21 intercepts), and (d) *strict* (i.e., equal uniquenesses).
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Study 3: Temporal Stability of the SREASS

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55 23 *Participants and procedure.* The third study was designed to test the reliability of the
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57 24 instrument over time and the internal consistency of the two subscales. The population
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1 consisted of 102 voluntary student athletes ($M_{age} = 20.45$ years; $SD = 1.46$ years) with 60
2 males and 42 females, who completed the questionnaire twice with a four-week interval.

3 *Study 4: External Validity of the SREASS*

4 *Participants and procedure.* The fourth study tested the external validity of the
5 SREASS by linking locus of control to eating attitudes. The sample was composed of 84
6 voluntary students ($M_{age} = 21.54$ years; $SD = 3.47$ years) with 32 females and 52 males
7 practicing individual sport. The participants were invited to complete a series of three
8 questionnaires after their training session in a private room.

9 *Measures.* In the fourth study, many questionnaires were used:

10 *Self-regulation of eating attitude in sports scale.* Self-regulation of eating attitude was
11 measured using the SREASS developed in studies 1, 2 and 3, and resulted in a 16-item scale.
12 The internal consistency of each of the subscales was acceptable ($\alpha > .70$).

13 *Locus of control scale specific to athletes' eating behaviors.* This scale was adapted from the
14 French version of the Multidimensional Health Locus of Control Scale (MHLCS) (Wallston,
15 Wallston & DeVellis, 1978), with four modified dimensions to distinguish between Favorable
16 Others and Unfavorable Others based on the work of Paquet, Berjot and Gillet (*in press*). The
17 former refers to the coach and sports friends, and the latter refers to family members (Scoffier
18 et al., *in press*). This adapted scale is composed of 20 items with Cronbach alphas ranging
19 from .59 to .75 for each dimension. The internal consistency of the scale factors is acceptable
20 and similar to the values for other scales of locus of control, like the French validation of the
21 Levenson scale (Rossier, Rigozzi & Berthoud, 2002).

22 *Eating attitudes.* The attitudes and behaviors associated with eating disorders were measured
23 with the French version of the Eating Attitude Test (EAT) of Garner et al. (1982), with 26
24 items on three subscales: (a) eating restriction (e.g., "I'm terrified at the thought of being too
25 fat"), (b) bulimia and food obsession (e.g., "I worry too much about food"), and (c) control of

1 eating (e.g., “I avoid eating when I’m hungry”). For each item the participant had to answer
2 on a 6-point Likert-type scale from “not at all true” (1) to “very true” (6). In line with other
3 works (e.g., Petrie & Greenleaf, 2007), a global index of eating attitudes and behaviors was
4 used. The internal consistency of these subscales was satisfactory ($.75 < \alpha > .90$).

5 *Analyses.* Pearson correlation coefficients were calculated for all subscales of the three
6 scales examined in this study.

7 Results

8 *Study 1: Development of a Preliminary Version of the SREASS*

9 Initially, the experts developed a pool of 25 items intended to measure self-regulation
10 of eating attitudes in sport. Some items were developed by adapting items from the existent
11 scale to the sports context. Other items were developed after analysis of qualitative interviews
12 and additional consultation with sports psychologists, team coaches, and athletes. The expert
13 committee finally retained 20 items (i.e., 4 items per subscale), with three items inverted.

14 In the second step, the clarity of the preliminary version of the SREASS, with 20
15 items, was assessed by 10 students ($M = 20.00$ years; $SD = 2.65$ years). They were asked to
16 evaluate the clarity of each item on a 6-point Likert-type scale from (1) “not at all clear” to (6)
17 “completely clear”. The minimum and maximum scores possible were 1 and 6 and all
18 possibilities were used by participants. They were encouraged during individual qualitative
19 interviews to justify the points they attributed to each item. Following these interviews,
20 modifications were then made to two items. Clarity was again assessed by another 10 students
21 and satisfactory scores were obtained for the clarity of each of the subscales (i.e., $M > 4.00$;
22 $SD < 1.50$).

