The Performance Enhancement Attitude Scale (PEAS) reached 'adulthood': Lessons and recommendations from a systematic review and meta-analysis[1]

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Highlights

- Performance Enhancement Attitude Scale (PEAS) has been the main assessment tool for doping attitude.
- This systematic review covers 18 years of doping attitude research using the PEAS.
- For the first time, meta-analysis was extended to internal consistency reliability.
- PEAS is reliable measure of moral doping attitude for adults.
- Evidence suggests that PEAS is not a suitable proxy for indexing doping behaviour.

Abstract

Doping is an omnipresent issue in both professional and amateur sports. Advances in social science research, including studies on doping attitude, have played a pivotal role in developing an understanding that prohibition and testing alone do not deter athletes from doping. Research on doping attitude has relied heavily on the Performance Enhancement Attitude Scale (PEAS). Yet, to date, no systematic review and meta-analysis of the PEAS have been conducted. Thus, the purpose of this study is, for the first time, to cumulate evidence for the psychometric properties of PEAS; specifically to conduct a qualitative synthesis and perform a meta-analysis to analyze the available results and findings for internal consistency reliability, gender differences and user/non-user differences in doping attitude assessed by the PEAS. PRISMA protocol was employed for data identification and selection. Included articles were assessed for data quality and biases. Meta-analysis with random effects models was used to determine overall internal consistency reliability (Cronbach's alpha) and descriptive statistics (Mean, SD) for a subset of studies using the full 17-item PEAS. Eighty-two studies were eligible for qualitative synthesis, and data from a subsample of 44 studies were meta-analyzed. The quantitative analyses yield an overall PEAS score of 39.18 (2.30 on a 6-point scale) and good internal consistency reliability (Cronbach's $\alpha = .81$ [95%CI .80, .83]). Males and admitted doping users scored higher on PEAS then females and non-users, but still within the 'negative' spectrum. Medium to strong correlations were recorded with moral disengagement ($r = .42$–$.75$). Overall, negative doping attitude characterized the athlete population, regardless of gender or involvement in doping. The latter, coupled with sole reliance on self-reports for doping, questions the validity of PEAS as proxy for indexing doping behavior. Future research will benefit from a standardized short version of PEAS. The consistent 'negative' range observed in PEAS scores, even among admitted dopers, suggests a potential moral conviction angle, which may limit the scale's utility as a global attitude measure and calls for further research whether re-calibration of the scale as a measure of moral doping attitude is warranted. Advances in doping behavior research calls for a more nuanced understanding of the role of attitudes toward doping and clean sport behavior; new and more specific attitude measures toward doping that separate moral and functional aspects effectively, along with a psychometrically sound instrument for adolescents.

Keywords

Doping; attitude; PEAS scale; performance-enhancement; sport; athlete

The use of prohibited doping substances to enhance physical and mental performance among athletes is an omnipresent and remaining issue in both professional and amateur sports (Aquilar-Navarro et al., 2020; Frenger et al., 2016; Ulrich et al., 2018). The formalized anti-doping system has made significant progress (Bowers & Bigard, 2017) and improved since the establishment of the World Anti-Doping Agency (WADA) in 1999 and the implementation of the first Anti-Doping Code in 2004. The Code has been revised four times since, with content changes reflecting the emerging new challenges. Globally installed formalizations of rules, responsibilities for athletes and stakeholders, and a network of doping control laboratories are strong indicators of a worldwide effort against doping use, along with the comparatively low figures of recent World Anti-Doping Agency's (WADA) annual report on tested athletes (1.42% Adverse Analytical Findings) (World Anti-Doping Agency, 2019). Notwithstanding, research and recently promulgated scandals among international sport federations suggest a higher use of doping substances among athletes (de Hon et al., 2015).

Traditionally, anti-doping policies have mainly focused on a 'detection and deterrence approach' (Elbe & Brand, 2016; Petróczi et al., 2017), which is designed to discourage athletes from using prohibited substances through bans from competition either for a certain period or for lifetime in case of proven use of substances. The history of doping control clearly shows that prohibition and testing alone do not deter athletes from doping. WADA and its signatories (national anti-doping associations, sport agencies and international sport federations) also target athletes with preventive strategies and anti-doping education. The focus here is on value-based character development, preferably beginning as early as possible in youth and adolescent ages. Athletes are supposed to develop and mature sound norms, self-efficacy, positive attitudes toward clean sport, which - coupled with favorable personality traits - should result in internal motivation to be clean and avoid use of doping.

