

The impact of shadowboxing on the psychological well-being of professional martial artists

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Abstract

Does martial arts practice contribute to psychological well-being in professional martial artists? If so, what are the specific ways that martial arts practice accomplishes this? It has been a long-standing and widely held belief that martial arts practice can contribute to psychological well-being, however, there has been a lack of empirical research in the psychological literature focused on investigating the details of this hypothesis. The purpose of this research is therefore to investigate the impact of a paradigmatic martial arts practice—shadowboxing—on the psychological well-being of professional martial artists. In this article I present the results from an original empirical study on professional Muay Thai practitioners ($n = 14$) that reveals how a martial arts practice (shadowboxing) contributes to their overall psychological well-being by contributing to their positive emotions, engagement, relationships, meaning, and accomplishment. I present general results for how shadowboxing contributes to the psychological well-being of these professional martial artists overall, as well as more specific results for how shadowboxing contributes to the psychological well-being of these professional martial artists based on factors such as their gender, fight experience, and training location. This article also provides qualitative first-person reports from professional Muay Thai practitioners ($n = 14$) about their use of visualization and mental imagery and their experience of flow while shadowboxing, offering unique insight into the minds of professional martial artists as they are actively engaged in their craft. Finally, this article discusses the value and limitations of the present study and outlines suggestions for future research.

Keywords Martial arts · Muay Thai · Shadowboxing · Psychological well-being · Emotions · Flow · Relationships · Meaning · Accomplishment

1 Introduction

Muay Thai has been the national sport of Thailand since the 1930s, and with over two dozen training camps across the country, Muay Thai remains a huge draw for tourism from all over the world [9, 20, 24]. In fact, Thai Fight recently invested over \$5.5 million USD (200 million THB) into developing and opening the world's first Muay Thai luxury hotel [15]. Not only is Muay Thai a fun and effective form of exercise that is enjoyed by people of all kinds from all over the world, it is also one of the most popular and effective striking systems in mixed martial arts, as evidenced by the prominent usage of Muay Thai techniques in contemporary MMA [2, 34]. Further, at the 138th International Olympic Committee session

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in 2021, Muay Thai received full IOC recognition, preparing Muay Thai for eventual integration into regularly occurring Olympic events [1]. Since Muay Thai is becoming increasingly popular and widely integrated into international martial arts and fitness communities, it is becoming increasingly important to investigate the potential costs and benefits of Muay Thai training for practitioners. For example, it has been a long-standing and widely held belief that martial arts practice can contribute to psychological well-being [4, 16, 17, 20, 23, 25, 26, 30, 31], however, there has been a lack of empirical research in the psychological literature focused on investigating the details of this hypothesis. The purpose of this research is therefore to investigate the impact of a paradigmatic martial arts practice—shadowboxing—on the psychological well-being of professional martial artists: more specifically, Muay Thai practitioners or Nak Muays that compete at the professional level in sanctioned competitions. This article offers a unique contribution to the literature by presenting the results from an original empirical study on professional Muay Thai practitioners ($n = 14$) that reveals how a martial arts practice (shadowboxing) contributes to their overall psychological well-being by contributing to their positive emotions, engagement, relationships, meaning, and accomplishment. This article presents general results for how shadowboxing contributes to the psychological well-being of these professional martial artists overall, as well as more specific results for how shadowboxing contributes to the psychological well-being of these professional martial artists based on factors such as their gender, experience, and training location. This article further provides qualitative first-person reports from professional Muay Thai practitioners ($n = 14$) about their use of visualization or mental imagery and their experience of flow while shadowboxing, offering unique insight into the minds of elite Muay Thai professionals as they are actively engaged in their craft.

2 Shadowboxing and the psychological well-being of professional martial artists

In the existing literature on martial arts, “shadowboxing” has been characterized by Croom [2] as:

The practice of rehearsing and refining martial arts techniques and mentally simulating training or combat-relevant scenarios in order to develop technical mastery and physical capacity. For example, a Muay Thai practitioner may use a shadowboxing session to practice their jab–cross–hook–roundhouse–kick combination, both aiming to improve the mechanics with which this complex movement pattern is executed as well as their energetic ability to execute this complex movement pattern successfully. (p. 13)

In other words, when professional martial artists are engaged in intentional shadowboxing practice, they are not simply producing random motor outputs in a thoughtless manner, but are rather intentionally creating different mental scenarios to work through, rehearsing and refining complex motor sequences, and adapting to the energetic and other physical requirements involved in these activities. There are at least two reasons for why shadowboxing is a particularly interesting activity to study among martial artists. First, shadowboxing is a particularly interesting activity to study because martial artists across all the striking arts engage in shadowboxing, including athletes involved in Boxing, Capoeira, Karate, Kickboxing, Krav Maga, Kung-Fu, Sambo, and Taekwondo. Although shadowboxing varies from art to art, all striking arts make important use of shadowboxing (as the individual rehearsal of technical forms) since rehearsal of relevant striking techniques is central to mastering any striking system. As Cynarski [8, 9] writes, “Technical forms for centuries have been used as the basic method of conveying the technical knowledge of a given style, about tactics and experiences of masters from previous generations” (p. 48, [10, 23]). Accordingly, I use the term *shadowboxing* in general to include the practice or rehearsal of relevant technical forms at any speed, with any technique, from any striking art. Second, shadowboxing is a particularly interesting activity to study because it is an especially intentional or cognitive activity that involves imagination, mental simulation, planning, and complex and accurate motor execution. Given the large number of individual strikes (variations of punches, kicks, knees, and elbows) and common combinations available in Muay Thai, shadowboxing sessions provide Nak Muays (professional Muay Thai practitioners) with a mentally and physically engaging activity with limitless aspects of their art to practice and improve upon. Finally, given that shadowboxing requires no additional equipment or training partners, it is also an extremely convenient form of martial arts training that can be done almost anywhere and at any time.

Exercise physiologists, sports psychologists, and positive psychologists have not yet investigated the physical and psychological effects of Muay Thai training, making this an exciting area for new research. For example, previous empirical research on Muay Thai largely adopted a semi-structured interview methodology and did not provide quantitative data on the influence of Muay Thai training on the individual elements of psychological well-being, such as positive emotions, flow experience, social relationships, meaning or purpose in life, and accomplishment [2, 4, 22]. Further, previous

empirical research did not yet consider how Muay Thai training may benefit people differently based on their gender, martial arts experience, and training location. An important goal of the present research on professional Nak Muays ($n = 14$) is therefore to address these important research questions and fill this gap in the literature by drawing upon quantitative methods from social psychology and positive psychology. Another important goal of the present research is to gain insight into the use of visualization or mental simulation among these professional and highly decorated martial artists ($n = 14$). Since no other empirical research on the psychological well-being of professional Muay Thai practitioners ($n = 14$) exists in the literature, results from this research can offer valuable new insights into the minds and practices of elite martial artists. Further, since the martial artists covered in this study include many professional Muay Thai champions (for example, IKF, Lion Fight, Muay Thai Grand Prix, WBC, and WKA world title holders), this article covers an especially elite population never before covered in the literature on Muay Thai and psychological well-being.

This original research article will focus on providing answers to the following research questions about shadowboxing and psychological well-being among Muay Thai professionals: (1) Does the practice of shadowboxing among professional Muay Thai practitioners contribute to their positive emotions? (2) Does the practice of shadowboxing among professional Muay Thai practitioners contribute to their engagement or flow experience? (3) Does the practice of shadowboxing among professional Muay Thai practitioners contribute to their social relationships? (4) Does the practice of shadowboxing among professional Muay Thai practitioners contribute to their meaning or purpose in life? (5) Does the practice of shadowboxing among professional Muay Thai practitioners contribute to their accomplishment? (6) Which elements of psychological well-being does shadowboxing contribute to the most and the least among professional Muay Thai practitioners? (7) Does shadowboxing contribute to the psychological well-being of professional Muay Thai practitioners differently based on factors such as their gender, fight experience, and training location?

3 Methods

This section provides details regarding the professional martial artists that participated in this research ($n = 14$) as well as the PERMA research questions regarding psychological well-being ($n = 23$). In “Flourish: Positive Psychology and Positive Interventions,” Seligman [27] explains that “Positive psychology is about the concept of well-being. The elements of well-being are PERMA: positive emotion, engagement, relationships, meaning, and accomplishment” (p. 236). For a detailed literature review of the PERMA framework for psychological well-being, especially as it applies to martial artists, see Croom [2, 4, 5]. This article will focus on a concise presentation of the empirical results about the psychological well-being of professional Muay Thai practitioners.

3.1 Participants

Participants were recruited through social media (Instagram) and were provided a link to a website that included a 23-item questionnaire. Since this study is focused on professional martial artists, only professional Muay Thai practitioners that had a record of winning professionally sanctioned fights were eligible to participate (professional events are regulated and sanctioned by official organizations such as the WBC). Participants in this study included 14 professional Muay Thai practitioners ($n = 14$, females = 4, males = 10) from 11 different locations around the world including Bangkok, Thailand (OT), Khao Lak, Thailand (MH), Phuket, Thailand (AN, JB, SG), London, England, UK (MP), Melton Mowbray, Leicestershire, UK (IB), Eagan, Minnesota, USA (IG), San Antonio, Texas, USA (CJ), Calgary, Alberta, Canada (JLP, SM), Brisbane, Queensland, Australia (CJ), Tulum, Mexico (BF), and Cagliari, Sardegna, Italy (FP) (pseudonyms are used for participants throughout this article).