23 The factorial structure was examined by principal-axis factor analysis (*Oblimin-type*
24 rotation). In order to extract the most appropriate factors, parallel analysis (Horn, 1965) was
25 used. In the random distribution, values lower than the factor weights were shown for the first

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3 1 five factors only [i.e., factor 1 (random value) = 1.64, (ACP value) = 4.85; factor 2 (random
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5 2 value) = 1.52, (ACP value) = 3.61; factor 3 (random value) = 1.43, (ACP value) = 2.47; factor
6
7 3 4 (random value) = 1.35, (ACP value) = 1.77; factor 5 (random value) = 1.29, (ACP value) =
8
9 4 1.32]. This extraction method revealed five factors without constraint to the model. Next, the
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11 5 five-factor model was examined by factor analysis without additional constraint. The
12
13 6 following items were not retained: items showing saturation coefficients above .40 on two
14
15 7 factors simultaneously, those whose saturation coefficients did not reach this value on either
16
17 8 of two factors, and those that did not saturate on a single factor that loaded most of the items
18
19 9 with similar semantic contents (Guttman, 1954). These criteria were used to select the 16
20
21 10 items presented in Table 1 and included two inversed items (items 2 and 9). Each of these
22
23 11 retained items saturated with a weight greater than .65 on the expected factor and with a
24
25 12 weight lower than .35 on the other factor.

26
27 13 The items were loaded onto five factors pertaining to the self-regulation of eating
28
29 14 attitude in the following contexts: (a) food temptation (i.e., Do you feel capable of controlling
30
31 15 what you eat when your favorite food is set before you?); (b) negative affects (e.g., Do you
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33 16 feel capable of controlling what you eat when you are irritable?); (c) social interaction (e.g.,
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35 17 Do you feel capable of eating a normal amount of food when you have a meal with your
36
37 18 parents?); (d) lack of compensatory strategies (e.g., Do you feel capable of making yourself
38
39 19 vomit if you've just eaten cake at a birthday celebration?); and (e) lack of anticipation of
40
41 20 consequences on performance (e.g., Do you feel capable of eating dessert without thinking
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43 21 about the consequences it may have on the next competition?). Next, the number of items for
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45 22 each of these five factors was extended so that we could select the most pertinent
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47 23 formulations in the next step.

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49 24 Factor 1 explained 24.23% of the variance and contained four items measuring the
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51 25 lack of anticipation of consequences related to performance; factor 2 explained 18.04% of the
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1 variance and contained three items relative to food temptation; factor 3 explained 12.35% of
2 the variance and contained three items relative to compensatory strategies; factor 4 explained
3 8.89% of the variance and contained three items relative to social pressure; and factor 5
4 explained 6.62% of the variance and contained three items relative to negative affects. The
5 data were subsequently organized according to a five-factor model with 70.15% of the
6 variance explained, which is satisfactory (Gorsuch, 1983).

7 *Study 2: Factorial Structure of the SREASS*

8 *Preliminary Analyses.* Multivariate Analyses of Variance (MANOVAs) were
9 performed on all observed variables, in order to examine the differences due to sport type.
10 The analysis indicated a non-significant main effect of sport type (Wilks' $\lambda = .70$, $F_{(16, 425)} =$
11 5.22 , $p > .01$, $\eta^2 = .30$). The variables did not differ according to sport type so the sample was
12 considered as homogeneous.

13 *Confirmatory factorial analysis.* The 16-item, five-factor model then underwent CFA.
14 Bootstrap re-sampling was performed with AMOS 7.0 software since the data presented
15 significant multivariate non-normality (normalized skewness: 126.40; normalized kurtosis:
16 54.29). Analysis revealed that the 16-item model (Figure 1) was significantly adjusted to the
17 data [$\chi^2 (94, N = 425) = 112.01$; $p < .01$ CFI = .97; TLI = .96; RMSEA = .06; LO/HI RMSEA
18 = .042/.076].

19 *Internal consistency of subscales and correlations between subscales.* The means and
20 standard deviation of each subscale were sufficiently homogeneous and are presented in Table
21 2. The Cronbach alpha coefficients were above .84 for the five subscales, demonstrating
22 satisfactory internal consistency (Nunnally, 1978) (Table 2). The inter-subscale correlation
23 coefficients were between -.26 and .91 and are presented with their significance level in
24 Figure 1.