Despite the tenuous direct link between attitude and behavior, doping behavior literature is teeming with attitudinal research based on the belief that 'wrong' attitudes are responsible for 'wrong' choices (using doping) by athletes. Blank et al. (2016) reviewed and affirmed the suggestion that attitude decisively influences and predicts doping susceptibility and behavior among competitive athletes. This is somewhat in contrast with a broader review and meta-analysis, which showed a moderate influence of doping attitude on doping use (Ntoumanis et al., 2014). It has been recognized that the decision behind doping is a complex psychological process involving environmental and social cognitive factors (Lazuras, 2015;

Hauw, 2017; Petróczi & Aidman, 2008; Petróczi et al., 2017; Woolf & Mazanov, 2017). Introduced to doping research by Petróczi et al. (2017), the Behavioural Reasoning Theory (Westaby, 2005) explains not only the planned actions but the motives underpinning human behaviors. The model addresses the theoretical and empirical importance of declared reasons, explanations and justifications for a given behavior; and posits that global motives (attitudes, subjective norms and perceived control) moderate the direct influence of values, beliefs and reasons on, but have no direct connection to, behavioral choices. In this model, which is in line with Ajzen's and Fishbein's theories of Planned Behavior and Reasoned Action (Ajzen, 1991; Fishbein & Ajzen, 1975), intentions predict behavior; global motives (e.g., attitudes, subjective norms, and perceived control) and reasons predict intentions. Importantly, beliefs and values predict reasons, and doing something and not doing it have their own separate set of reasons (Richetin et al., 2011). Applying this to doping, we can say that the reasons for doing something (e.g., using doping) are not the negated version of the reasons for not doing something (e.g., avoiding doping or following clean sport behavior). The former may be rationalized by perceived pressure to perform and progress, wanting to level the playing field or gain competitive advantage, making a fast return after injury, being competitive, or curiosity; whereas the latter may be driven by values and early childhood experiences, seeing doping as cheating, concerns about health and well-being – not the lack of perceived need for doping. (For details on reasons for and against doping use, readers are advised to consult Kegelaers et al. (2018), Lazuras et al. (2017) and Overby et al. (2013)).

Studies investigating doping behavior more often than not include attitude towards, alongside knowledge and beliefs about, doping, although the actual construct measured as 'attitude' is not always attitude *per se* but a mix of views, beliefs, expressed values and even hypothetical willingness. Attitudes and beliefs of various stakeholder groups such as athletes (Mazzeo, 2019; Morente-Sánchez & Zabala, 2013), medical professionals (Backhouse & McKenna, 2011) and pharmacists (Hooper et al., 2019), coaches (Barnes et al., 2020; Backhouse & McKenna, 2012) and athlete support personnel (Mazanov et al., 2014) have been extensively researched and reviewed. The role of athlete support networks on influencing athletes' attitudes toward doping and building anti-doping culture in the athletes' environment also received attention. For example, Barkoukis et al. (2019) investigated athletes' and coaches' views on the role of athlete support personnel on forming anti-doping attitude. Parental influence on athletes' attitudes has also been investigated (e.g., Blank et al., 2015a, 2015b; Dodge et al., 2015; Erickson et al., 2017).

In the athlete population, the most widely used standard measure of doping attitude, the Performance Enhancement Attitude Scale (PEAS; Petróczi, 2002; Petróczi & Aidman, 2009), has received support in empirical applications, but also attracted criticism. Nicholls et al. (2017a), based on empirical data from 1,154 athletes and simulations (i.e., dropping a different set of items from the full 17-item data), tested the structural validity of PEAS and showed poor model fit among adult (59%, aged between 19 and 68 years) and adolescent (41%, aged between 12 and 18 years) athletes except a short 8-item version for adults. The unsuitability of PEAS for adolescents was noted. Choi et al. (2019) replicated the study with 180 elite athletes using the Korean version of the scale and came to the same conclusion with good model fit for the 8-item version for adults. Not a criticism of PEAS *per se* but its application to empirical research, Nicholls et al. (2017a) also highlighted the dominance of Western developed countries in the data available for PEAS and called for research with a more balanced ethnic sample. This limitation, however, is more likely reflective of social science doping research in general than a PEAS-specific issue. Nonetheless, these observations, coupled with post data-collection item-dropping practices (e.g., Gucciardi et al., 2011; Manouchehri & Tojari, 2013a; Mudrak et al., 2018; Soltanabadi et al. 2015; Wang et al., 2020), which are often employed to obtain acceptable internal consistency reliability for the existing data, makes it timely to review the literature for empirical application of the PEAS.

