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Original article

Motivation dimensions for running a marathon: A new model emerging from the Motivation of Marathon Scale (MOMS)

Sima Zach [a,*], Yan Xia [b], Aviva Zeev [a], Michal Arnon [a], Noa Choresh [a], Gershon Tenenbaum [b]

[a] *Zinman College for Physical Education and Sport Sciences, Wingate Institute, Netanya 42902, Israel*

[b] *Department of Educational Psychology and Learning Systems, College of Education, Florida State University, Tallahassee, FL 32306-4453, USA*

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Abstract

Purpose: The aim of this study was to test and expand the Motivation of Marathoners Scale (MOMS) model (Masters et al., 1993).

Methods: The MOMS questionnaire was distributed to 306 male and female marathon runners (age range: 20–77 years) with experience in marathon running (range: 1–44 runs). A confirmatory factor analysis (CFA) revealed that the original model failed to fit the data. Hence, exploratory factor analysis (EFA) was performed to test the best factorial solution for the current data, and a subsequent CFA was performed on the revised factorial structure. Then, a series of EFAs using maximum likelihood factor extraction method were performed.

Results: The best structure solution for model-data fit resulted in 11 factors: psychological coping—emotional-related coping, psychological coping—everyday-life management, life meaning, self-esteem, recognition, affiliation, weight concerns, general health orientation—reduced disease prevalence and longevity, general health orientation—keep fit, competition, and personal goal achievement.

Conclusion: This study provides a sound and solid framework for studying motivation for physically demanding tasks such as marathon runs, and needs to be similarly applied and tested in studies incorporating physical tasks which vary in mental demands.

Keywords: Exercise adherence; Marathon; Motives; Psychological characteristics

1. Introduction

The number of recreational runners who complete a marathon, a running race of 42.2 km, has significantly increased in the last 30 years.[1] Data from the USA show a rise from 22,000 runners in 1977 to more than 407,000 runners in 2007.[2,3] In Israel the marathon has also become increasingly popular, from 938 runners in 2008 to 6320 in 2014 (http://www.raceview.net/). This change is attributed mainly to the fact that marathon races are no longer limited to the Olympics or reserved for the elite athletes who train for important competition.[4] In recent years, runners come from different demographic and socio-economic strata who run for both recreational and competitive reasons.[5]

A marathon runner must adopt training habits and a lifestyle behavior which is far beyond what is defined as recreational exercise, and beyond what is recommended for acquiring the basic health benefits of exercise.[6] Such behavior requires demanding psychological, physiological, and financial resources, with the high costs, and not necessarily positive.[7]

Motives for running the marathon have been widely explored.[8–13] Masters et al.[12] developed the Motivation of Marathoners Scale (MOMS) and identified 4 main categories of motives: (1) psychological motives included maintaining or enhancing self-esteem (e.g., "to improve my sense of self-worth"), providing a sense of life meaning (e.g., "to make my life more complete"), and problem solving or coping with negative emotions (e.g., "to become less anxious"); (2) social motives included desire to affiliate with other runners (e.g., "to socialize with other runners") and to receive recognition or approval from others (e.g., "to earn respect of peers"); (3) physical motives for running included general health (e.g., "to become more physically fit") and benefits and weight concern (e.g., "to look leaner"); and (4) achievement motives included competition with other runners (e.g., "to see how high I can place") and personal goal achievement (e.g., "to push myself beyond my current limits").

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* Corresponding author.

E-mail address: simaz@wincol.ac.il (S. Zach)

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Using the MOMS, research was conducted to gain insight regarding motivation for running the marathon among groups with different demographic backgrounds. For example, Masters and Ogles[11] documented the motivation characteristics of marathon runners who varied in their participation experience. The most experienced veterans, who had participated in more than 3 marathons, were motivated more by social and competitive reinforcements than by personal accomplishment or internal psychological rejuvenation. The mid-level experienced runners, after their second or third marathon, were primarily motivated by personal performance enhancement and psychological rewards. For the rookie marathon runners, self-esteem appeared to be a more important motivation than for the more experienced runners. In addition, since rookies had not yet realized marathon goal accomplishment, they were less concerned with performance improvement.

Havenar and Lochbaum[9] examined dropouts compared to race finishers, and found that dropouts rated social motives and weight concerns as significantly more important than did the finishers. Others, such as Ziegler,[10] studied gender differences. He examined the perceived benefits of marathon running in males and females, and reported that men perceived running to be more beneficial than did women, while women felt that running had a positive effect on self-image and that their lives were richer because of running—more so than men. Deaner et al.[8] compared marathon performance as a predictor of competitiveness and training between men and women. Their results showed that the males reported significantly greater competitiveness than the females.

Furthermore, Ogles and Masters[13] found that young marathon participants (20–28 years) reported being more motivated by personal goal achievement than did the older marathon runners (≥50 years), and that older runners were more motivated by general health orientation, weight concerns, life meaning, and affiliation with other runners. In order to further understand runners' motives, Ogles and Masters[13] conducted a cluster analysis based on a motivational profile and demographic and training characteristics of 1519 marathon runners. Their analysis yielded 5 definable subgroups: running enthusiasts, lifestyle managers, personal goal achievers, personal accomplishers, and competitive achievers. Personal motives were endorsed most often across all groups.

Nevertheless, these studies concentrated solely on motive identification, and did not consider any conceptual framework for either developing the MOMS or supporting their findings. The bottom-up procedure was used to develop the MOMS. Furthermore, a substantial change in the demographics of marathon runners in recent years[14] necessitates a new look at the motives for engaging in such a physically and mentally demanding endeavor.

In this study we test the validity of the MOMS in a new sample of marathon runners using the Self-Determination Theory (SDT)[15] as a conceptual framework. According to the SDT, motivational states exist along a self-determination continuum that ranges from no intention to act (i.e., amotivation—the least self-determined form of motivation) at one end to intrinsic motivation at the other end (representing the most self-determined form of motivation). Between these 2 ends, extrinsically motivated behaviors are located, varying in the extent to which their regulation is self-determined from the least self-determined form of extrinsic motivation—external regulation, to the most self-determined form of extrinsic motivation—integrated regulation.