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3 1 *Invariance across gender.* Invariance analyses across gender were done with bootstrap
4
5 2 resampling. CFA (cf. Table 3) was performed on samples of 98 males ($M = 23.50$ years; SD
6
7 = 5.25 years) and 83 females ($M = 23.20$ years; $SD = 6.50$ years). Moreover, CFI, TLI and
8
9 3 RMSEA were all satisfactory (> 0.90 for CFI and TLI; $< .06$ for RMSEA). The first
10
11 4 invariance model (*dimensional*) showed a significant χ^2 value suggesting a lack of fit between
12
13 5 the hypothesized model and the data. However, due to the sensitivity of χ^2 in large samples,
14
15 6 other fit indices were assessed (Kline, 1998). The model showed indices of CFI and TLI ($>$
16
17 7 $.90$) and RMSEA ($< .05$). The *metric* model showed a significant χ^2 value and satisfactory
18
19 8 indices of CFI and TLI ($> .90$) and RMSEA ($< .05$) [$\Delta SB \chi^2 = 15.07$; $\Delta ML \chi^2 = 16.58$, $\Delta df =$
20
21 9 10 , $p = .08$; $\Delta CFI < .01$; $\Delta RMSEA < .015$]. The third model (i.e., *strong / scalar*) showed a
22
23 10 significant χ^2 value and satisfactory indices of CFI and TLI ($> .90$) and RMSEA ($< .05$) [ΔSB
24
25 11 $\chi^2 = 14.57$; $\Delta ML \chi^2 = 18.88$, $\Delta df = 14$, $p = .17$; $\Delta CFI < .01$; $\Delta RMSEA < .015$]. The *strict*
26
27 12 model showed a significant χ^2 value and satisfactory indices of CFI and TLI ($> .90$) and
28
29 13 RMSEA ($< .06$). Strict factorial invariance was not seen in any case. The modification indices
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31 14 proposed by AMOS 7.0 suggested that the gender equivalence, which was constrained to the
32
33 15 error of measurement for item 10, contributed to limiting the invariance of the factorial
34
35 16 structure of the SREASS. The fifth model, unconstrained for the error of measurement for
36
37 17 item 10 in both groups, showed satisfactory partial *strict* invariance [$\Delta SB \chi^2 = 27.02$; $\Delta ML \chi^2$
38
39 18 = 16.45, $\Delta df = 12$, $p = .17$; $\Delta CFI < .01$; $\Delta RMSEA < .015$].
40
41 19

42
43 20 This series of sample analyses indicated partial invariance at the most complex level
44
45 21 (*strict*) of the SREASS factor structure across gender. These results indicate that this
46
47 22 instrument is valid for both males and females.
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50 23 *Study 3: Temporal Stability of the SREASS*

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52 24 The time stability of the scale was first verified with a paired Student t-test. The result
53
54 25 was overall non-significant, which indicates a lack of significant difference between the two
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1 occasions of measure. Correlation analysis confirmed the time stability of the subscales at T1
2 and T2. The scores (Bravais-Pearson r) were above .70 for each of the subscales
3 (respectively, factor 1: .70, factor 2: .75, factor 3: .80, factor 4: .85, factor 5: .71 and all $p <$
4 .01).

5 *Study 4: External Validity of the SREASS*

6 The analyses showed significant correlations, in agreement with the literature (see
7 Table 4). The subscales of the SREASS for food temptation, social interaction and lack of
8 anticipation of consequences on performance were negatively correlated with the subscale of
9 external locus of control regarding the influence of coach and sports friends. The subscale of
10 self-regulation of eating attitude in the context of social interaction was positively correlated
11 with external locus of control regarding parental influence. Thus, in agreement with the
12 literature (Bandura, 1977, 1997), we observed lower self-regulation of eating attitude when
13 significant others were influential. Significant correlations ($p < .05$) were also observed
14 between self-regulation of eating attitude in contexts of food temptation, negative affects,
15 social interaction, consequences on performance and several of the subscales of eating
16 attitudes. These results confirm the findings of Baranowski et al. (1997) concerning the
17 capacity for self-regulation and students' control of fruit and vegetable consumption.

18 Discussion

19 The purpose of this study was to develop and validate a French language scale
20 assessing self-regulation of eating attitudes in sports contexts. Four studies were conducted in
21 line with the steps outlined by Vallerand (1989), in order to validate the Self-Regulation of
22 Eating Attitudes in Sports Scale (SREASS). The validity of the tool was successively
23 demonstrated by exploratory factor analysis (study 1), and confirmatory factorial analysis and
24 partial invariance according to gender (study 2). The reliability of the SREASS was
25 demonstrated by satisfactory internal consistency and temporal stability (study 3), and

1 external validity was confirmed (study 4). These analyses confirmed the validity of a five-
2 factor model. The SREASS is composed of five subscales that refer to the specific contexts
3 that significantly influence the control of eating attitude in athletes. These are: food
4 temptation, negative affects, social interaction, lack of compensatory strategies, and lack of
5 anticipation of consequences on performance.