Specifically, we aim for qualitative syntheses to (1) determine the scope of the application of PEAS in the past 20 years; to (2) quantitatively assess its psychometric properties and (3) examine the different variations that emerged over time (i.e., translations and item combinations). To contextualize our critical review and catalyze future improvement, we provide a brief overview of PEAS and its development in 'historical context'. The latter is important because PEAS was developed when doping behavior research was in its infancy, if that at all. The past twenty years have seen significant development in both breadth and scope of social science research into a plethora of doping related issues. The collective understanding of doping- and clean sport behavior has advanced considerably (Williams et al., 2020), thus a critical review of PEAS is both timely and warranted.

1 The Performance Enhancement Attitude Scale

At the turn of the 21st century, the hiatus for a reliable measure of general doping attitude led to the development of the Performance-Enhancement Attitude Scale (PEAS). The

PEAS is a self-reporting questionnaire instrument, measuring the consciously thought and deliberately expressed (explicit) attitude toward doping. Its original version, Petróczi (2002) presented 17 statements about doping and substance use, which are judged unidimensional on a 6-point Likert-type scale (Table 1). The resulting total score ranges from 17 to 102, with a theoretical middle-point at 59.5 (or 3.5 on the 6-point scale). Generally, the scale scores are interpreted as the higher the score, the more positive or lenient is the attitude toward doping.

Table 1

PEAS Items during Scale Development. Asterisks Denote the 8-item Short Form Items (PEAS-8)

Item	Categories	‚Reasons' for Doping
Legalizing performance enhancements would be beneficial for sport.* [Legalizing performance enhancements would not be beneficial for sports.]	Regulation, Shortcut	Behavior justified on positive need (‚remove anti-doping rules as barriers, make behavior not being against the rules' for the sake of sport')
2. Doping is necessary to be competitive.* [Doping is not necessary to be competitive]	Peer pressure, pressure to win, success	Behavior justified on circumstances (‚must do')
3. The risks related to doping are exaggerated.*	Doping, knowledge about performance-enhancing drug, known risk to health	Behavior justified on minimizing the issue (‚doping is not such a big issue')
4. Recreational drugs give the motivation to train and compete at the highest level.	Pressure to win, Recreational drug	Behavior justified on positive need (‚helps to work hard for being better at sport')
5. Athletes should not feel guilty about breaking the rules and taking performance-enhancing drugs. * [Athletes should feel guilty about breaking the rules and taking performance-enhancing drugs.]	Knowledge about performance-enhancing drug, Victimless crime	Behavior justified on being permissive
6. Athletes (in my sport) are pressured to take performance-enhancing drugs.	Peer pressure, Pressure to win, Testing, Unnatural	Behavior justified on circumstances (‚must do')
7. Health problems related to rigorous training and injuries are just as bad as from doping.	Body vs. Drugs, known risks to health, Tiredness and injuries	Behavior justified on circumstances (‚comes with being an elite athlete')
8. The media blows the doping issue out of proportion.	Media	Behavior justified on minimizing the issue (‚doping is not such a big issue')
9. Media should talk less about doping.	Media	Behavior justified on minimizing the issue (‚doping is not such a big issue')
10. Athletes have no alternative career choices, but sport.	Investment, Pressure to win, Unfair advantage	Behavior justified on circumstances (‚must do')
11. Athletes who take recreational drugs , use them because they help them in sport situations.	Cheating, Recreational drug	Behavior justified on positive need (‚helps to work hard for being better at sport')