Ryan and Deci[16] argued that an individual is situated on the motivational continuum according to the degree to which competence, autonomy, and relatedness, 3 psychological needs, are satisfied. Numerous studies have demonstrated that environments encouraging competence, autonomy, and relatedness produce persistence and other motivational consequences.[17,18] The question of whether such consequences also exist in marathon runners is very intriguing.

Considering SDT postulations, we sought to better understand marathon runners' motives. Furthermore, we maintain that recognizing the reasons for people's motives may be valuable for several reasons. First, such knowledge may be beneficial for understanding the reasons individuals drop out of exercise programs, as well as their barriers to engaging in exercise.[19] Second, since the psychological influence on exercise behavior may be modifiable, determining the psychological characteristics of the marathon runner is pertinent. Third, understanding the adherent behavior required for persistence in training for participation in the marathon may assist in developing effective interventions for enhancing exercise motivation and adherence in order to assimilate a life-long active lifestyle.[10,20–22] Such knowledge may assist the runner in applying the determination to finish a marathon to other demanding challenges in life.[21]

Consequently, we sought a better understanding of the motives to participate in a physically and mentally demanding task. Masters et al.'s[12] study was published more than 20 years ago. During this period sporting events generate buzz that attracts various response among participants, their families, sport events' organizers and marketers, and attracts many participants to the events.[4] Social media platforms that did not exist in the past are strongly present nowadays.[23] However, implications of these processes on motivation for sport participation were not researched so far. Following findings showing that recreational marathon runners nowadays are mainly intrinsically or task-related motivated,[24,25] we assumed that motives to marathon participation have changed along these years. Moreover, the fact that the participants in our study are Israelis, and that the questionnaire was translated from English to Hebrew, brings about the cross-cultural issue. Along the line of others,[5,26,27] reporting that cultural aspects are related to running motives, our study aimed at examining evidence for a cross-cultural validation of the MOMS model[12] to explore the best factorial structure solution associated with the current data. We hypothesized that the social (meaning of life-self esteem) and health—mental and physical—domains would result as main motives of the current cohort of participants.

2. Methods

2.1. Participants

Permission of Institutional Review Board of Zinman College was obtained prior to the beginning of the study. Three hundred

and six participants (233 men, 58 women, 15 genders not designated), age ranging 20–77 years (41.87 ± 8.58, mean ± SD), filled out the Hebrew version of the MOMS questionnaire.[12] The inclusion criterion required that the participant had already completed at least 1 marathon. Distribution of participants according to their age showed that almost half (47%) of the participants were in their forties. Distribution according to experience in marathon running showed that 77 had participated in 1 marathon, 131 in 2–4 marathons, and 98 in 5 or more marathons, among them 11 had participated in more than 20 marathons (range 1–44; 4.27 ± 5.56). Distribution of their training session habits during a regular season, when not preparing for a coming event, showed that 76% practiced 4–6 times a week, 8% practiced more than 6 times a week, and 16% practiced less than 4 times a week (range 2–11; 4.76 ± 1.48). The range of training session duration lasted between 30 and 255 min (78.01 ± 27.12); 78.1% of the participants ran between 60 and 90 min per session, 9.0% ran less, and the rest ran longer than 90 min.

2.2. Questionnaire

Demographic questions were asked, including gender and age, and training habits questions such as the number of weekly training sessions and training session duration, in addition to the number of completed marathons.

The MOMS was translated from English to Hebrew using back translation and the committee approach.[28,29] A group of 3 bilingual translators translated the questionnaire from the language of origin (English) to the target language (Hebrew). Then a translator translated the questionnaire back into the original language. In a committee form, the 4 experts reached consensus on language discrepancies and produced the final version. The scale is comprised of 56 questions rated on a 7-point Likert-type scale (1 = *not a reason*, 7 = *a most important reason*). The original questionnaire had psychometric properties as follows: (a) reliability—internal consistency—α coefficients range from 0.80 to 0.93. Temporal stability of the 9 factors with 3 months apart ranged from 0.71 to 0.90; (b) validity—exploratory factor analysis (EFA) and construct validity were used to validate the motivational factors which emerged in Masters et al.'s study.[12]

Convergent and discriminant validity of the MOMS were demonstrated by correlating "competitiveness" with marathon's finish time and "training miles" per week as well as with the "win" and "competition" goal orientations. Personal goal achievement motives were negatively correlated with current and previous finish times. Goal achievement motives were positively related to training miles. Personal goal achievement accounted for approximately 4 times as much as the variance of the Goal and Competitiveness Sport Orientation Questionnaire (SOQ) scales as it did on the Win scales. According to the authors this is an evidence for the construct validity of this scale. Finally the affiliation motive scales were positively correlated to the number of times the runners met with their peers and negatively with occasions of training alone. The psychological coping motives were positively correlated with dissociative attention strategies during the run. The weight concern motive was positively correlated with body mass index (BMI), endorsing weight concerns and less body satisfaction, feeling heavier and reporting for burning calories. The MOMS was not correlated with social desirability showing satisfactory discriminant validity.

2.3. Procedure

Participants were recruited by the following means: (1) Names were taken from 3 online marathon running listserves. Listserve administrators were initially contacted in order to obtain permission to post recruitment information on the website. After permission was granted, an announcement explaining the study purpose was posted to the listserves; (2) A post was published on the researcher's Facebook wall, asking friends to participate in the procedure of "a friend brings a friend"; (3) Different running groups were approached, and an e-mail message was sent to the group coach; (4) A research assistant arrived at the annual half-marathon—"Brooks-Marathonia" event, where many marathon runners were expected to participate, and distributed questionnaires to runners who agreed to participate in the study. All participants in the current study were provided with information about the study topic. Participants who chose to participate online clicked on a link to the questionnaire and anonymously answered through the Google Docs system. Questionnaire completion time was approximately 10 min.