6 The results support in part the findings of Glynn and Ruderman (1986) and Pinto et al.
7 (2006; 2008). Our results are nevertheless original in that they validate an instrument that is
8 highly specific to athletes and that embodies several facets of the concept of self-regulation as
9 it pertains to eating attitudes. Glynn and Ruderman (1986) dealt with two factors: (a) negative
10 affects and socially acceptable circumstances, and Pinto et al. (2006; 2008) took into account
11 two other factors: (a) normative self-regulation of eating and (b) self-regulation of body
12 image. Based on the review of the literature by Petrie and Greenleaf (2007), the qualitative
13 interviews of Marsollier (2007), and published findings (Bandura, 1986), we chose five
14 factors to define self-regulation of eating attitudes in sport. The results confirmed this choice.

15 We tested the invariance of the SREASS across gender and showed that this
16 instrument is valid for both males and females. Moreover, the partial invariance of the model
17 was demonstrated at the most complex level. The SREASS can thus be used to test
18 hypotheses about across-group differences in self-regulation of eating attitude in sport,
19 independently of or in relation with other psychological constructs. These findings enrich the
20 literature because earlier works did not particularly focus on gender differences.

21 Several limitations of the current series of studies must be taken into account when
22 interpreting these findings, however. First, the data were mostly self-reported and thus may
23 have been biased by social desirability. Second, the fourth study was cross-sectional, which
24 limits the stability across time of the relationships between variables. Moreover, this study
25 was only performed with student athletes, who have basic knowledge about the components

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3 1 of a healthy lifestyle. The observed results thus cannot be generalized to high-level athletes
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5 2 who may inadvertently take in an insufficient number of calories to cover their energy
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8 3 expenditure. In this case, they experience low energy availability but do not display a truly
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10 4 disordered eating pattern. It might be useful to develop a self-regulatory scale for athletes so
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12 5 that they can specifically examine their ability to regulate food intake along the periodized
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14 6 training plan.

17 7 The external validity was examined through correlational analyses, which showed
18
19 8 significant correlations among locus of control, eating attitudes and self-regulation of eating
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21 9 attitude, in agreement with the literature (e.g., AbuSabha & Achterberg, 1997). Further
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23 10 research is needed to confirm the validity of our scale in other athletes and to determine the
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25 11 range of its appropriateness. First, the validity of the SREASS should be tested in adolescents
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27 12 and, if necessary, an age-appropriate instrument could be developed. It would also be
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29 13 interesting to validate this instrument in English to enable cross-cultural studies. Second, the
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31 14 external validity should be examined by associating self-regulation of eating attitudes with
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33 15 other theoretically pertinent variables. The relationships among self-regulation of eating
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35 16 attitudes in sport, the psychosocial factors that determine eating behavior, and the eating
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37 17 attitude itself (Petrie & Greenleaf, 2007) could be examined. For instance, athletes'
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39 18 achievement goals and self-regulation of eating attitude should be studied in relation to eating
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41 19 disorders (e.g., Pelletier, Dion & Levesque, 2004). These studies will be facilitated because
42
43 20 our scale is specific to the sports context, as opposed to the more generic scales currently in
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45 21 use (Glynn & Ruderman, 1986; Pinto et al., 2006; 2008).

52 22 In conclusion, the SREASS has satisfactory psychometric properties and can be used
53
54 23 in a population of young French adults. This scale is a useful instrument that should lead to
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56 24 greater understanding of the self-regulatory mechanisms of eating attitudes in the sports
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58 25 context. Better insight into these mechanisms could then be applied to developing well-aimed
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3 1 strategies to prevent or resolve athletes' eating disorders. Self-regulatory efficacy related to
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6 2 eating attitudes could be a good index for dietitians, nutritionists and other professionals
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8 3 involved in this aspect of sports medicine, facilitating the diagnosis of eating disorders with
9
10 4 specific symptoms. Coaches would also benefit from greater awareness of their athletes' self-
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13 5 regulation of eating attitudes, as they would be better positioned to develop educational
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15 6 strategies to enhance their athletes' self-regulatory skills.
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PROOF

1 **Table 1.** Self-Regulation of Eating Attitudes in Sports Scale (SREASS)