12. Recreational drugs help to overcome boredom during training.	Cheating, Tiredness and injury	Behavior justified on positive need (‚helps to work hard for being better at sport‘)
13. Doping is an unavoidable part of the competitive sport.∗	Doping, Hypocrisy	Behavior justified on circumstances (‚comes with being an elite athlete‘)
14. Athletes often lose time due to injuries and drugs can help to make up the lost time.	Tiredness and injury, Unknown risk to health	Behavior justified on positive need (‚helps to overcome injury and train again for being better at sport‘)
15. Doping is not cheating since everyone does it.∗	Cheating, Hypocrisy & Knowledge about	Behavior justified on circumstances (‚doping is the norm‘)
16. Only the quality of performance should matter, not the way athletes achieve it.∗	Hypocrisy, Sport as activity, Success	Behavior justified on positive need (‚remove anti-doping rules as barriers, make behavior not being against the rules‘ for the sake of sport‘)
17. There is no difference between drugs, fiberglass poles and speedy swimsuits that are all used to enhance performance.∗	Investment, Unfair advantage	Behavior justified on minimizing the issue (‚doping is not such a big issue‘)

The PEAS was developed in 2000 to facilitate the attempt to explain doping behavior with psychological factors in environmental context (Petróczi, 2007). At the time when PEAS was developed (Petróczi, 2002), doping behavior research was in its infancy, with no doping-specific psychometric tools being available. WADA had just been created, the first Anti-Doping Code was still years away, and targeted social science research funding in anti-doping was non-existent. Thus, social science doping literature was limited to the use of anabolic steroids and recreational drugs use among college athletes and those involved in strength training (e.g., Anshel, 1991; Anshel & Russell, 1997 ; DuRant et al., 1995; Ferenchick, 1996; Luetkemeier et al., 1995; Komorski & Rickert, 1992; Kindlundh et al., 1999; Nutter, 1997; Goldberg et al., 1991; Tricker & Connolly, 1997; Schwerin & Corcoran, 1996) or moral arguments around doping control in sport (e.g., Breivik, 1987; Lüschen, 2000).

For the development of PEAS, a total of 97 potential items was created in a two-step process (Petróczi, 2002). First, a concept map was generated to specify areas to be covered by the scale. Based on a thorough review of the available literature at that time and personal consultations with experts (coaches, athletes, sport officials and academics), 26 specific areas were identified. These areas together covered a wide range of topics related to performance-enhancement in sport: access to drugs, body vs. drugs, cheating, doping, gender, hypocrisy, investment, knowledge about performance-enhancing drugs, known risk to health, media, national pride, outsiders, peer pressure, postmodern sport, pressure to win, recreational drugs, regulation, shortcut, sport as activity, success, testing, tiredness and injuries, unfair advantage, unknown risk to health, unnatural and victimless crime. Following a literature review, an item pool was created based on four sources: 1) existing literature, 2) other relevant attitude scales (e.g., attitude toward anabolic steroid use, or social drugs), 3) empirical studies on doping and 4) personal experience and knowledge of competitive sport (Petróczi, 2002). Each of the 26 categories contained multiple items. Next, two experts (one coach and one athlete) were asked to sort the 97 items back into the 26 categories. This back-sorting task achieved 67% agreement with the original categories. The remaining 31% accounted for items that belong to multiple categories. These were marked but retained for the initial screening.

The initial 97 items were empirically tested before being reduced, first to 32 items, then to the final set of 17 items. In later applications, an 8-item version was created with a clearer focus on ‘sport drugs’, excluding the use of recreational drugs in sporting contexts and spurious external factors (e.g., media attention to doping). These are marked with an asterisk in Table 1. Items that could be reversed for the short-form version are presented in brackets. The final version of PEAS exhibited good internal consistency reliability, with Cronbach's alpha values ranging from .71 to .91 among multiple samples. Additionally, a good test-retest correlation ($r = .752$, $p < .001$) was verified (Petróczi & Aidman, 2009). Further studies gathering empirical evidence for the validity of the PEAS in French (Hauw et al., 2016), Spanish (Morente-Sánchez et al., 2014a) and German (Elbe & Brand, 2016) confirmed these results. In the past 18 years, the PEAS has been the primary tool for assessing doping attitudes.

1.1 Objectives of this Study

Over the past two decades, a plethora of articles have been published on doping attitude, including a multitude of correlational tests towards other social-cognitive or psychological scales and tools, as well as difference tests among, for example, males and females, and self-reported doping users (see Blank et al., 2016; Morente-Sánchez & Zabala, 2013; Ntoumanis et al., 2014). A large proportion of these studies employed the PEAS. Yet, to date, no systematic review and meta-analysis of the PEAS have been conducted. Therefore, the primary aim of this study was to identify and assess systematically the extant empirical literature utilizing the PEAS. Second, a meta-analysis was performed in order to analyze the available results and findings for gender differences and user/non-user differences in doping attitude, and for the first time, internal consistency reliability.