2.4. Data analysis

The analyses pertaining to the MOMS are presented in several subsequent stages as follows:

(a) The validation of the new model was based on a systematic series of procedures, as recommended previously by others.[30,31] We first tested the fit of the general model reported by Masters et al.[12] to our data via CFA using Muthén and Muthén's[31] M*plus* (Version 2.01 software). If the model fit the data, a cross-cultural validation was evident. Fit statistics followed recommendations.[32] Cutoff criteria for fit indices were: χ^2 = non-significant ($p > 0.05$), $\chi^2/df > 2.00$, root mean square error of approximation (*RMSEA*) < 0.08, Comparative Fit Index (*CFI*) > 0.90, Tucker and Lewis Index (*TLI*) > 0.90, and standard root mean-square residual (*SRMR*) < 0.08.

(b) An EFA was performed to test the best factorial solution for the current data. A subsequent CFA was performed to test the fit of the revised factorial structure to the data. If the fit was satisfactory, a new cultural-dependent structure would be evident.

(c) A series of EFAs using the maximum likelihood factor extraction method were performed to explore the best factorial structure produced by the data. The best structure solution was tested for fit to the data, and reported herein.

3. Results

3.1. Testing the original model of Masters et al.[12]

The MOMS consists of 56 items which load on 9 latent factors: 9 on psychological coping (PC), 8 on self-esteem (SE),

Table 1
Initial exploratory factor analysis (EFA) solution yielding 7 factors with means, SDs, and internal consistencies.

Factor	No. of items	Items $\lambda > 0.30$	*Mean*	*SD*	Cronbach's α
Life meaning (LM)	3	13, 20, 25	4.74	1.54	0.83
Personal goal achievement (PGA)	9	2, 5, 9, 22, 35, 40, 43, 46, 52	4.32	1.18	0.87
General health orientation (GHO)	4	8, 14, 26, 44	4.29	1.63	0.88
Psychological coping (PC)	7	18, 28, 36, 38, 39, 47, 50	4.18	1.50	0.91
Affiliation (AFF)	6	7, 12, 16, 24, 30, 33	3.26	1.40	0.89
Weight concerns (WC)	3	1, 4, 21	3.86	1.83	0.93
Recognition (REC)	5	3, 19, 45, 48, 54	3.15	1.45	0.90

and 7 on life meaning (LM), which together constitute a second-order latent factor termed psychological motives (PM). Similarly, 6 items load on a latent factor termed general health orientation (GHO) and 4 items load on weight concern (WC), which together constitute a second-order latent factor termed physical health motives (PHM). Next, 6 items load on affiliation (AFF) and 6 on recognition (REC), which together define a second-order latent factor termed social motives (SM). Finally 4 items load on competition (COM) and 6 on personal goal achievement (PGA), which together constitute achievement motives (AM). According to Ogles and Masters[13] the 4 second-order motives were moderately to strongly correlated; specifically, psychological and social motives ($r = 0.74$), psychological and physical health motives ($r = 0.67$), and social and achievement motives ($r = 0.65$). Furthermore the authors claimed a sufficient fit of this model to the data, $\chi^2 = 6808.12$, $df = 1460$, $p < 0.001$, $\chi^2/df = 4.66$, *Goodness of Fit Index* (*GFI*) = 0.641, *RMSEA* = 0.09. These fit indices cannot be considered satisfactory in order to justify the marathon motivation structure as claimed by its developers. The CFA fit statistics of the original factor structure for the current sample were $\chi^2 = 4858.67$, $df = 1469$, $\chi^2/df = 3.31$, $p < 0.001$, *RMSEA* = 0.09, *CFI* = 0.73, *TLI* = 0.71, *SRMR* = 0.11, indicating that the original MOMS structure does not sufficiently fit the current data, and therefore additional exploration is required to attain a better fitting solution.

3.2. EFA

EFA performed on the current data using a principal component procedure followed by oblimin rotation with eigenvalue $\lambda > 0.30$ revealed 7 factors instead of the 9 original ones, and 37 items with loadings >0.30 instead of the original 56 items. Particularly LM, but also PGA, GHO, and PC were rated higher as motives (*mean* = 4.18–4.74 on a 7-point scale) than AFF, WC, and REC (*mean* = 3.15–3.86). Cronbach's α coefficients were satisfactory and ranged from 0.83 to 0.93. This analysis is summarized in Table 1. The correlations among the newly emerged factors are presented in Table 2. The correlations among these factors were low to moderate ($r = 0.09$–0.57), indicating sufficient inter-independence among the 7 factors. However, the CFA failed to confirm this reduced model ($\chi^2 = 1934.11$, $df = 608$, $p < 0.001$, *RMSEA* = 0.09, *CFI* = 0.82, *TLI* = 0.81, *SRMR* = 0.08 for uncorrelated residuals; or $\chi^2 = 1608.37$, $df = 605$, $p < 0.001$, *RMSEA* = 0.07, *CFI* = 0.87, *TLI* = 0.85, *SRMR* = 0.07 for correlated residuals). Thus, a new solution was explored using EFA with maximum likelihood extraction method.

3.3. EFA with maximum likelihood extraction method

EFA with maximum likelihood extraction method was implemented by using M*plus* 7.0.[30] Because the latent factors of the model were found to be moderately correlated in our analysis as well as in Masters et al.'s[12] study, an oblique Geomin rotation was applied to determine the best factorial solution. The full information maximum likelihood estimation method was used for parameter estimation, as this method is the best for working with missing data.[33] A sample correlation matrix was the matrix of association by M*plus* 7.0 (Appendix). To determine the number of factors to retain, we assumed $\lambda > 1$ rule, scree test and fit indices provided by M*plus*, which includes *RMSEA*, *CFI*, *TLI*, and *SRMR*, and can be interpreted similarly to the fit indices in CFA.

Accordingly, the number of factors to retain was 11, as indicated by the 11 λ at 1.1 and the scree test, as well as the more appropriate fit statistics than any of the other 5–10 factor solutions. Table 3 shows the model fit indices of all the

Table 2
Pearson product moment correlations among the MOMS' 7 factors.