Participants were an average of 31 years old (30.86 ± 7.34 , CI 26.62–35.09), had an average of 27 pro fights each (27.29 ± 28.23 , CI 10.99–43.58), and practiced shadowboxing an average of 6 days per week (6.18 ± 1.64 , CI 5.23–7.12). Since this research aims to examine any potential differences in how Muay Thai training may impact individuals based on their fight experience, training location, and gender, breakdowns by fight experience, training location, and gender are provided. The Muay Thai practitioners ($n = 7$) with more fight experience (top half for pro fights) were an average age of 34 years old (34.00 ± 8.12 , CI 26.49–41.51), had an average of 44 pro fights each (43.71 ± 32.30 , CI 13.84–73.59), and practiced shadowboxing an average of 6 days per week (5.86 ± 2.27 , CI 3.76–7.95) while the Muay Thai practitioners ($n = 7$) with less fight experience (bottom half for pro fights) were an average age of 28 years old (27.71 ± 5.25 , CI 22.86–32.57), had an average of 11 pro fights each (10.86 ± 7.29 , CI 4.12–17.60), and practiced shadowboxing an average of 6 days per week (6.50 ± 0.65 , CI 5.90–7.10). Male Muay Thai practitioners ($n = 10$) were an average age of 32 years old (32.10 ± 7.78 ,

CI 26.53–37.67), had an average of 20 pro fights each (19.60 ± 14.06 , CI 9.54–29.66), and practiced shadowboxing an average of 6 days per week (6.05 ± 1.92 , CI 4.68–7.42) while female Muay Thai practitioners ($n = 4$) were an average age of 28 years old (27.75 ± 5.80 , CI 18.53–36.97), had an average of 47 pro fights each (46.50 ± 46.58 , CI 27.62–120.62), and practiced shadowboxing an average of 6 days per week (6.50 ± 0.58 , CI 5.58–7.42). Finally, Muay Thai practitioners training in Thailand ($n = 5$) were an average age of 30 years old (29.60 ± 5.94 , CI 22.22–36.98), had an average of 26 pro fights each (25.80 ± 11.26 , CI 11.82–39.78), and practiced shadowboxing an average of 6 days per week (5.90 ± 0.74 , CI 4.98–6.82) while Muay Thai practitioners training outside of Thailand ($n = 9$) were an average age of 32 years old (31.56 ± 8.26 , CI 25.20–37.91), had an average of 28 pro fights each (28.11 ± 35.06 , CI 1.16–55.06), and practiced shadowboxing an average of 6 days per week (6.33 ± 2.00 , CI 4.80–7.87).

Participants in this study include some of the most distinguished champions in Muay Thai. For example, OT's professional titles include IKF World Champion (Lightweight Division), Lion Fight World Champion (Lightweight Division), Muay Thai Grand Prix World Champion (Lightweight Division), WBC North American Champion (Super Featherweight Division), and WKA North American Champion (Lightweight Division). IB's titles include Enfusion World Champion (54 kg Division), Lion Fight World Champion (Super Bantamweight Division), WBC Muay Thai World Champion (54 kg Division), WKA World Champion (Bantamweight Division), WPMF World Champion (Bantamweight Division), and WRSA World Champion (54 kg Division). SG's titles include WMC European Champion (Flyweight Division) and WAKO Pro K1 Nordic Champion (50 kg Division), SM's titles include Pan American Champion (75 kg Division) and IKF World Classic Champion (Middleweight Division), MP's titles include WKA World Champion (Light Welterweight Division), and BJ's titles include WBC Muay Thai World Champion (Light Heavyweight Division). Finally, AN is King's Cup Champion (67 kg Division) and Omnoi Stadium Champion (140 lb Division), FP is WBC Muay Thai Italian Champion (Super Welterweight Division), and JLP is Lion Fight North American Champion (Super Welterweight Division).

3.2 Questionnaire

13 of the 23 items were free response questions that asked: (Q1) "What is your name?", (Q2) "What is your age, location, and affiliated gym?", (Q3) "Which martial art do you practice?", (Q4) "How long have you been training in martial arts?", (Q5) "How many professional fights do you have?", (Q6) "How frequently do you shadowbox?", (Q7) "With your best guess, how many total shadowboxing sessions have you done in your life?", (Q8) "What is your shadowboxing-to-fighting ratio?", (Q9) "How long are your shadowboxing sessions?", (Q10) "Why do you shadowbox?", (Q11) "What do you think about or visualize when you shadowbox?", (Q12) "What are the benefits of shadowboxing?", and (Q13) "What are the harms of shadowboxing?". The remaining 10 items concerned psychological well-being and were presented with 7-point scales from 1 (strongly disagree) to 7 (strongly agree). The remaining 10 items regarding psychological well-being were adopted from the influential PERMA framework in positive psychology [2–4, 27–29] that characterizes psychological well-being in terms of five elements including positive emotions (P), engagement or flow experience (E), social relationships (R), meaning or purpose in life (M), and accomplishment (A). The PERMA element P for positive emotions was assessed with two sentences: (Q14) and (Q20). (Q14) was positively scored and stated: "On a scale from 1 (strongly disagree) to 7 (strongly agree), rate this sentence: "Shadowboxing contributes to my experience of positive emotions."" (Q20) was negatively scored and stated: "On a scale from 1 (strongly disagree) to 7 (strongly agree), rate this sentence: "Shadowboxing contributes to my experience of negative emotions."" The scores from (Q14) and (Q20) were then combined to form a composite score for the PERMA element P for positive emotions. The PERMA element E for engagement or flow experience was assessed with two sentences: (Q17) and (Q22). (Q17) was positively scored and stated: "On a scale from 1 (strongly disagree) to 7 (strongly agree), rate this sentence: "Shadowboxing contributes to my experience of flow or absorbed engagement in what I'm doing."" (Q22) was negatively scored and stated: "On a scale from 1 (strongly disagree) to 7 (strongly agree), rate this sentence: "Shadowboxing detracts from my experience of flow or absorbed engagement in what I'm doing."" The scores from (Q17) and (Q22) were then combined to form a composite score for the PERMA element E for engagement or flow experience. The PERMA element R for social relationships was assessed with two sentences: (Q18) and (Q15). (Q18) was positively scored and stated: "On a scale from 1 (strongly disagree) to 7 (strongly agree), rate this sentence: "Shadowboxing contributes to my positive relationships with others."" (Q15) was negatively scored and stated: "On a scale from 1 (strongly disagree) to 7 (strongly agree), rate this sentence: "Shadowboxing detracts from my positive relationships with others."" The scores from (Q18) and (Q15) were then combined to form a composite score for the PERMA element R for social relationships. The PERMA element M for meaning or purpose in life was assessed with two sentences: (Q21) and (Q19). (Q21) was positively scored and stated: "On a scale from 1 (strongly disagree) to 7 (strongly agree), rate this sentence: "Shadowboxing contributes to my sense of meaning or purpose in life."" (Q19) was negatively scored and stated: "On a scale from 1 (strongly disagree)

to 7 (strongly agree), rate this sentence: "Shadowboxing detracts from my sense of meaning or purpose in life." The scores from (Q21) and (Q19) were then combined to form a composite score for the PERMA element M for meaning or purpose in life. Finally, the PERMA element A for accomplishment was assessed with two sentences: (Q23) and (Q16). (Q23) was positively scored and stated: "On a scale from 1 (strongly disagree) to 7 (strongly agree), rate this sentence: "Shadowboxing contributes to my sense of accomplishment."" (Q16) was negatively scored and stated: "On a scale from 1 (strongly disagree) to 7 (strongly agree), rate this sentence: "Shadowboxing detracts from my sense of accomplishment."" The scores from (Q23) and (Q16) were then combined to form a composite score for the PERMA element A for accomplishment. The scoring method for positive sentences (positively scored) and negative sentences (negatively scored) adopted in this study follow standard scoring conventions in the field such as those adopted in the Oxford Happiness Inventory and the Oxford Happiness Questionnaire [6, 11, 12, 14, 18, 19, 21, 33].

4 Results

This section presents general results for how shadowboxing contributes to the psychological well-being of professional Muay Thai practitioners overall ($n = 14$), as well as more specific results for how shadowboxing contributes to the psychological well-being of these professional martial artists based on factors such as their gender, fight experience, and training location.

One research question that I raised was whether the practice of shadowboxing among professional martial artists contributes to positive emotions. Results from this study demonstrate that professional Muay Thai practitioners strongly agreed with the statement "Shadowboxing contributes to my experience of positive emotions" (6.32 ± 1.23 , CI 5.61–7.03) and strongly disagreed with the statement "Shadowboxing contributes to my experience of negative emotions" (1.14 ± 0.36 , CI 0.93–1.35). A composite score of 14 (out of 14) on this dimension indicates the strongest possible agreement that shadowboxing contributes positively to emotions whereas a composite score of 2 (out of 14) indicates the strongest possible agreement that shadowboxing contributes negatively to emotions. A composite score of 8 (out of 14) on this dimension reflects a neutral position on whether shadowboxing contributes positively or negatively to emotions. Results show that the composite score for the influence of shadowboxing on positive emotions was 13.18 out of 14.00 (13.18 ± 1.20 , CI 12.48–13.87) confirming our hypothesis that the practice of shadowboxing contributes to positive emotions among professional Muay Thai practitioners (Fig. 1).