Factors	N°	Items
Factor 1. Food temptation	3	Te sens-tu capable de contrôler ce que tu manges quand de la nourriture alléchante est devant toi ? (<i>Do you feel capable of controlling what you eat when tempting food is put before you?</i>)
	4	Te sens-tu capable de contrôler ce que tu manges quand il y a beaucoup de nourriture disponible pour toi ? (<i>Do you feel capable of controlling what you eat when a lot of food is easily available?</i>)
	16	Te sens-tu capable de résister à la tentation de sucreries que tu apprécies beaucoup ? (<i>Do you feel capable of resisting the sweet foods that you like the most?</i>)
Factor 2. Negative affects	5	Te sens-tu capable de contrôler ce que tu manges quand tu es anxieux(se) ou inquiet(e) ? (<i>Do you feel capable of controlling what you eat when you are anxious or worried?</i>)
	6	Te sens-tu capable de contrôler ce que tu manges quand tu es irritable ? (<i>Do you feel capable of controlling what you eat when you are irritable?</i>)
	10	Te sens-tu capable de contrôler ce que tu manges quand tu es déprimé(e) ? (<i>Do you feel capable of controlling what you eat when you are depressed?</i>)
Factor 3. Social interactions	7	Te sens-tu capable de manger avec tes partenaires d'entraînement et ne pas te priver ? (<i>Do you feel capable of eating with your training partners without depriving yourself?</i>)
	9	Te sens-tu capable de ne rien manger à un repas sous prétexte de la présence de ton entraîneur ? (<i>Do you feel capable of eating nothing at a meal using the pretext that your coach is present?</i>)
	15	Te sens-tu capable de prendre un repas avec tes parents en mangeant en quantité normale ? (<i>Do you feel capable of eating a normal amount of food when you have a meal with your parents?</i>)
Factor 4. Compensatory strategies	2	Te sens-tu capable d'aller te faire vomir si tu as mangé du gâteau d'anniversaire à une fête ? (<i>Do you feel capable of making yourself vomit if you've just eaten cake at a birthday celebration?</i>)
	13	Te sens-tu capable de manger trois repas par jour sans te faire vomir, pratiquer de l'exercice excessif, prendre des diurétiques ou des laxatifs ? (<i>Do you feel capable of eating three meals a day without making yourself vomit, exercise to excess, or take diuretics or laxatives?</i>)
	14	Te sens-tu capable de manger de la nourriture riche en graisses sans te faire vomir, pratique de l'exercice excessif, prendre des diurétiques ou des laxatifs ? (<i>Do you feel capable of eating high-fat foods without making yourself vomit, exercise to excess, or take diuretics or laxatives?</i>)
Factor 5. Lack of anticipation of consequences on performance	1	Te sens-tu capable de manger un gâteau sans penser aux conséquences que cela va pouvoir avoir pour ta prochaine compétition ? (<i>Do you feel capable of eating a dessert without thinking of the consequences this may have on your next competition?</i>)
	8	Te sens-tu capable de manger des frites sans penser aux conséquences que cela va pouvoir avoir sur tes performances ? (<i>Do you feel capable of eating french fries without thinking of the consequences this may have on your performance?</i>)
	11	Te sens-tu capable de manger des sucreries sans penser aux conséquences que cela va pouvoir avoir sur ta prochaine compétition ? (<i>Do you feel capable of eating sweets without thinking of the consequences this may have on your next competition?</i>)
	12	Te sens-tu capable de manger en grosse quantité sans penser aux conséquences que cela va pouvoir avoir sur tes performances ? (<i>Do you feel capable of eating a lot of food at a time without thinking of the consequence this may have of your performance?</i>)

2 **Notes.** Inversed items: 2 and 9. For each item the participant had to answer on a 6-point
3 Likert-type scale from “not at all agreed” (1) to “totally agreed” (6).

1 **Table 2.** Descriptive Statistics and Coefficients of Internal Consistency (Cronbach
2 alpha) for the Self-Regulation of Eating Attitudes in Sports Scale constructs ($N = 160$).

Scale	M	SD	α
Factor 1. Food temptation	3.92	.17	.84
Factor 2. Negative affects	3.99	.06	.90
Factor 3. Social interaction	5.16	.22	.88
Factor 4. Compensatory strategies	4.77	.18	.92
Factor 5. Lack of anticipation of consequences on performance	4.16	.46	.85

3 *Notes.* *M*: Means; *SD*: Standard deviation; α : Cronbach alpha; scores can range from 1 to 6.