2 Methods

2.1 Information Sources and Search Strategy

The systematic review and meta-analysis followed the PRISMA recommendations by Moher et al. (2015). An original systematic database search on OvidSP: Journals@Ovid, PsycINFO and PsycArticles Full Text, PubMed, SPORTDiscus and Scopus was conducted in February 2019, using five difference search terms (1) 'Performance Enhancement Attitude Scale', 2) 'PEAS' AND Attitude AND Sport OR Exercise', 3) 'PEAS AND Drug', 4) 'PEAS' AND Doping' and 5) 'PEAS AND Performance'). Search terms and strategy were based on the 'snowball' approach as suggested by Greenhalgh and Peacock (2005), with the search terms broadened or narrowed by evaluating the search results and their reference lists. Literature published up to June 2020 are included.

Search results from all used databases were exported as individual citation list files, imported into separate folders for each database in RefWorks (RefWorks Citation Manager, ProQuest LLC). Finally, all files were transferred into one folder for de-duplication, which was then imported into Rayyan (Ouzzani et al., 2016). Duplicates were removed using the ‘find duplicates’-option, with automatically identified duplicates manually checked before definite removal. Lastly, any duplicates that persisted were manually removed during study selection process. Screening of studies was also conducted in Rayyan. In addition to the online database search, a hand search of the reference lists of articles included in the final analysis and other reviews, PhD dissertations and commentaries was conducted and further ‘related articles’ were identified. The identification and selection process are depicted in Figure 1.