A second research question that I raised was whether the practice of shadowboxing among professional martial artists contributes to engagement or flow experience. Results from this study demonstrate that professional Muay Thai practitioners strongly agreed with the statement "Shadowboxing contributes to my experience of flow or absorbed engagement in what I'm doing" (6.36 ± 1.65 , CI 5.41–7.31) and strongly disagreed with the statement "Shadowboxing detracts from my experience of flow or absorbed engagement in what I'm doing" (1.00 ± 0.00 , CI 1.00–1.00). A composite score of 14 (out of 14) on this dimension indicates the strongest possible agreement that shadowboxing contributes positively to engagement or flow experience whereas a composite score of 2 (out of 14) indicates the strongest possible agreement that shadowboxing contributes negatively to engagement or flow experience. A composite score of 8 (out of 14) on this dimension reflects a neutral position on whether shadowboxing contributes positively or negatively to engagement or flow experience. Results show that the composite score for the influence of shadowboxing on engagement or flow experience was 13.36 out of 14.00 (13.36 ± 1.65 , CI 12.41–14.31) confirming our hypothesis that the practice of shadowboxing contributes to engagement or flow experience among professional Muay Thai practitioners (Fig. 1).

A third research question that I raised was whether the practice of shadowboxing among professional martial artists contributes to social relationships. Results from this study demonstrate that professional Muay Thai practitioners strongly agreed with the statement "Shadowboxing contributes to my positive relationships with others" (4.54 ± 2.36 , CI 3.17–5.90) and strongly disagreed with the statement "Shadowboxing detracts from my positive relationships with others" (1.00 ± 0.00 , CI 1.00–1.00). A composite score of 14 (out of 14) on this dimension indicates the strongest possible agreement that shadowboxing contributes positively to relationships whereas a composite score of 2 (out of 14) indicates the strongest possible agreement that shadowboxing contributes negatively to relationships. A composite score of 8 (out of 14) on this dimension reflects a neutral position on whether shadowboxing contributes positively or negatively to relationships. Results show that the composite score for the influence of shadowboxing on relationships was 11.54 out of 14.00 (11.54 ± 2.36 , CI 10.17–12.90) confirming our hypothesis that the practice of shadowboxing contributes to social relationships among professional Muay Thai practitioners (Fig. 1).

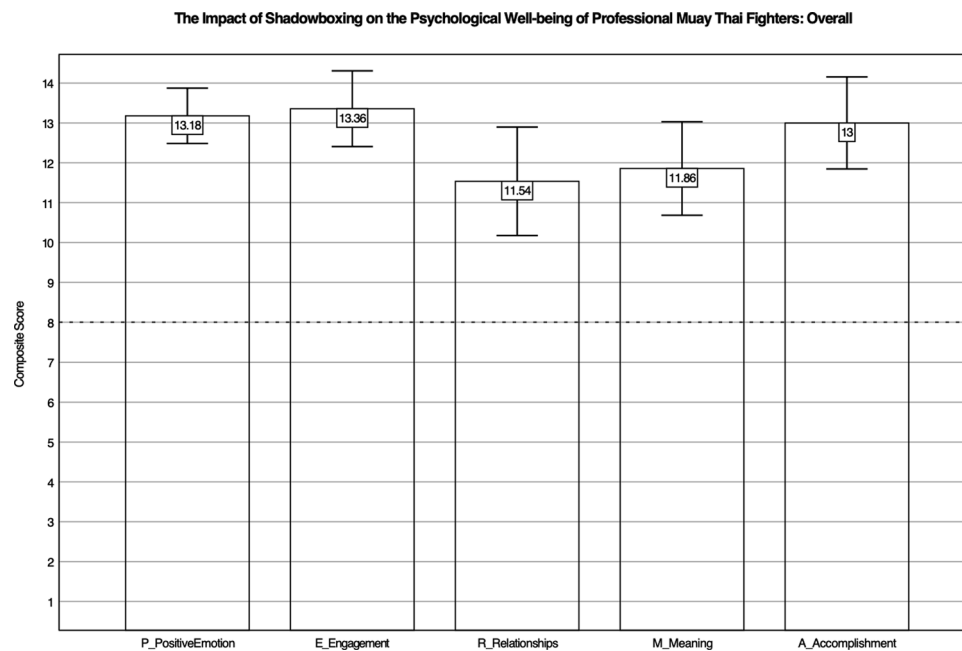


Fig. 1 This figure provides a bar plot with 95% confidence intervals (CIs) for composite PERMA scores: overall ($n=14$). For each element of psychological well-being, the lowest possible composite score is 2 representing that professional Nak Muays strongly agree that shadowboxing negatively impacts that element of psychological well-being, whereas the highest possible composite score is 14 representing that professional Nak Muays strongly agree that shadowboxing positively impacts that element of psychological well-being. A composite score of 8 (dotted line) reflects a neutral position on whether shadowboxing contributes positively or negatively to that element. Results in this figure show that professional Nak Muays strongly agree that shadowboxing positively contributes to all elements of their psychological well-being. Further, results in this figure show that shadowboxing contributes to the elements of psychological well-being in the following rank-order for professional Muay Thai fighters overall: engagement (E), positive emotions (P), accomplishment (A), meaning (M), and relationships (R). Statistics were calculated using IBM SPSS Statistics software

A fourth research question that I raised was whether the practice of shadowboxing among professional martial artists contributes to meaning or purpose in life. Results from this study demonstrate that professional Muay Thai practitioners strongly agreed with the statement “Shadowboxing contributes to my sense of meaning or purpose in life” (4.93 ± 2.23 , CI 3.64–6.22) and strongly disagreed with the statement “Shadowboxing detracts from my sense of meaning or purpose in life” (1.14 ± 0.53 , CI 0.83–1.45). A composite score of 14 (out of 14) on this dimension indicates the strongest possible agreement that shadowboxing contributes positively to meaning or purpose in life whereas a composite score of 2 (out of 14) indicates the strongest possible agreement that shadowboxing contributes negatively to meaning or purpose in life. A composite score of 8 (out of 14) on this dimension reflects a neutral position on whether shadowboxing contributes positively or negatively to meaning or purpose in life. Results show that the composite score for the influence of shadowboxing on meaning or purpose in life was 11.86 out of 14.00 (11.86 ± 2.03 , CI 10.68–13.03) confirming our hypothesis that the practice of shadowboxing contributes to meaning or purpose in life among professional Muay Thai practitioners (Fig. 1).

A fifth research question that I raised was whether the practice of shadowboxing among professional martial artists contributes to accomplishment. Results from this study demonstrate that professional Muay Thai practitioners strongly agreed with the statement “Shadowboxing contributes to my sense of accomplishment” (6.00 ± 2.00 , CI 4.85–7.15) and strongly disagreed with the statement “Shadowboxing detracts from my sense of accomplishment” (1.00 ± 0.00 , CI 1.00–1.00). A composite score of 14 (out of 14) on this dimension indicates the strongest possible agreement that shadowboxing contributes positively to accomplishment whereas a composite score of 2 (out of 14) indicates the strongest possible agreement that shadowboxing contributes negatively to accomplishment. A composite score of 8 (out of 14) on this dimension reflects a neutral position on whether shadowboxing contributes positively or negatively to accomplishment. Results show that the composite score for the influence of shadowboxing on accomplishment was 13.00 out of 14.00 (13.00 ± 2.00 , CI 11.85–14.15) confirming our hypothesis that the practice of shadowboxing contributes to accomplishment among professional Muay Thai practitioners (Fig. 1).

Given that the composite score for the influence of shadowboxing on positive emotions (P) is 13.18 out of 14.00 (13.18 ± 1.20 , CI 12.48–13.87), the composite score for the influence of shadowboxing on engagement or flow experience (E) is 13.36 out of 14.00 (13.36 ± 1.65 , CI 12.41–14.31), the composite score for the influence of shadowboxing on social relationships (R) is 11.54 out of 14.00 (11.54 ± 2.36 , CI 10.17–12.90), the composite score for the influence of shadowboxing on meaning or purpose in life (M) is 11.86 out of 14.00 (11.86 ± 2.03 , CI 10.68–13.03), and the composite score for the influence of shadowboxing on accomplishment (A) is 13.00 out of 14.00 (13.00 ± 2.00 , CI 11.85–14.15), the results from this study provide clear empirical support for the hypothesis that shadowboxing significantly contributes to all five elements of psychological well-being in professional Muay Thai practitioners (Fig. 1).