Variable	LM	GHO	AFF	REC	PC	WC
GHO	0.27**					
AFF	0.50**	0.30**				
REC	0.44**	0.17**	0.57**			
PC	0.56**	0.38**	0.43**	0.37**		
WC	0.15**	0.37**	0.22**	0.32**	0.28**	
PGA	0.26**	0.09	0.32**	0.50**	0.33**	0.15*

*$p < 0.05$, **$p < 0.01$.
Abbreviations: AFF = affiliation; GHO = general health orientation; LM = life meaning; MOMS = Motivation of Marathon Scale; PC = psychological coping; PGA = personal goal achievement; REC = recognition; WC = weight concern.

Table 3
Fit indices for exploratory factor analysis with 5–11 factors.

No. of factor	χ^2	*df*	χ^2/df	*RMSEA*	*CFI*	*TLI*	*SRMR*
5	4743.66	1270	3.74	0.10	0.72	0.66	0.05
6	4009.11	1219	3.29	0.09	0.77	0.71	0.05
7	3396.82	1169	2.91	0.08	0.82	0.76	0.04
8	2978.49	1120	2.66	0.07	0.85	0.79	0.03
9	2700.19	1072	2.52	0.07	0.87	0.81	0.03
10	2358.18	1025	2.30	0.07	0.89	0.84	0.03
11	2088.19	979	2.13	0.06	0.91	0.86	0.02

Abbreviations: *CFI* = Comparative Fit Index; *RMSEA* = root mean square error of approximation; *SRMR* = standard root mean-square residual; *TLI* = Tucker and Lewis Index.

Table 4
Factor correlation matrix after Geomin rotation.

	PC1	PC2	LM	SE	REC	AFF	WC	GHO1	GHO2	COM
PC2	0.36	–								
LM	0.33	0.50	–							
SE	0.27	0.23	0.20	–						
REC	0.30	0.18	0.31	0.36	–					
AFF	0.27	0.34	0.40	0.27	0.38	–				
WC	0.19	0.23	0.14	0.17	0.29	0.16	–			
GHO1	0.15	0.28	0.22	0.12	0.00	0.18	0.34	–		
GHO2	0.07	0.23	0.22	−0.04	0.02	0.13	0.05	0.14	–	
COM	0.12	0.16	0.04	0.14	0.23	0.15	0.14	0.02	0.08	–
PGA	0.17	0.21	0.30	0.13	0.27	0.09	−0.05	0.01	0.26	0.22

Abbreviations: AFF = affiliation; COM = competition; GHO1 = general health orientation—reduced disease prevalence and longevity; GHO2 = general health orientation—keep fit; LM = life meaning; PC1 = psychological coping—emotional-related coping; PC2 = psychological coping—everyday-life management; PGA = personal goal achievement; REC = recognition; SE = self-esteem; WC = weight concern.

solutions, revealing that the EFA model with 11 factors retained the best model fit statistics ($\chi^2 = 2088.19$, $df = 979$, $\chi^2/df = 2.13$, $RMSEA = 0.06$, $CFI = 0.91$, $TLI = 0.86$, and $SRMR = 0.02$). The correlations among the 11 factors indicate low-to-moderate correlations among the factors and a satisfactory independence solution (Table 4). Item 31 ("it is a positive emotional experience for me") and 56 ("to feel like a winner") had low loading parameter estimates (<0.30) on all latent factors except for GHO2 (0.311) and PGA (0.381), respectively. We therefore deleted these 2 items from the final model due to lack of theoretical rationale behind their unexpected loading structures. The final model is shown in Fig. 1. The factor loadings are derived from the Geomin rotated procedure.

The 11-factor model solution, which fits the data best, makes several changes to the original model.[12] Specifically, the PC unitary factor was broken down into 2 factors: PC1, which pertains to emotional-related coping, and PC2, which pertains to motives related to everyday-life management. SE came out as a new factor with 4 items, which failed to define it as such in the original model. The original SE items were distributed among the other current factors. The factor GHO was divided here into GHO1—reduction in disease prevalence, and GHO2—keeping fit. Overall, the original model remained conceptually similar to the model reported herein, but the current model is psychologically sounder and fits better to the data.

A further CFA analysis was implemented to test the model described in Fig. 1. Based on modification indices, error correlations between Items 3 with 6; 5 with 22; 36 with 38; and 49 with 50 were added. Results show unsatisfactory fit indices ($\chi^2 = 3703.276$, $df = 1422$, $\chi^2/df = 2.60$, $RMSEA = 0.07$, $CFI = 0.82$, $TLI = 0.80$, and $SRMR = 0.10$). Second-order CFA model fit (e.g., similar to the original model) yielded indices of $\chi^2 = 4042.251$, $df = 1460$, $\chi^2/df = 2.77$, $RMSEA = 0.08$, $CFI = 0.79$, $TLI = 0.78$, and $SRMR = 0.12$. Thus, the 11-factor independent model presented in Fig. 1 is the best fit to the data.

4. Discussion

The purpose of this study was to examine evidence for a cross-cultural validation of the MOMS model of marathon run motivation,[12] and to explore the best factorial structure solution associated with the data. The study presented findings related to validation of a new model for the MOMS. The psychometric soundness of the new MOMS model not only exceeds the former model, but also essentially proves what the former failed to do. The poor fit of the original model demonstrated that the nature of motives for running a marathon is not hierarchically oriented with first-order and second-order factors. We showed that, conversely, all factors could be better viewed as independent factors.

The validation of the new model was based on a systematic series of procedures, as recommended previously by others,[30,31] involving CFA and EFA, in which a cross-cultural validation was not evident. A series of EFAs using the maximum likelihood factor extraction method found the best factorial structure solution representing marathoners' motives. In other words, the present results indicate that the Masters et al's.[12] model cannot be supported.

The new model distinguished an additional 2 factors from the same 56 original items. Two factors emerged for psychological coping: emotional-related coping and everyday-life management, whereas only 1 factor appeared in the original model. Two factors emerged for general health orientation: reduced disease prevalence and longevity and keep fit, whereas only 1 factor appeared in the original model. We maintain that such an addition gives a better perspective, with meaningful distinctions, on running motives.