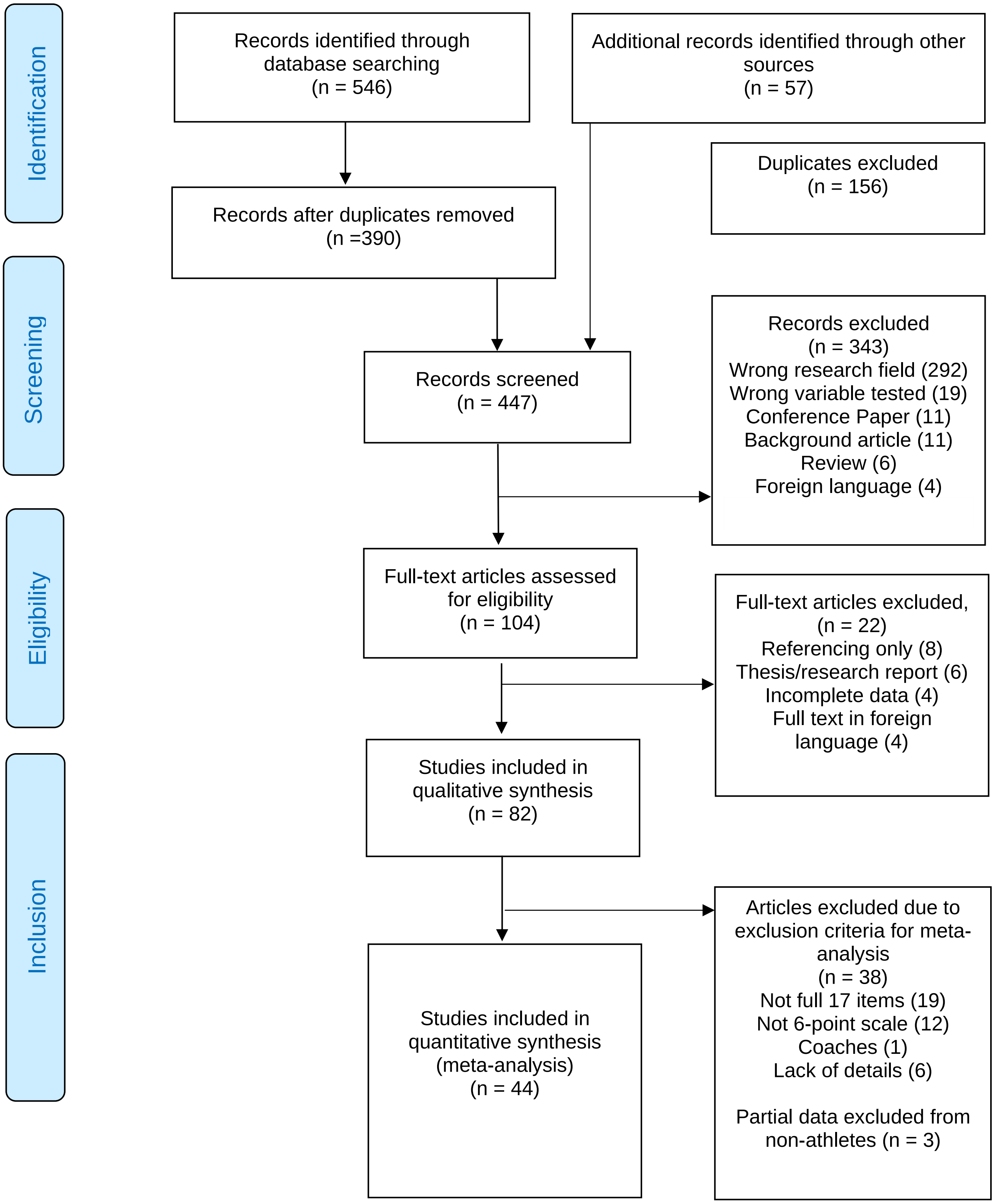

Figure 1: PRISMA flow diagram for identifying and selection of studies using the PEAS.

2.2 Study Selection

For qualitative synthesis, we included empirical studies which used any variant of the PEAS with athletes as participants and reported at least the mean(s) and standard deviation(s) for the sample or subsamples, and published in peer-reviewed journals. Official grant reports were included when these were published by the funding body. The literature search was conducted in English but studies published in other languages were included if sufficient details were accessible in English (i.e., reported in the English abstract or result tables were included in English). No time limit was imposed. For quantitative synthesis, we further limited the dataset to the full 17-item version of PEAS and to athletes, except for internal consistency reliability where we included all studies using the 17-item version and reported Cronbach alpha. The detailed inclusion and exclusion criteria are presented in Supplementary material 1: Table A. Studies were independently assessed for inclusion by two authors (Author 1, Author 2), with disagreements resolved via discussion.

2.3 Data Extraction

The following information was extracted from the included studies: author name(s), title, publication year, participant characteristics (location, performance level, gender and doping user status) sample size, PEAS version and response scaling, language and outcomes: 1) Cronbach's alpha; 2) PEAS Mean (M) and Standard Deviation (SD) and 3) correlations with other constructs where reported.

3 Quality/Risk of Bias Assessment

3.1 Quality Assessment

A self-administered version of the 'QATSO - quality assessment checklist for observational studies' (Wong, Cheung, & Hart, 2008) was used to assess the quality of the included studies (see Supplementary material 1: Table B). Each component was rated with 'Yes' or 'No' and resulted in a score of 0, 1, in some cases a score of 2 points is possible. Assessments were performed independently by two authors (Author 1, Author 2) with discussion and arbitration (Author 3) in case of disagreements. QATSO tool allows to achieve scores from 0-9, with the higher the score, the better the quality. The absolute score of each individual study is transferred into percentage results and finally judged as either poor (0-33%), satisfactory (34-66%) or good (67-100%).

3.2 Risk of Bias

Risk of bias among included articles was assessed by using a modified version of the 'Cochrane risk of bias tool' (Higgins et al., 2011). It was not assumed that 'allocation concealment', 'blinding of participants and personnel' and 'blinding of outcome assessment' influence biases were relevant in this case. Instead, socially desired answering bias was considered under 'other bias'. Assessments were performed independently by two authors (Author 1, Author 2) with discussion in case of disagreements (Author 3) (see Supplementary material 1: Table H).

3.3 Data Management, Missing Data

If required data information was not available in the published texts, the corresponding authors were contacted via e-mail. In case of absent response, the affected study was omitted from the meta-analysis and indicated as incomplete data.

3.4 Data Synthesis

The emerged PEAS results (Mean; SD) as well as the calculated Cronbach's alpha outcomes were collected to perform a random effects model analysis. Variables of interest were internal consistency (Cronbach's alpha), and descriptive statistics (M; SD) for the PEAS scores. All statistical calculations for summary measures, Cronbach's alpha (Vacha-Haase, 1998), and PEAS scores were performed in R (The R Project for Statistical Computing), with the metafor package (Viechtbauer, 2010), using random effects models.