Further, the results from this study provide an answer to a sixth research question that I raised concerning which elements of psychological well-being shadowboxing contributes to the most, and which elements of psychological well-being shadowboxing contributes to the least. Figure 1 provides a visualization of the overall results and Table S1 provides relevant descriptive statistics (prepared using IBM SPSS Statistics software). A comparison of composite scores reveals that shadowboxing contributed to the elements of psychological well-being in the following rank-order: (1) engagement (13.36 ± 1.65 , CI 12.41–14.31), (2) positive emotions (13.18 ± 1.20 , CI 12.48–13.87), (3) accomplishment (13.00 ± 2.00 , CI 11.85–14.15), (4) meaning (11.86 ± 2.03 , CI 10.68–13.03), and (5) relationships (11.54 ± 2.36 , CI 10.17–12.90). In other words, results from this study show that although shadowboxing contributes to all elements of psychological well-being in professional Muay Thai practitioners (all composite scores are above 8 and the dotted line in Fig. 1), shadowboxing contributes most strongly to engagement or flow experience (1st), followed by positive emotions (2nd), accomplishment (3rd), meaning or purpose in life (4th), and finally, social relationships (5th).

A seventh research question that I raised was whether shadowboxing contributes to the psychological well-being of individuals differently based on factors such as their gender, fight experience, and training location. A comparison of composite scores shows that shadowboxing contributed to the elements of psychological well-being in the following rank-order for men, women, more experienced practitioners, less experienced practitioners, practitioners training in Thailand, and practitioners training outside of Thailand, respectively:

For men ($n = 10$), shadowboxing contributed to the elements of psychological well-being in the following rank-order: (1) engagement (13.30 ± 1.89 , CI 11.95–14.65), (2) accomplishment (13.10 ± 1.91 , CI 11.73–14.47), (3) positive emotions (12.95 ± 1.34 , CI 11.99–13.91), (4) meaning (11.90 ± 2.23 , CI 10.30–13.50), and (5) relationships (11.65 ± 2.43 , CI 9.91–13.39). In other words, results show that although shadowboxing contributes to all elements of psychological well-being in male Muay Thai practitioners ($n = 10$), it contributes most strongly to their engagement or flow experience (1st), followed by accomplishment (2nd), positive emotions (3rd), meaning or purpose in life (4th), and finally, social relationships (5th) (Fig. 2).

For women ($n = 4$), shadowboxing contributed to the elements of psychological well-being in the following rank-order: (1) positive emotions (13.75 ± 0.50 , CI 12.95–14.55), (2) engagement (13.50 ± 1.00 , CI 11.91–15.09), (3) accomplishment (12.75 ± 2.50 , CI 8.77–16.73), (4) meaning (11.75 ± 1.71 , CI 9.03–14.47), and (5) relationships (11.25 ± 2.50 , CI 7.27–15.23). In other words, results show that although shadowboxing contributes to all elements of psychological well-being in female Muay Thai practitioners ($n = 4$), it contributes most strongly to their positive emotions (1st), followed by engagement or flow experience (2nd), accomplishment (3rd), meaning or purpose in life (4th), and finally, social relationships (5th) (Fig. 3).

For more experienced practitioners ($n = 7$), shadowboxing contributed to the elements of psychological well-being in the following rank-order: (1) engagement (13.00 ± 2.24 , CI 10.93–15.07), (2) positive emotions (12.79 ± 1.47 , CI 11.43–14.14), (3) accomplishment (12.00 ± 2.52 , CI 9.67–14.33), (4) relationships (11.07 ± 2.49 , CI 8.77–13.37), and (5) meaning (11.00 ± 2.08 , CI 9.07–12.93). In other words, results from this study show that although shadowboxing contributes to all elements of psychological well-being in more experienced Muay Thai practitioners ($n = 7$), it contributes most strongly to their engagement or flow experience (1st), followed by positive emotions (2nd), accomplishment (3rd), social relationships (4th), and finally, meaning or purpose in life (5th) (Fig. 4).

For less experienced practitioners ($n = 7$), shadowboxing contributed to the elements of psychological well-being in the following rank-order: (1) accomplishment (14.00 ± 0.00 , CI 14.00–14.00), (2) engagement (13.71 ± 0.76 , CI 13.02–14.41), (3) positive emotions (13.57 ± 0.79 , CI 12.84–14.30), (4) meaning (12.71 ± 1.70 , CI 11.14–14.29), and (5) relationships (12.00 ± 2.31 , CI 9.86–14.14). In other words, results show that although shadowboxing contributes to all elements of psychological well-being in less experienced Muay Thai practitioners ($n = 7$), it contributes most strongly to their accomplishment (1st), followed by engagement or flow experience (2nd), positive emotions (3rd), meaning or purpose in life (4th), and finally, social relationships (5th) (Fig. 5).

For practitioners training in Thailand ($n = 5$), shadowboxing contributed to the elements of psychological well-being in the following rank-order: (1) accomplishment (13.60 ± 0.89 , CI 12.49–14.71), (2) engagement (13.40 ± 0.89 , CI 12.30–14.51),

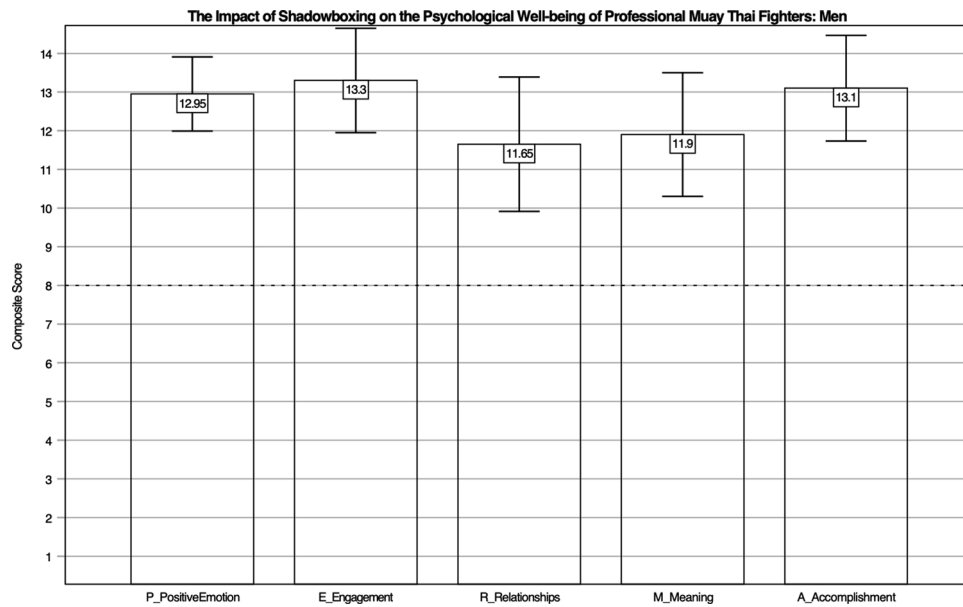


Fig. 2 This figure provides a bar plot with 95% confidence intervals (CIs) for composite PERMA scores: men (n=10). For each element of psychological well-being, the lowest possible composite score is 2 representing that professional Nak Muays strongly agree that shadowboxing negatively impacts that element of psychological well-being, whereas the highest possible composite score is 14 representing that professional Nak Muays strongly agree that shadowboxing positively impacts that element of psychological well-being. A composite score of 8 (dotted line) reflects a neutral position on whether shadowboxing contributes positively or negatively to that element. Results in this figure show that male Nak Muays strongly agree that shadowboxing positively contributes to all elements of their psychological well-being. Further, results in this figure show that shadowboxing contributes to the elements of psychological well-being in the following rank-order for men: engagement (E), accomplishment (A), positive emotions (P), meaning (M), and relationships (R)

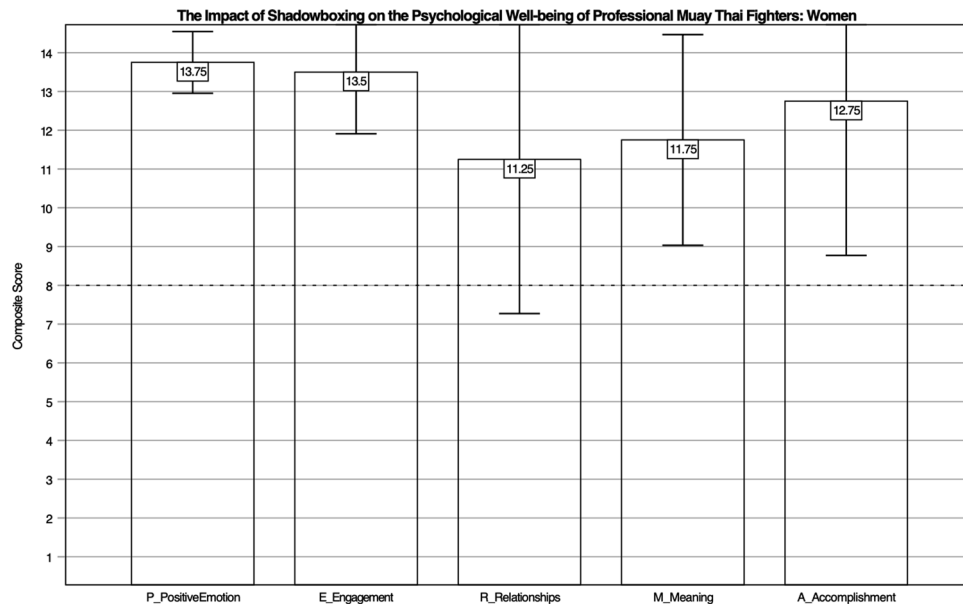


Fig. 3 This figure provides a bar plot with 95% confidence intervals (CIs) for composite PERMA scores: women (n=4). For each element of psychological well-being, the lowest possible composite score is 2 representing that professional Nak Muays strongly agree that shadowboxing negatively impacts that element of psychological well-being, whereas the highest possible composite score is 14 representing that professional Nak Muays strongly agree that shadowboxing positively impacts that element of psychological well-being. A composite score of 8 (dotted line) reflects a neutral position on whether shadowboxing contributes positively or negatively to that element. Results in this figure show that female Nak Muays strongly agree that shadowboxing positively contributes to all elements of their psychological well-being. Further, results in this figure show that shadowboxing contributes to the elements of psychological well-being in the following rank-order for women: positive emotions (P), engagement (E), accomplishment (A), meaning (M), and relationships (R)