Since we could not provide additional evidence for the construct validity of the original MOMS, we suggest using the new version of the model, which explains the construct validity of the questionnaire, in order to enhance understanding the nature of motivation for running a marathon.

The last major argument in favor of the current model is that while the former was not based on any theoretical framework, the new emergent model is grounded on SDT. Along the lines of SDT with its 3-needs argument, we claim that the additional factors that emerged in the current model represent the need for autonomy and competence more comprehensively. As such, we join others who maintained that satisfaction of these needs produces self-determined motivational consequences.[17,18] Specifically, individuals who are motivated to emotionally cope with challenges, and strive to manage their lives while adopting running as an ongoing habit, are situated in a high self-

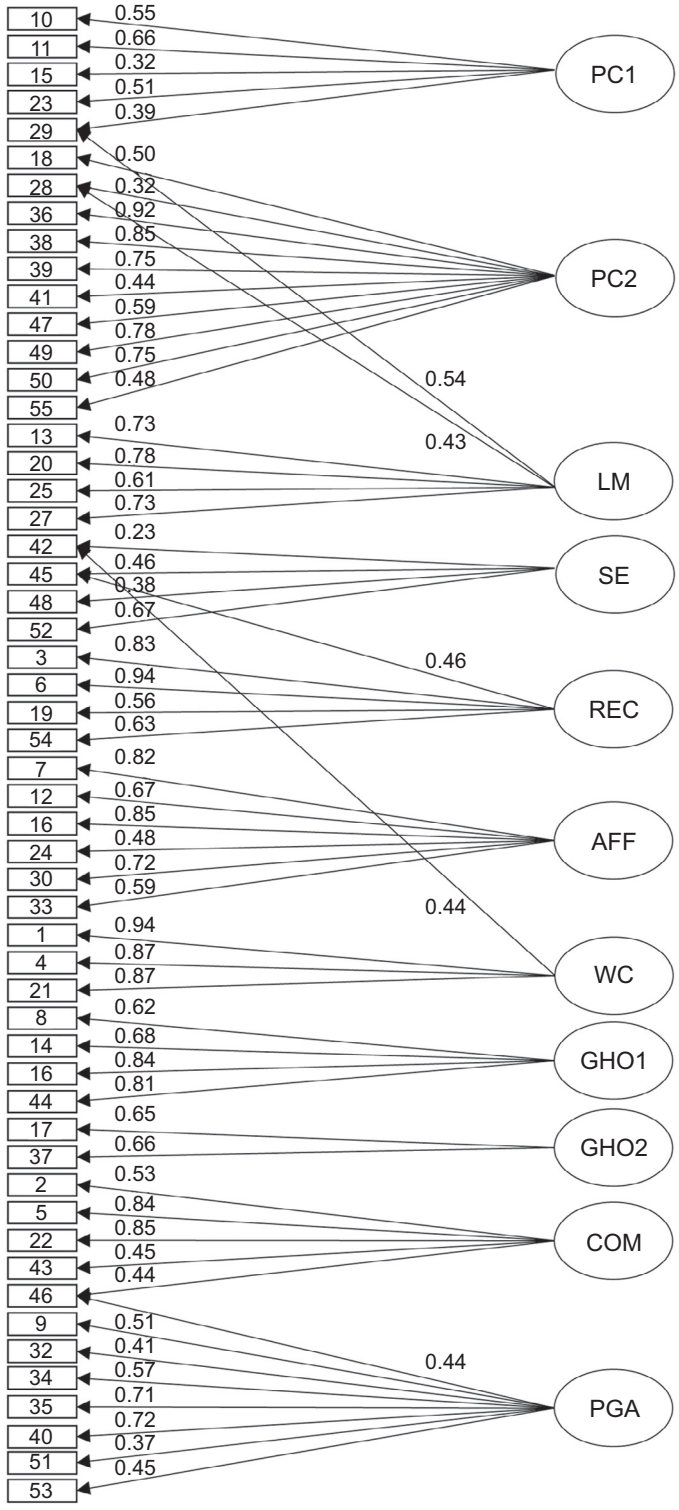

Fig. 1. Final model structure and standardized item loadings. AFF = affiliation; COM = competition; GHO1 = general health orientation—reduced disease prevalence and longevity; GHO2 = general health orientation—keep fit; LM = life meaning; PC1 = psychological coping—emotional-related coping; PC2 = psychological coping—everyday-life management; PGA = personal goal achievement; REC = recognition; SE = self-esteem; WC = weight concern.

determined motivation state along the continuum. In addition, the emergence of 2 factors related to general health orientation reflects 2 distinct aspects: one regarding prevention or reduction of health problems, and the other regarding health promotion—2 motives that can satisfy the need for competence and autonomy.

Looking deeper into the content of 56 items represented by 11 factors, we found that the new model provides a detailed description of people's motives to run that thoroughly represents the 3 needs postulated by SDT. Life meaning, self-esteem, weight concerns, and general health orientation aimed at reducing disease prevalence and enhancing longevity, general health orientation—keeping fit; all can refer to the need for autonomy. Psychological coping—emotional-related and everyday-life management can refer to the need for competence. Recognition and affiliation can refer to the need for relatedness.

Along the lines of SDT, people's motivation behavior varies in the extent to which their regulation is self-determined. Therefore, we found not only a variety of motives for running, but also a different self-determined level that set the running behavior. Specifically, competition and personal goal achievement represent motives that stem from the need for competence. Psychological coping—emotional-related, and everyday-life management, life meaning, self-esteem, weight concerns, and general health orientation aimed at disease prevalence reduction and longevity, and keeping fit represent motives that stem from the need for autonomy. Finally, recognition and affiliation represent motives that stem from the need for relatedness. Thus, our findings support the SDT premise that satisfying the individual's needs satisfaction is the underlying mechanism that drives marathon runners.[16]

Although this study provided preliminary evidence of the validity of the MOMS new model, we recommended that its psychometric properties should be tested in other cultures, and then be used to compare the motives of leisure *vs.* competitive athletes, male *vs.* female athletes, experienced *vs.* unexperienced athletes, as well as any cross-sectional criteria deemed of interest. Such knowledge can promote understanding of the complex dynamics involved in such demanding challenges as the marathon adherence-exercise behavior. In addition, it should be noted that we tested the factorial validity of the MOMS without changing, adding, or revising items. It is likely that other motivational factors will be uncovered in the future.