PROOF

1 **Table 3.** Goodness-of-Fit Indices of Factorial Invariance Tests across Gender of the Self-Regulation of Eating Attitudes in Sports Scale

Model	χ^2 (SB)	χ^2 (ML)	df	p	CFI	TLI	RMSEA	Comparison model	$\Delta\chi^2$ (SB)	Δ df	Δ p	$\Delta\chi^2$ (ML)	Δ df	Δ p	Δ CFI	Δ RMSEA
Males ^a	133.38	133.40	94	.005	.96	.95	.08	-	-	-	-	-	-	-	-	-
Females ^b	13.76	14.30	8	.000	.98	.98	.05	-	-	-	-	-	-	-	-	-
1 Dimensional (no invariance)	243.51	298.49	188	.05	.98	.97	.03	-	-	-	-	-	-	-	-	-
2 Metric (λ equal)	258.58	315.07	198	.04	.98	.97	.03	1	15.07	10	NS	16.58	10	NS	0	.001
3 Strong (τ equal)	273.16	333.96	212	.03	.98	.97	.03	2	14.57	14	NS	18.88	14	NS	0	0
4 Strict (δ equal)	337.12	423.47	228	.001	.95	.95	.058	3	63.96	16	S	89.51	16	S	.028	.029
5 Partial strict (δ_{10} free)	293.18	35.41	224	.009	.98	.98	.032	3	2.02	12	NS	16.45	12	NS	.007	.003

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Notes. χ^2 (ML): Mean level chi-square; χ^2 (BS): Bollen-Stine chi-square; df: Degrees of freedom; CFI: Comparative Fit Index; TLI: Tucker-Lewis Index; RMSEA: Root Mean Square Error of Approximation; $\Delta\chi^2$: Difference in χ^2 ; Δ df: Differences in degrees of freedom; Δ CFI: Difference in Comparative Fit Index; Δ RMSEA: Difference in Mean Square Error of Approximation; ^a $n = 98$; ^b $n = 83$; τ : Intercepts; δ : Mean.

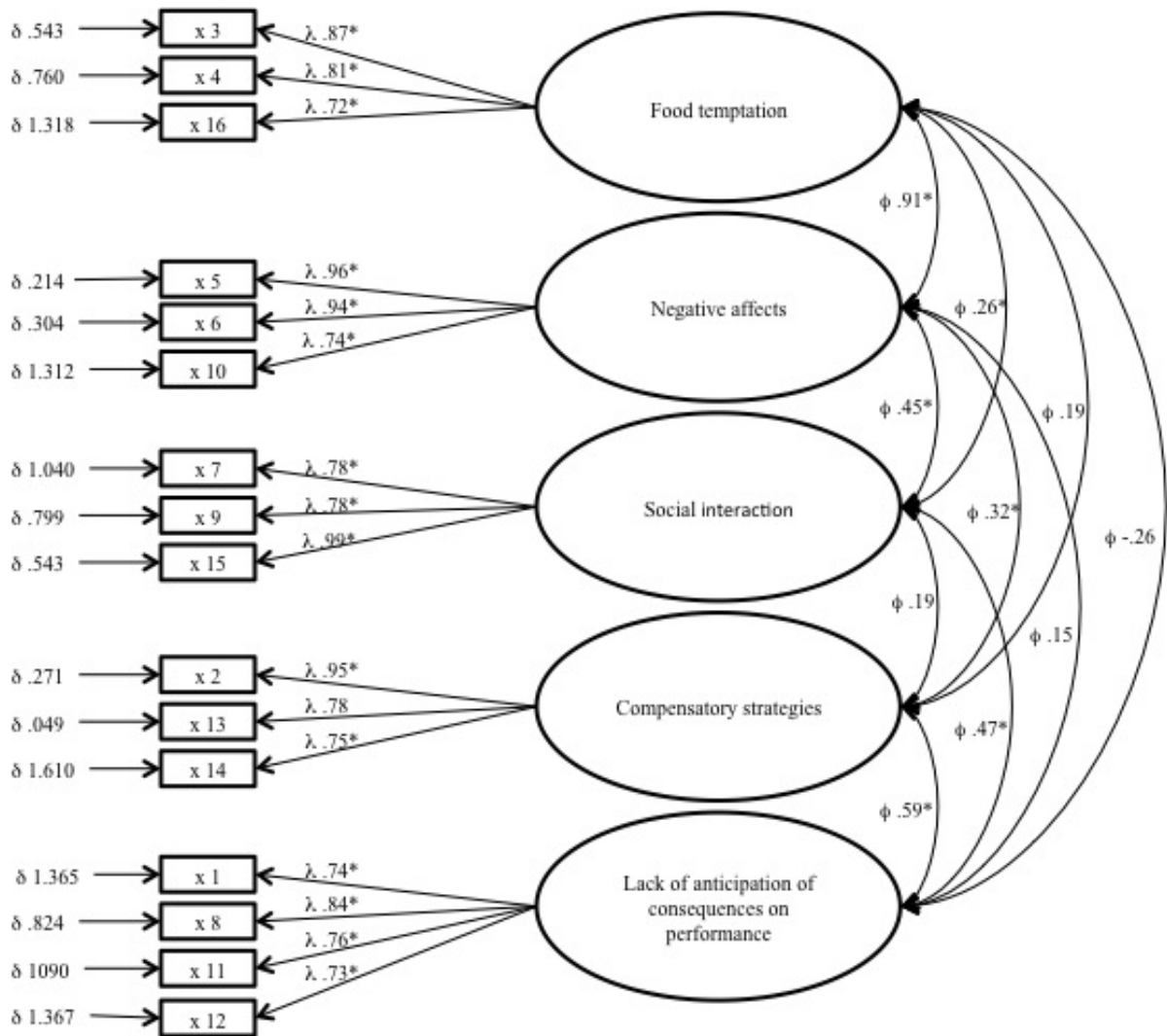
Table 4. Descriptive Statistics and Inter-Subscale Correlations of the Self-Regulation of Eating Attitudes in Sports Scale and their Associations to Locus of Control and Eating Attitudes ($N = 84$)