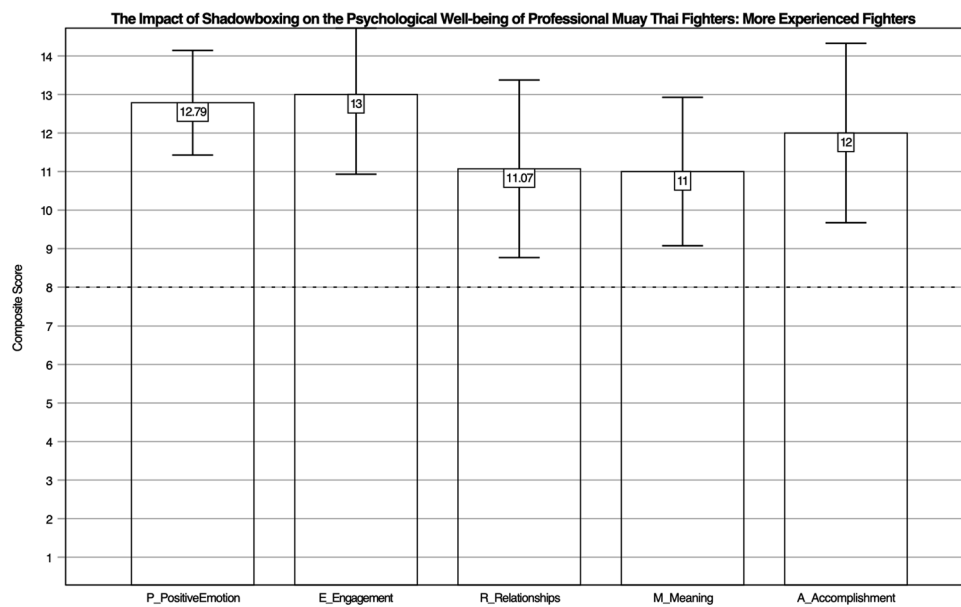


Fig. 4 This figure provides a bar plot with 95% confidence intervals (CIs) for composite PERMA scores: more experienced Nak Muays (n = 7). For each element of psychological well-being, the lowest possible composite score is 2 representing that professional Nak Muays strongly agree that shadowboxing negatively impacts that element of psychological well-being, whereas the highest possible composite score is 14 representing that professional Nak Muays strongly agree that shadowboxing positively impacts that element of psychological well-being. A composite score of 8 (dotted line) reflects a neutral position on whether shadowboxing contributes positively or negatively to that element. Results in this figure show that more experienced Nak Muays strongly agree that shadowboxing positively contributes to all elements of their psychological well-being. Further, results in this figure show that shadowboxing contributes to the elements of psychological well-being in the following rank-order for more experienced Nak Muays: engagement (E), positive emotions (P), accomplishment (A), relationships (R), and meaning (M)

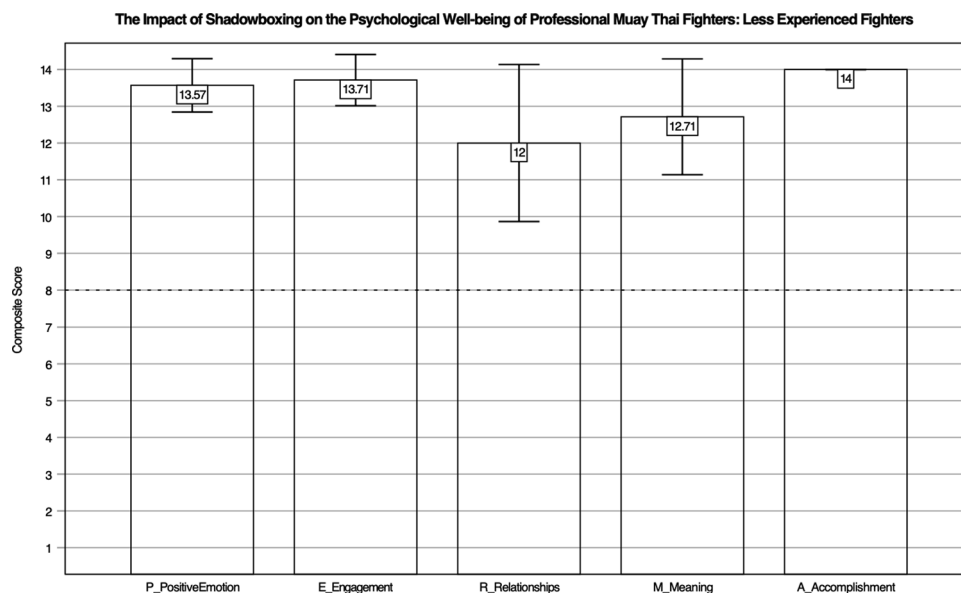


Fig. 5 This figure provides a bar plot with 95% confidence intervals (CIs) for composite PERMA scores: less experienced Nak Muays (n = 7). For each element of psychological well-being, the lowest possible composite score is 2 representing that professional Nak Muays strongly agree that shadowboxing negatively impacts that element of psychological well-being, whereas the highest possible composite score is 14 representing that professional Nak Muays strongly agree that shadowboxing positively impacts that element of psychological well-being. A composite score of 8 (dotted line) reflects a neutral position on whether shadowboxing contributes positively or negatively to that element. Results in this figure show that less experienced Nak Muays strongly agree that shadowboxing positively contributes to all elements of their psychological well-being. Further, results in this figure show that shadowboxing contributes to the elements of psychological well-being in the following rank-order for less experienced Nak Muays: accomplishment (A), engagement (E), positive emotions (P), meaning (M), and relationships (R)

(3) positive emotions (12.80 ± 1.79 , CI 10.58–15.02), (4) meaning (12.00 ± 2.12 , CI 9.37–14.63), and (5) relationships (10.40 ± 2.19 , CI 7.68–13.12). In other words, results show that although shadowboxing contributes to all elements of psychological well-being in Muay Thai practitioners training in Thailand ($n = 5$), it contributes most strongly to their accomplishment (1st), followed by engagement or flow experience (2nd), positive emotions (3rd), meaning or purpose in life (4th), and finally, social relationships (5th) (Fig. 6).

For practitioners training outside of Thailand ($n = 9$), shadowboxing contributed to the elements of psychological well-being in the following rank-order: (1) positive emotions (13.39 ± 0.78 , CI 12.79–13.99), (2) engagement (13.33 ± 2.00 , CI 11.80–14.87), (3) accomplishment (12.67 ± 2.40 , CI 10.82–14.51), (4) relationships (12.17 ± 2.32 , CI 10.38–13.95), and (5) meaning (11.78 ± 2.11 , CI 10.16–13.40). In other words, results show that although shadowboxing contributes to all elements of psychological well-being in Muay Thai practitioners training outside of Thailand ($n = 9$), it contributes most strongly to their positive emotions (1st), followed by engagement or flow experience (2nd), accomplishment (3rd), social relationships (4th), and finally, meaning or purpose in life (5th) (Fig. 7).

5 Free responses about visualization or mental imagery and flow experience

This section provides qualitative first-person reports from professional Muay Thai practitioners ($n = 14$) about their use of visualization or mental imagery and their experience of flow while shadowboxing, offering unique insight into the minds of professional martial artists as they are actively engaged in their craft. Some of the most insightful free responses are provided below. Since no other studies in the extant literature have published first-person reports from Muay Thai champions about their use of visualization or mental imagery and their experience of flow while shadowboxing, I provide substantive quotations from their free responses below. To assist the reader in thematic analysis of this content, reports regarding flow are bolded and reports regarding social interaction are underlined>.