From an academic viewpoint, characterization of the motives for running marathons can spur further research into the growing trend toward participation in long runs, elicit generalizations pertaining to other endeavors, and serve as the basis for more complex studies in terms of the number and essence of variables. For these purposes, the instrument validated in this study can be useful.

A longitudinal study would enable researchers to identify motivational trends for marathon running over time, which can be compared to trends of engagement in other sports or examined in relation to various epidemiological or sociological phenomena.

For coaches in the field and other interested parties, an understanding of motivation can help channel runners into frameworks most suited to their needs and motivation,

including factors such as age, gender, and personal characteristics. It may also be possible to predict and/or influence the decision by participants to drop out.

Coaches, coordinators, and sport associations can use data about motivation to tailor programs that cater to specific needs, such as marathon running for a healthy lifestyle, social marathon running, running to realize personal potential, and running for achievement, and to direct each approach to relevant target populations. Also, marketers and sports event organizers can use the knowledge regarding participants' motives and expectations in their plans and decisions.

Authors' contributions

SZ conceived of, carried out the study, and drafted the manuscript; NC collected the data, YX, AZ, and MA performed the statistical analysis; GT participated in its design and coordination and helped to draft the manuscript. All authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

Competing interests

The authors declare that they have no competing interests.

Appendix

Correlation matrix for the input association matrix of EFA (Part 1)

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
2	0.15																								
3	0.27	0.45																							
4	0.82	0.18	0.32																						
5	0.17	0.48	0.29	0.18																					
6	0.27	0.35	0.87	0.32	0.28																				
7	0.10	0.23	0.37	0.15	0.29	0.41																			
8	0.37	0.02	0.03	0.32	0.009	0.03	0.17																		
9	−0.03	0.26	0.20	−0.01	0.032	0.24	0.15	0.04																	
10	0.14	0.13	0.23	0.16	0.16	0.25	0.29	0.21	0.17																
11	0.13	0.22	0.44	0.19	0.19	0.48	0.30	0.12	0.33	0.54															
12	0.11	0.09	0.35	0.20	0.11	0.40	0.57	0.19	0.15	0.37	0.42														
13	0.02	0.07	0.24	0.08	0.07	0.29	0.34	0.11	0.21	0.26	0.49	0.49													
14	0.23	0.08	0.02	0.25	0.09	0.05	0.17	0.58	−0.01	0.22	0.16	0.21	0.27												
15	0.21	0.14	0.16	0.26	0.14	0.22	0.19	0.20	0.18	0.52	0.45	0.32	0.42	0.34											
16	0.14	0.14	0.29	0.19	0.12	0.31	0.74	0.22	0.10	0.27	0.33	0.64	0.44	0.26	0.37										
17	0.12	0.08	0.03	0.04	0.25	0.08	0.21	0.33	0.18	−0.02	0.08	0.11	0.20	0.30	0.14	0.22									
18	0.21	0.08	0.20	0.24	0.15	0.26	0.28	0.29	0.22	0.37	0.32	0.34	0.38	0.22	0.55	0.37	0.28								
19	0.16	0.26	0.61	0.27	0.15	0.67	0.38	0.12	0.23	0.23	0.48	0.42	0.32	0.23	0.29	0.38	0.09	0.31							
20	0.08	0.07	0.27	0.12	0.12	0.31	0.29	0.15	0.25	0.25	0.49	0.41	0.77	0.23	0.45	0.41	0.20	0.43	0.43						
21	0.80	0.14	0.31	0.80	0.016	0.34	0.12	0.27	0.05	0.17	0.18	0.22	0.13	0.26	0.28	0.20	0.08	0.28	0.28	0.19					
22	0.06	0.45	0.21	0.09	0.077	0.21	0.20	0.02	0.49	0.10	0.19	0.07	0.06	0.07	0.12	0.06	0.33	0.17	0.18	0.18	0.13				
23	0.17	0.26	0.47	0.22	0.25	0.53	0.37	0.12	0.28	0.48	0.75	0.47	0.48	0.15	0.49	0.42	0.18	0.42	0.48	0.48	0.26	0.27			
24	0.14	0.18	0.26	0.21	0.17	0.30	0.44	0.24	0.11	0.30	0.29	0.51	0.29	0.27	0.25	0.47	0.12	0.28	0.37	0.34	0.22	0.16	0.38		
25	0.09	0.12	0.22	0.17	0.16	0.29	0.19	0.15	0.19	0.29	0.51	0.30	0.55	0.21	0.42	0.29	0.17	0.38	0.30	0.54	0.20	0.14	0.57	0.32	
26	0.30	0.03	0.00	0.35	0.11	0.04	0.11	0.57	−0.05	0.24	0.15	0.16	0.17	0.66	0.31	0.21	0.25	0.30	0.18	0.24	0.31	0.08	0.14	0.30	0.25

Correlation matrix for the input association matrix of EFA (Part 2)