	1	2	3	4	5	6	7	8	9	10	11	12
1. Internal locus of control ^a	-											
2. External locus: the coach ^a	-.04	-										
3. External locus: parents ^a	-.06	.51*	-									
4. External locus: luck ^a	-.21	.31*	.11	-								
5. Self-regulation in context of food temptation ^b	.07	-.22*	-.05	-.14	-							
6. Self-regulation in context of negative affects ^b	.10	-.07	.08	-.15	.57*	-						
7. Self-regulation in context of social interaction ^b	.17	-.25*	.23*	-.02	.25*	.33*	-					
8. Self-regulation in context of compensatory strategies ^b	-.14	-.05	.10	.025	-.08	-.11	-.02	-				
9. Self-regulation in context of lack of anticipation of consequences on performance ^b	.14	-.35*	-.10	-.02	.03	.17	.39*	.07	-			
10. Diet ^c	-.02	.30*	.07	-.02	-.07	-.33*	-.22*	.05	-.63*	-		
11. Control of eating ^c	-.19	.36*	.15	.29*	-.15	-.13	-.17	.13	-.41*	.43*	-	
12. Bulimia ^c	-.09	.28*	.15	.28*	-.29*	-.51*	-.24*	.20	-.40*	.65*	.52*	-
<i>M</i>	3.28	1.90	2.40	1.60	3.91	3.70	4.10	3.00	4.60	2.64	2.16	2.01
<i>SD</i>	.47	.60	.70	.60	1.10	1.30	.07	1.40	1.30	.86	.69	.84
Range	1-4	1-4	1-4	1-4	1-6	1-6	1-6	1-6	1-6	1-6	1-6	1-6

Notes. (1, 2, 3, 4) Subscales of the French locus of control scale specific to athletes' eating behaviors adapted from Wallston et al. (1978); (5, 6, 7, 8, 9) subscales of the SREASS; (10, 11, 12) subscales of the Eating Attitudes Test (EAT) of Garner et al. (1982). *M*: Mean, *SD*: Standard deviation; * $p < .05$.

1

FIGURES



2

3 **Figure 1.** Coefficient of Estimation and Standard Error of Measurement of the Self-
 4 Regulation of Eating Attitudes in Sports Scale

5 *Notes.* λ = Standardized factor loading; x = Latent factor indicator; ϕ = covariance
 6 between latent factors; δ = Error variance of latent factor indicator. *: $p < .05$; Standard
 7 coefficients of estimation are all significant at $p < .05$.

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