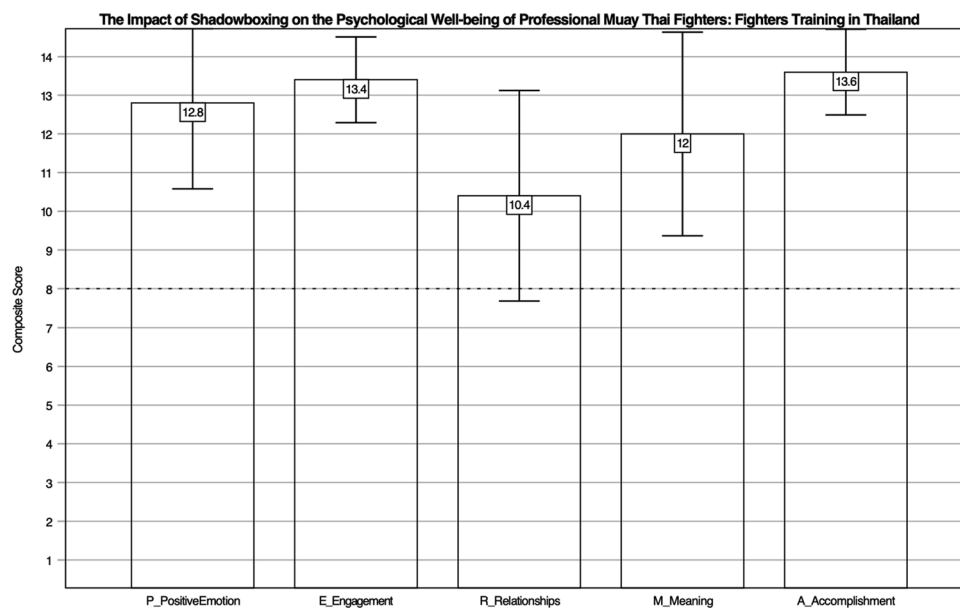


Fig. 6 This figure provides a bar plot with 95% confidence intervals (CIs) for composite PERMA scores: Nak Muays training in Thailand ($n = 5$). For each element of psychological well-being, the lowest possible composite score is 2 representing that professional Nak Muays strongly agree that shadowboxing negatively impacts that element of psychological well-being, whereas the highest possible composite score is 14 representing that professional Nak Muays strongly agree that shadowboxing positively impacts that element of psychological well-being. A composite score of 8 (dotted line) reflects a neutral position on whether shadowboxing contributes positively or negatively to that element. Results in this figure show that Nak Muays training in Thailand strongly agree that shadowboxing positively contributes to all elements of their psychological well-being. Further, results in this figure show that shadowboxing contributes to the elements of psychological well-being in the following rank-order for Nak Muays training in Thailand: accomplishment (A), engagement (E), positive emotions (P), meaning (M), and relationships (R)

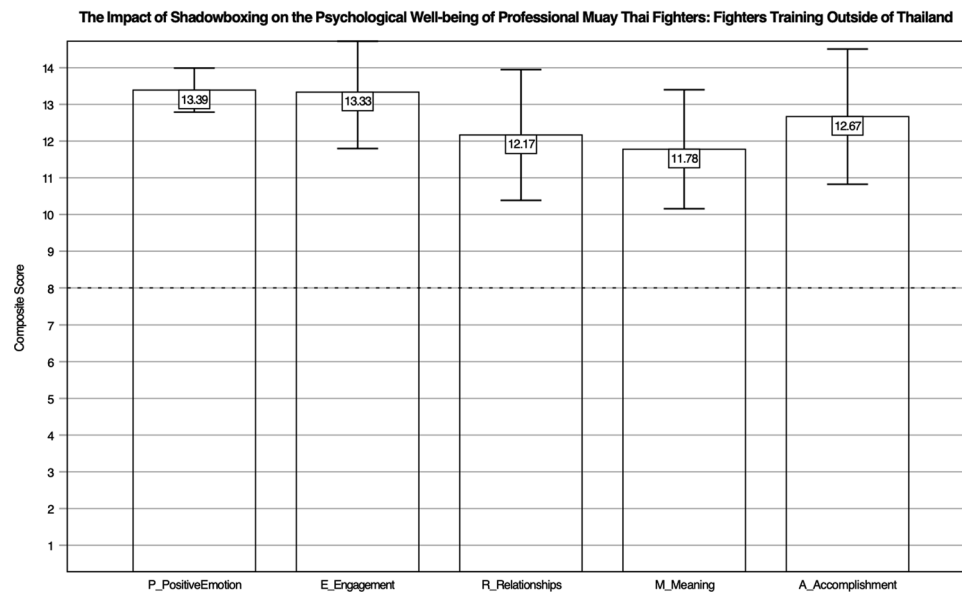


Fig. 7 This figure provides a bar plot with 95% confidence intervals (CIs) for composite PERMA scores: Nak Muays training outside of Thailand ($n=9$). For each element of psychological well-being, the lowest possible composite score is 2 representing that professional Nak Muays strongly agree that shadowboxing negatively impacts that element of psychological well-being, whereas the highest possible composite score is 14 representing that professional Nak Muays strongly agree that shadowboxing positively impacts that element of psychological well-being. A composite score of 8 (dotted line) reflects a neutral position on whether shadowboxing contributes positively or negatively to that element. Results in this figure show that Nak Muays training outside of Thailand strongly agree that shadowboxing positively contributes to all elements of their psychological well-being. Further, results in this figure show that shadowboxing contributes to the elements of psychological well-being in the following rank-order for Nak Muays training outside of Thailand: positive emotions (P), engagement (E), accomplishment (A), relationships (R), and meaning (M)

AN: “To be honest **I don’t really think too much** [while shadowboxing], **I just flow** as if I’m sparring with someone. **I just imagine I’m in a fight** and **I just shadow naturally without overthinking** really”.

BJ: “If I’m shadowboxing [...] as a warmup, a lot of the time it’s a little bit mindless. Then as I get a rhythm, like I’m just sort of throwing punches and kicks and knees just to warm and limber up the motions that I’m about to use on the pads or bag or partner or sparring or whatever, but **as I start to get limber I then start to channel in a little bit more, like imagining that there’s an opponent in front of me and I’m trying to hit in between or around the guard, or knee up the middle, or grab the hands, like I try to visualize someone being there and actually hitting them.** If I’m doing it as a real technical thing, then I’ll shadowbox with the purpose of trying to perfect a jab, or perfect a cross, I might even sometimes film it, so I’ll film my shadowboxing and review the video, film the shadowboxing then review the video, so that’s a really slow and long process but I tend to find that I get good results from that”.

CJ: “**When shadowboxing make sure to put yourself in the moment!** Don’t just do it mindlessly, **really create the atmosphere with your mind**”.

FP: “I do it because it’s like **I simulate the fight**, I think about my best movements and techniques and **I try to imagine the movements of my opponent.** The shadow is fundamental for staying focused on the fight with your mind”.

IG: “**I visualize my opponent, and his attacks. I also visualize myself setting my opponent up with techniques using angles, fakes, and feints**”.

IB: “I think of different techniques I can put together. I think about and concentrate on my footwork and how to move. I also include defending techniques and practice blocking and then countering. **Sometimes I imagine I have my opponent in front of me and practice what I would do**”.

JLP: “**One of the biggest reasons I shadowbox is because I can visualize: visualize my opponent, visualize the fight, visualize how I want the fight to play out. THE GAME PLAN - what I need to do and what my opponent might do.** How I need to move. Visualization is essential. I also use shadowboxing to visualize my own technique and to repeat techniques over and over again. Slow or fast. Repetition in any sport is crucial, and shadowboxing is a fantastic way to work on your skill and technique development without anyone or any equipment needed. You can make your technique/movement/footwork/defense PERFECT with slow thoughtful shadowboxing. Lastly, shadowboxing can

be used on a less technical basis to cut weight, to stay active and to improve focus and discipline. I love shadowboxing and believe that many underestimate the benefits”.

JB: “I visualize different things at different times. Sometimes I focus on good footwork, other times on good balance while performing powerful techniques. Combinations, correct breathing and also putting it all together”.

MH: “I visualize an opponent to train different fight scenes, for example, attacking and blocking and answering back”.

MP: “You simulate the process of a fight in your mind. You create mental scenarios of fighting your opponent and where you use all aspects of your fighting skills. Working on attack and defense as well as technique. **It’s key to be able to freestyle your movement with fluidity and flow of the mind and body** [...] The benefits to shadowboxing primarily for me is enabling the mind to be active in a process of fighting without fighting. It allows you to be creative and try movements. To develop better self body awareness”.

OT: “I think about my opponent’s attacks/think about specific defense techniques that I need to improve on. It helps prepare the mind for the techniques that you are trying to improve on before trying them on pads then sparring/helps visualize your opponent’s moves”.

SG: “It depends on the goal of the session. If I for example work on speed and throw 40 jabs as fast as possible, I focus on counting and to explode back and forth. If I do shadow as a warmup, I visualize an opponent and work on attack and defense”.

SM: “Visualization, especially if I know my opponent or I want to prepare for dealing with or throwing specific techniques in specific circumstances (I call this “mental reps”) [...] If I have an opponent lined up, I picture them in front of me and try to make my shadowboxing as close to (how I think) our fight will go. I visualize the strengths of my opponent or common sparring partners and shadowbox ways of dealing with their strengths. I visualize different scenarios and adapt my style of shadowboxing based on each: example, I’ll picture fighting a pressure fighter, fighting a kicker, fighting someone who runs, fighting someone with a crazy right hand, etc. [...] **I enjoy shadowboxing, especially outside, I find it meditative**”.