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
27	0.13	0.08	0.21	0.20	0.18	0.27	0.25	0.19	0.20	0.31	0.45	0.31	0.67	0.26	0.48	0.39	0.24	0.48	0.27	0.70	0.25	0.15	0.52	0.32	0.71	0.35
28	0.17	0.11	0.20	0.16	0.14	0.27	0.20	0.29	0.31	0.33	0.47	0.30	0.53	0.24	0.58	0.36	0.27	0.57	0.28	0.56	0.24	0.17	0.51	0.21	0.54	0.27
29	0.12	0.13	0.39	0.18	0.12	0.47	0.25	0.12	0.28	0.40	0.73	0.37	0.58	0.21	0.53	0.35	0.19	0.43	0.49	0.65	0.25	0.19	0.71	0.32	0.60	0.21
30	0.02	0.18	0.33	0.10	0.21	0.36	0.64	0.15	0.19	0.34	0.37	0.61	0.41	0.22	0.24	0.67	0.18	0.28	0.42	0.41	0.14	0.22	0.45	0.58	0.34	0.21
31	−0.08	0.10	0.03	−0.01	0.06	0.10	0.21	0.10	0.20	0.07	0.15	0.22	0.25	0.11	0.13	0.27	0.32	0.27	0.12	0.20	−0.01	0.14	0.22	0.13	0.30	0.11
32	0.12	0.16	0.34	0.08	0.13	0.45	0.29	0.08	0.35	0.15	0.45	0.33	0.45	0.12	0.26	0.29	0.30	0.34	0.48	0.52	0.17	0.21	0.47	0.27	0.42	0.09
33	0.19	0.23	0.30	0.24	0.18	0.32	0.51	0.19	0.09	0.28	0.24	0.52	0.35	0.26	0.37	0.64	0.14	0.33	0.38	0.39	0.27	0.15	0.40	0.51	0.31	0.23
34	−0.07	0.12	0.28	−0.02	0.11	0.35	0.21	0.08	0.38	0.12	0.41	0.21	0.40	0.17	0.17	0.15	0.32	0.25	0.33	0.39	0.02	0.20	0.35	0.13	0.36	0.04
35	0.01	0.23	0.23	−0.01	0.29	0.24	0.18	0.05	0.55	0.12	0.30	0.15	0.28	0.06	0.14	0.14	0.27	0.25	0.25	0.27	0.02	0.40	0.29	0.10	0.21	0.02
36	0.19	0.08	0.14	0.22	0.22	0.23	0.15	0.24	0.24	0.31	0.31	0.23	0.36	0.28	0.46	0.26	0.18	0.57	0.28	0.40	0.23	0.24	0.40	0.31	0.40	0.30
37	0.21	0.13	0.08	0.16	0.25	0.16	0.23	0.48	0.14	0.10	0.16	0.14	0.22	0.38	0.17	0.19	0.66	0.38	0.16	0.25	0.20	0.31	0.21	0.26	0.25	0.41
38	0.16	0.13	0.14	0.19	0.22	0.22	0.21	0.24	0.17	0.28	0.34	0.25	0.38	0.31	0.45	0.31	0.28	0.55	0.29	0.38	0.22	0.22	0.42	0.30	0.39	0.36
39	0.18	0.12	0.14	0.22	0.20	0.23	0.20	0.25	0.21	0.34	0.32	0.27	0.32	0.29	0.48	0.27	0.21	0.52	0.27	0.35	0.26	0.24	0.39	0.31	0.38	0.31
40	0.02	0.30	0.27	0.05	0.32	0.27	0.14	0.02	0.56	0.06	0.24	0.07	0.19	0.03	0.07	0.06	0.27	0.18	0.29	0.24	0.09	0.50	0.22	0.12	0.16	0.02
41	0.04	0.13	0.17	0.05	0.09	0.18	0.22	0.12	0.14	0.27	0.26	0.28	0.34	0.17	0.30	0.32	0.14	0.34	0.25	0.36	0.09	0.07	0.39	0.38	0.36	0.12
42	0.52	0.23	0.30	0.48	0.23	0.33	0.22	0.32	0.11	0.23	0.30	0.26	0.28	0.32	0.32	0.29	0.30	0.37	0.34	0.28	0.54	0.16	0.34	0.28	0.24	0.31
43	0.12	0.69	0.52	0.20	0.47	0.48	0.34	−0.02	0.28	0.17	0.29	0.24	0.17	0.12	0.16	0.25	0.09	0.17	0.44	0.16	0.21	0.47	0.39	0.29	0.16	0.08
44	0.31	0.07	0.03	0.31	0.10	0.07	0.10	0.66	−0.02	0.21	0.20	0.15	0.16	0.61	0.26	0.21	0.37	0.26	0.21	0.20	0.27	0.07	0.21	0.29	0.24	0.78
45	0.18	0.35	0.62	0.28	0.22	0.64	0.32	0.08	0.19	0.28	0.45	0.32	0.30	0.17	0.32	0.35	0.04	0.21	0.64	0.35	0.27	0.17	0.51	0.27	0.31	0.14
46	−0.05	0.37	0.26	−0.03	0.42	0.25	0.17	−0.08	0.46	0.01	0.22	0.04	0.13	−0.07	−0.04	0.05	0.26	0.04	0.19	0.13	0.00	0.53	0.19	0.10	0.14	−0.08
47	0.27	0.10	0.14	0.27	0.24	0.18	0.23	0.27	0.23	0.36	0.37	0.27	0.34	0.22	0.52	0.35	0.33	0.65	0.24	0.39	0.27	0.27	0.47	0.27	0.40	0.27
48	0.13	0.27	0.51	0.23	0.24	0.56	0.44	0.06	0.19	0.35	0.48	0.49	0.39	0.19	0.37	0.48	0.13	0.35	0.56	0.44	0.27	0.24	0.57	0.40	0.41	0.17
49	0.14	0.04	0.14	0.18	0.13	0.18	0.15	0.19	0.18	0.25	0.31	0.22	0.35	0.21	0.39	0.25	0.14	0.48	0.27	0.41	0.18	0.14	0.41	0.23	0.38	0.24
50	0.12	0.04	0.19	0.14	0.13	0.24	0.18	0.17	0.20	0.27	0.32	0.24	0.30	0.14	0.37	0.23	0.16	0.54	0.25	0.33	0.18	0.16	0.42	0.20	0.31	0.14
51	0.07	0.22	0.18	0.11	0.37	0.22	0.13	0.14	0.32	0.14	0.31	0.14	0.14	0.07	0.13	0.12	0.30	0.17	0.21	0.18	0.10	0.45	0.34	0.16	0.24	0.14
52	0.12	0.59	0.45	0.23	0.37	0.40	0.21	0.06	0.16	0.23	0.32	0.19	0.11	0.18	0.23	0.23	0.08	0.17	0.45	0.19	0.23	0.34	0.40	0.32	0.21	0.18
53	0.08	0.17	0.24	0.06	0.15	0.27	0.17	0.16	0.31	0.18	0.42	0.19	0.26	0.16	0.20	0.21	0.26	0.19	0.27	0.29	0.08	0.22	0.41	0.20	0.32	0.10
54	0.21	0.32	0.75	0.29	0.23	0.77	0.42	0.04	0.21	0.24	0.48	0.44	0.29	0.11	0.24	0.41	0.09	0.22	0.67	0.35	0.31	0.21	0.55	0.37	0.27	0.07
55	0.15	0.17	0.28	0.19	0.11	0.30	0.26	0.20	0.10	0.36	0.36	0.32	0.33	0.31	0.49	0.40	0.06	0.43	0.34	0.36	0.21	0.09	0.43	0.35	0.43	0.27
56	0.13	0.36	0.41	0.18	0.24	0.42	0.25	0.08	0.39	0.19	0.45	0.20	0.32	0.21	0.25	0.25	0.13	0.23	0.46	0.37	0.16	0.35	0.44	0.21	0.34	0.20