One important insight from the first-person reports provided by Muay Thai professionals is that flow experience (in bolded sections) is an important component of their shadowboxing. For example, MP reports that flow and fluidity of movement is a key component of shadowboxing, CJ reports the importance of putting yourself in the moment while shadowboxing, and SM reports that shadowboxing (especially outside) is a meditative practice. Another important insight from the first-person reports provided by Muay Thai professionals is that mentally visualizing and simulating interaction with others (in underlined sections) is another important component of their shadowboxing. For example, JLP reports that visualizing possible interactions with others is the main reason that they shadowbox, MH reports the importance of visualizing an opponent and simulating how their interactions might play out during a competition, and OT reports the importance of mentally simulating possible attacks from opponents as well as defensive techniques and counterattacks while shadowboxing. Finally, a third important insight from the first-person reports provided by Muay Thai professionals is that shadowboxing is often a component part of a larger system of training that involves a continuous fine-tuning of technical mastery through reiterated physical training and film analysis. For example, as BJ reports, “I’ll film my shadowboxing and review the video, film the shadowboxing then review the video, so that’s a really slow and long process but I tend to find that I get good results from that”. We can therefore see from this collection of first-person reports provided by Muay Thai champions that shadowboxing is often highly meditative and conducive for flow experience, often involves visualization and mentally simulating interaction with others, and forms an important part of a larger training system that often involves film analysis as well as other forms of physical training (drills, pad work, bag work, technical sparring, etc.).

6 Discussion

The results from this study are interesting and significant since this is the first empirical study to report that the practice of Muay Thai shadowboxing contributes to the psychological well-being of professional Muay Thai practitioners ($n = 14$). Further, results from this study show that although shadowboxing contributes to all elements of psychological well-being in professional Muay Thai practitioners (all composite scores are above 8 and the dotted line in Fig. 1), shadowboxing contributes most strongly to engagement or flow experience (1st), followed by positive emotions (2nd), accomplishment (3rd), meaning or purpose in life (4th), and finally, social relationships (5th). Although shadowboxing contributed to social

relationships less than it contributed to other elements of psychological well-being, notice that professional Muay Thai practitioners ($n = 14$) nonetheless still rated shadowboxing as significantly contributing to their social relationships. Interestingly enough, results from this study on professional martial artists suggests that even when professional martial artists are engaged in individual training like shadowboxing, this individual training often *mentally includes interacting with partners* and significantly contributes to the social relationship (R) element of their psychological well-being (11.54 ± 2.36 , CI 10.17–12.90; Fig. 1). This is a particularly interesting result, since the use of mental simulation to create social contexts that promote psychological well-being is a topic that has not yet been rigorously explored in the psychological literature. This study is also the first to investigate whether shadowboxing contributes to the psychological well-being of professional Muay Thai practitioners differently based on factors such as their gender, fight experience, and training location. Results from this study reveal that although shadowboxing contributes positively to the psychological well-being of all the professional martial artists involved in this study, shadowboxing did not contribute to the psychological well-being of everyone in precisely the same way. Rather, men found that shadowboxing contributed most to their engagement or flow experience (Fig. 2) whereas women found that it contributed most to their positive emotions (Fig. 3), more experienced practitioners found that it contributed most to their positive emotions (Fig. 4) whereas less experienced practitioners found that it contributed most to their accomplishment (Fig. 5), and practitioners training in Thailand found that it contributed most to their accomplishment (Fig. 6) whereas practitioners training outside of Thailand found that it contributed most to their positive emotions (Fig. 7). As mentioned in Sect. 2 of this article, shadowboxing (as the individual rehearsal of technical forms) is an important component of training across all striking-based martial art systems since rehearsal of relevant striking techniques is central to mastering any striking system [2], and this study is the first to provide data from professional Muay Thai practitioners suggesting that shadowboxing generally contributes to the overall psychological well-being of martial artists while also providing different psychological benefits for individuals of different kinds and in different training contexts. This initial exploratory study suggests that shadowboxing may even contribute to psychological well-being differently for the same individual over time, since shadowboxing impacts people differently based on their training and experience (Figs. 4 and 5).

Furthermore, the free responses provided by the professional Muay Thai practitioners in this study also gives psychologists a unique opportunity to gain insight into the mental state of elite martial artists engaged in their professional craft. Several important points about the free responses are worth highlighting. First, notice that shadowboxing is often highly *technical*, for example, martial artists visualize and mentally simulate different movement patterns for attacking, defending, faking and feinting, exploring angles and setups against opponents, and perfecting particular strikes. The professional martial artists in this study also discussed how they often filmed their shadowboxing sessions so that they could analyze their own work and reflect on what to improve upon in future sessions. The process of (shadowboxing) practice and (film) analysis is then reiterated repeatedly to improve mastery of martial arts techniques. Second, notice that shadowboxing is often described as “meditative” and occurring “with fluidity and flow of the mind and body” and “without overthinking”. These reports on flow experience from professional Muay Thai practitioners are highly consistent with previous research on flow experience carried out by Csikszentmihalyi [7] and Dietrich [13]. Previous research by Ulrich et al. [32] also found that experimentally induced flow experience involved decreased activation in the amygdala and medial prefrontal cortex and increased activation in the inferior frontal gyrus and putamen, so an interesting avenue for future research would be to employ fNIRS and other portable neuroimaging techniques to investigate whether self-reports of flow while shadowboxing among martial artists correlate with decreased activation in the amygdala and medial prefrontal cortex and increased activation in the inferior frontal gyrus and putamen [13, 32].

7 Limitations

There are necessarily limitations to every study, and in this section I discuss three limitations of the present research on shadowboxing and psychological well-being. Although a notable strength of the present research is that it provides original insight about the training practices and psychological well-being of a rarely studied population in the psychological literature—professional Muay Thai practitioners—this focus on a specialized population entails that the results of this study remain limited to this specialized population and do not necessarily generalize to other populations. It would therefore be valuable for future research to investigate how shadowboxing impacts the psychological well-being of amateur Muay Thai practitioners, as well as amateurs and professionals practicing other martial arts that utilize shadowboxing such as Boxing, Kickboxing, Karate, Taekwondo, Kung Fu, Krav Maga, and Capoeira. Despite this limitation on the generalizability of the present results, it is nonetheless clear that a focused study on professional Nak Muays is still

important since it can provide unique insight into the training practices and psychological well-being of the most elite champions in this increasingly popular martial art. Currently there are no published studies on the mental visualization and psychological well-being of elite Muay Thai champions, so this initial study utilizing the PERMA framework fills an important gap in the extant literature and takes a modest step forward in motivating future research.

A second limitation concerns the sample size of Nak Muays included in the present study. Although a notable strength of the present research is that it provides original insight about the training practices and psychological well-being of some of the world's most elite Muay Thai champions, this focus on elite Muay Thai professionals rather than the general public entails that the sample size in this kind of study will necessarily be smaller than that focused on amateurs or the general public. Consider for example that although it is easy to recruit hundreds of participants from college classes and by using crowdsourcing methods such as Amazon's Mechanical Turk, this is not likewise possible with certain specific and specialized populations such as Muay Thai champions, free climbers that have completed grade 9c climbs, and other professionals that are the very best in the world at their craft. The number of elite professionals and decorated champions in many fields will necessarily be smaller and more limited compared to the general population, so sample sizes of studies that focus on elite professionals and decorated champions in many fields will also be comparatively smaller. Yet despite this limitation on the sample size of elite Nak Muays in the present study, it is nonetheless clear that a study focusing specifically on this group is still important since it can provide new insight into the training practices and psychological well-being of elite (rather than amateur) Muay Thai fighters. Currently there remains a lack of psychological research focusing on top performing professionals in martial arts and other sports, so this study fills another important gap in the literature and contributes to future research on elite martial artists.

Finally, a third limitation of the present study is the usage of the 23-item questionnaire and open-ended question methodology. Although a notable strength of the present research is that it provides initial insight into the psychological well-being of professional Muay Thai practitioners based on the PERMA framework, psychological well-being in this study was assessed by means of the commonly utilized self-report methodology in social and positive psychology [11, 12, 27–29]. Accordingly, future research should build upon the initial results presented in this study by utilizing supplementary research methods including longitudinal studies and neuroimaging studies to investigate the influence of shadowboxing on the psychological well-being of martial artists. For example, future neuroscience research can use the results from the present study to investigate whether self-reports of flow while shadowboxing correlate with decreased activation in the amygdala and medial prefrontal cortex and increased activation in the inferior frontal gyrus and putamen since previous experimental research has established these brain areas as involved in the experience of flow [13, 32]. Despite the methodological limitations of the present research, it is nonetheless clear that research on martial artists using self-report methods still offers one useful approach for understanding the practices and perspectives of professional martial artists.