Correlation matrix for the input association matrix of EFA (Part 3)

Item	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
28	0.62																												
29	0.62	0.67																											
30	0.38	0.27	0.42																										
31	0.29	0.30	0.19	0.25																									
32	0.46	0.45	0.57	0.39	0.34																								
33	0.40	0.31	0.32	0.62	0.16	0.25																							
34	0.38	0.38	0.44	0.28	0.40	0.64	0.15																						
35	0.23	0.28	0.27	0.24	0.25	0.47	0.11	0.54																					
36	0.52	0.55	0.43	0.29	0.29	0.31	0.38	0.28	0.28																				
37	0.32	0.31	0.23	0.19	0.38	0.32	0.19	0.28	0.20	0.29																			
38	0.52	0.53	0.45	0.31	0.34	0.32	0.38	0.27	0.22	0.85	0.35																		
39	0.44	0.52	0.42	0.32	0.25	0.31	0.42	0.24	0.20	0.73	0.32	0.76																	
40	0.22	0.21	0.23	0.19	0.24	0.43	0.11	0.54	0.69	0.24	0.23	0.20	0.19																
41	0.43	0.39	0.36	0.31	0.22	0.24	0.40	0.18	0.19	0.44	0.21	0.45	0.48	0.16															
42	0.35	0.32	0.34	0.28	0.22	0.33	0.32	0.16	0.16	0.24	0.43	0.31	0.30	0.16	0.32														
43	0.20	0.16	0.24	0.35	0.10	0.26	0.39	0.21	0.28	0.19	0.18	0.23	0.20	0.35	0.23	0.28													
44	0.32	0.28	0.24	0.22	0.17	0.18	0.27	0.12	0.06	0.29	0.52	0.36	0.35	0.05	0.20	0.46	0.13												
45	0.32	0.28	0.45	0.39	0.07	0.36	0.41	0.27	0.27	0.18	0.12	0.21	0.25	0.22	0.28	0.37	0.54	0.25											
46	0.09	0.07	0.18	0.22	0.24	0.31	0.06	0.40	0.42	0.08	0.17	0.12	0.14	0.56	0.05	0.16	0.39	0.00	0.20										
47	0.48	0.60	0.46	0.27	0.33	0.31	0.39	0.21	0.24	0.64	0.43	0.64	0.62	0.20	0.42	0.37	0.28	0.34	0.25	0.13									
48	0.41	0.35	0.49	0.53	0.15	0.38	0.53	0.30	0.25	0.33	0.20	0.38	0.39	0.18	0.35	0.35	0.52	0.20	0.70	0.24	0.44								
49	0.49	0.45	0.37	0.24	0.23	0.28	0.31	0.21	0.20	0.68	0.24	0.67	0.57	0.16	0.54	0.31	0.20	0.27	0.26	0.05	0.60	0.40							
50	0.41	0.46	0.36	0.27	0.26	0.29	0.32	0.24	0.23	0.62	0.21	0.58	0.54	0.18	0.46	0.29	0.22	0.19	0.26	0.10	0.58	0.41	0.83						
51	0.21	0.21	0.28	0.23	0.25	0.32	0.12	0.35	0.43	0.20	0.34	0.23	0.22	0.43	0.21	0.31	0.29	0.23	0.24	0.51	0.33	0.27	0.26	0.30					
52	0.17	0.17	0.28	0.34	0.10	0.22	0.40	0.15	0.19	0.24	0.13	0.26	0.29	0.25	0.33	0.28	0.73	0.24	0.54	0.34	0.31	0.51	0.25	0.27	0.35				
53	0.29	0.31	0.40	0.26	0.28	0.41	0.19	0.46	0.46	0.24	0.29	0.27	0.25	0.39	0.36	0.33	0.24	0.28	0.30	0.34	0.36	0.31	0.23	0.27	0.54	0.31			
54	0.26	0.25	0.48	0.46	0.09	0.44	0.40	0.30	0.29	0.20	0.14	0.22	0.23	0.23	0.25	0.39	0.54	0.15	0.75	0.24	0.25	0.69	0.22	0.25	0.26	0.53	0.33		
55	0.51	0.43	0.42	0.35	0.13	0.25	0.51	0.16	0.09	0.51	0.15	0.53	0.55	0.05	0.54	0.31	0.29	0.28	0.41	−0.04	0.48	0.47	0.55	0.52	0.14	0.39	0.28	0.40	
56	0.37	0.35	0.46	0.33	0.22	0.47	0.22	0.47	0.44	0.24	0.17	0.27	0.26	0.41	0.20	0.28	0.44	0.24	0.47	0.33	0.32	0.39	0.25	0.26	0.36	0.40	0.53	0.50	0.37

Abbreviation: EFA = exploratory factor analysis.

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