8 Conclusion

Does martial arts practice contribute to psychological well-being in professional martial artists? If so, what are the specific ways that martial arts practice accomplishes this? It has been a long-standing and widely held belief that martial arts practice can contribute to psychological well-being, however, there has been a lack of empirical research in the psychological literature focused on investigating the details of this hypothesis. The purpose of this research was therefore to investigate the impact of a paradigmatic martial arts practice—shadowboxing—on the psychological well-being of Muay Thai professionals. Throughout this article several important contributions to the literature on martial arts and psychological well-being have been made, including (1) this article provided qualitative first-person reports from professional Muay Thai practitioners ($n = 14$) about their use of visualization and mental imagery and their experience of flow while shadowboxing, (2) this article provided quantitative data from professional Muay Thai practitioners ($n = 14$) that reveals how Muay Thai training influences the five elements of their psychological well-being including positive emotions, engagement, relationships, meaning, and accomplishment, (3) this article discussed how shadowboxing differentially impacts the psychological well-being of professional Muay Thai practitioners ($n = 14$) based on their experience, gender,

and training location, and (4) this article discussed limitations of the present study and offered suggestions for future research. As it has been revealed through empirical research presented in this article, martial arts practice (shadowboxing) provides an opportunity for individuals to experience improved psychological well-being in at least five distinct ways, by contributing to their positive emotions, engagement or flow experience, social relationships, meaning or purpose in life, and accomplishment. Shadowboxing specifically is a non-contact form of martial arts training that is used across many different martial arts disciplines, and a form of martial arts training that can offer a flexible means for individuals to tap into a positive psychological resource as required. By better understanding how each martial art and practice provides a unique profile of psychological costs and benefits to practitioners, researchers can offer valuable insight into the psychological effects of martial arts training and even help to more effectively match individuals to optimal martial arts training programs.

Author contributions The author is responsible for all contributions. The author read and approved the final manuscript.

Data availability The datasets generated and analyzed during the current study are available from the corresponding author upon approval of the request.

Declarations

Ethics approval and consent to participate The present research had ethics approval and participants provided informed consent. All procedures performed in this study were in accordance with the ethical standards of the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent for publication The participants have consented to the use of their interview data for publication.

Competing interests The authors declare no competing interests.

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References

1. Chow A. Kickboxing, Muay Thai, and Sambo receive full Olympic recognition. HypeBeast. 2021. <https://hypebeast.com/2021/7/kickboxing-muay-thai-and-sambo-receive-full-olympic-recognition-news>. Accessed 20 Nov 2022.
2. Croom AM. Muay Thai, psychological well-being, and cultivation of combat-relevant affordances. *Philosophies*. 2022;7:65. <https://doi.org/10.3390/philosophies7030065>.
3. Croom AM. Music practice and participation for psychological well-being: a review of how music influences positive emotion, engagement, relationships, meaning, and accomplishment. *Music Sci*. 2015;19:44–64. <https://doi.org/10.1177/1029864914561709>.
4. Croom AM. Embodying martial arts for mental health: cultivating psychological well-being with martial arts practice. *Arch Budo Sci Martial Arts Extrem Sports*. 2014;10:59–70.
5. Croom AM. Music, neuroscience, and the psychology of well-being: a precis. *Front Psychol*. 2012;2:393. <https://doi.org/10.3389/fpsyg.2011.00393>.
6. Cruise SM, Lewis CA, Guckin C. Internal consistency, reliability, and temporal stability of the Oxford Happiness Questionnaire short-form: test-retest data over two weeks. *Soc Behav Pers*. 2006;34:123–6. <https://doi.org/10.2224/sbp.2006.34.2.123>.
7. Csikszentmihalyi M. Play and intrinsic rewards. *J Humanist Psychol*. 1975;15:41–63. <https://doi.org/10.1177/002216787501500306>.
8. Cynarski WJ. Fighting arts: Between formality and spontaneity. *Ido Mov Cult*. 2021;21:47–52. <https://doi.org/10.14589/ido.21.4.7>.
9. Cynarski WJ. Bangkok and Muay Thai: the next episode of martial arts tourism. *Ido Mov Cult*. 2012;12:28–32.
10. Cynarski WJ, Yu JH, Borysiuk Z. Technical forms in teaching karate and taekwondo. *J Combat Sports Martial Arts*. 2017;8:31–6. <https://doi.org/10.5604/01.3001.0010.4619>.
11. Diener E, Wirtz D, Biswas-Diener R, Tov W, Kim-Prieto C, Choi DW, Oishi S. New measures of well-being. In: Diener E, editor. *Assessing well-being: the collected works of Ed Diener*. Dordrecht: Springer; 2009. p. 247–66. https://doi.org/10.1007/978-90-481-2354-4_12.
12. Diener E, Wirtz D, Tov W, Kim-Prieto C, Choi DW, Oishi S, Biswas-Diener R. New well-being measures: short scales to assess flourishing and positive and negative feelings. *Soc Indic Res*. 2010;97:143–56. <https://doi.org/10.1007/s11205-009-9493-y>.
13. Dietrich A. Neurocognitive mechanisms underlying the experience of flow. *Conscious Cogn*. 2004;13:746–61. <https://doi.org/10.1016/j.concog.2004.07.002>.

14. Downing SM. Validity: on the meaningful interaction of assessment data. *Med Educ.* 2003;37:830–7. <https://doi.org/10.1046/j.1365-2923.2003.01594.x>.
15. Fight Sports (2022) The world's first Muay Thai luxury hotel. Fight Sports. 2022. <https://www.fightsports.tv/the-worlds-first-muay-thai-luxury-hotel>. Accessed 31 Oct 2022.
16. Fuller C, Lloyd V, editors. *Martial arts and well-being: connecting communities and promoting health*. New York: Routledge; 2020. <https://doi.org/10.4324/9781315448084>.
17. Guo Y, Qiu P, Liu T, Tai Ji Quan: an overview of its history, health benefits, and cultural value. *J Sport Health Sci.* 2014;3:3–8. <https://doi.org/10.1016/j.jshs.2013.10.004>.
18. Hadinezhad H, Zaree F. Reliability, validity, and normalization of the Oxford Happiness Questionnaire. *Psychol Res.* 2009;12:62–77.
19. Hills P, Argyle M. The Oxford Happiness Questionnaire: a compact scale for the measurement of psychological well-being. *Personal Individ Differ.* 2002;33:1073–82. [https://doi.org/10.1016/S0191-8869\(01\)00213-6](https://doi.org/10.1016/S0191-8869(01)00213-6).
20. International Federation of Muaythai Associations. *History of Muaythai*. 2019. <https://muaythai.sport/history-of-muaythai>. Accessed 20 Nov 2022.
21. Kay SR, Opler LA, Lindenmayer JP. Reliability and validity of the positive and negative syndrome scale for schizophrenics. *Psychiatry Res.* 1988;23:99–110. [https://doi.org/10.1016/0165-1781\(88\)90038-8](https://doi.org/10.1016/0165-1781(88)90038-8).
22. Kohoutkova J, Masaryk P, Reguli Z. The experience of the state of flow in Brazilian jiu-jitsu. *Ido Mov Cult.* 2018;18:1–6. <https://doi.org/10.14589/ido.18.3.1>.
23. Panczyk W, Cynarski WJ. Imitative forms of movement as a way of counteracting physical passivity of a contemporary man. *Arch Budo.* 2006;2:45–52.
24. Pookaiyaudom G. Understanding Muay Thai camp tourist motivations in Bangkok, Thailand. *J Sport Tour.* 2020;24:285–302. <https://doi.org/10.1080/14775085.2020.1851290>.
25. Raimondo S, Stampi MT, Giacometti M. Muay Thai, structuring the experience of oneself and the others in the martial arts: a pilot study. *Ido Mov Cult.* 2019;19:77–88. <https://doi.org/10.14589/ido.19.15.12>.
26. Ross DD. *Martial Arts for Your Mind and Body*. Chantilly: The Teaching Company; 2017.
27. Seligman M. Flourish: positive psychology and positive interventions. In: Seligman M, editor. *The Tanner lectures on human values*. Ann Arbor: University of Michigan Press; 2010. p. 1–243.
28. Seligman MEP. *Flourish: a visionary new understanding of happiness and well-being*. New York: Free Press; 2011.
29. Seligman MEP, Ernst RM, Gillham J, Reivich K, Linkins M. Positive education: positive psychology and classroom interventions. *Oxf Rev Educ.* 2009;35:293–311. <https://doi.org/10.1080/03054980902934563>.
30. Skrzeta M, Wlodyka R, Pop T, Wlodyka K, Piasecka K, Rusek W, Cynarski WJ. Attempts to assess the impact of Taiji Quan and Qigong exercises on emotional states. *Ido Mov Cult.* 2021;21:77–88. <https://doi.org/10.14589/ido.21.3.9>.
31. Svitych A. Northeast Asian modern martial arts: embodied synthesis of virtue ethics and deontology. *Int J Hist Sport.* 2021;38:751–67. <https://doi.org/10.1080/09523367.2021.1887143>.
32. Ulrich M, Keller J, Hoenig K, Waller C, Gron G. Neural correlates of experimentally induced flow experiences. *Neuroimage.* 2014;86:194–202. <https://doi.org/10.1016/j.neuroimage.2013.08.019>.
33. Weller SC. Structured interviewing and questionnaire construction. In: Bernard HR, Gravlee CC, editors. *Handbook of methods in cultural anthropology*. New York: Rowman and Littlefield; 2014. p. 343–90.
34. Zivanovic T. Why is Muay Thai so effective in MMA? Medium. 2021. <https://medium.com/martial-arts-unleashed/why-muay-thai-is-so-effective-in-mma-b60f3e17bfd0>. Accessed 10 Aug 2021.

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