4 Meta-Analysis

Assessment of heterogeneity. Statistical heterogeneity was tested with the χ^2 test ($p < 0.05$) and I^2 statistic (0% to 40%: might not be important; 30% to 60%: may represent moderate heterogeneity; 50% to 90%: may represent substantial heterogeneity; 75% to 100%: considerable heterogeneity).

Publication bias. Funnel plots and Egger's regression test (Egger et al., 1997) were used to assess publication bias if more than ten studies were included in the meta-analysis (Sterne et al., 2010). The method of Henmi and Copas (2010) was used to calculate the summary score in the event of publication bias.

5 Results

5.1 Systematic Review

The initial database search identified 546 studies. Cross-referencing generated 57 further studies. In total, 447 studies were eligible for screening after removing duplicates. Following, 343 studies were excluded based on their title and abstract. Studies excluded here were either from a different research field, did not use the Performance Enhancement Attitude Scale or were reviews, conference abstracts or written in a non-English language. Of these remaining 104 studies, 22 were excluded after a full-text assessment, yielding a set of 82 included studies for quality and bias assessment and qualitative synthesis. According to the stricter inclusion criteria for the quantitative synthesis 38 studies were excluded from the meta-analysis on the basis of their used Likert or Likert-type scale (5- or 7-point), PEAS version (used ad hoc shorter than 17-item version) or an incomplete data set reported.

All steps considered, a total of 82 studies was included in the qualitative analysis and 44 included in the meta-analysis. The summary of the included studies in the qualitative synthesis is shown in Supplementary material 1: Table C, with details for Cronbach's alpha values for the studies included in the meta-analysis in Supplementary material 1: Table D, correlation between PEAS and other social cognitive variables in Supplementary material 1: Table E, mean PEAS score by gender in Supplementary material 1: Table F and mean PEAS score by self-admitted doping use in Supplementary material 1: Table G. Breakdown by sport was not feasible.

In addition, between 2008 and 2016, the PEAS was used in six WADA funded research projects in six different countries on three different continents (Europe, Australia, Africa). Participants were high-performance or elite (youth) athletes (Elbe et al., 2008; Dimeo et al., 2011; Moran et al., 2008), youth and fitness athletes (Bondarev et al., 2009; Skinner et al., 2012) as well as "athletes" studying to become physical education (PE) teachers (Kamenju et al., 2016). The projects focused on research aiming at scale development (Moran et al., 2008), testing the effectiveness of an ethical decision training program (Elbe et al., 2008), investigating the role of social influence/team dynamics on attitudes toward performance enhancing drugs (Dimeo et al., 2011) or the relationship between moral code, sport participation and doping attitudes, respectively.

Furthermore, PEAS was also adapted to assess general attitude toward cognitive enhancement. In all three studies, the rationale for this choice was linked to attitudes toward performance enhancement in sport, either within the study itself (Vargo et al., 2015) or through previous studies of relevance (Stoeber & Hotham, 2016; Wolff & Brand, 2013). Stoeber and

Hotham (2016), as well as Wolff and Brand (2013) only used adapted scales measuring attitude towards cognitive/neuro enhancement and did not – at least partially – use original PEAS items. Stoeber and Hotham (2016) adapted the full 17-item PEAS scale, modifying item content, so that it reflected participants' attitudes toward cognitive enhancers instead of doping in sport, to examine the relationship between multidimensional perfectionism and attitudes toward cognitive enhancers. Wolff and Brand (2013) examined the relationship between students' subjective stressors in school settings and use of neuro-enhancing drugs (NE). NE attitude was assessed using a shortened 9-item version of the PEAS. For all items used doping related terminology was adapted to that of neuroenhancement, and sport performance related terminology to that of academic performance. Vargo et al. (2015), however, used 16 items to assess attitudes toward neuroenhancement and doping. Part of this set of questions were the items of the short, 8-item version of the PEAS to assess doping attitude. Additionally, they used eight items to measure attitudes toward cognitive enhancements. These items were created in a process similar to the one adapted by Wolff and Brand (2013), where doping and sport related terminology in original PEAS items was replaced to refer to neuroenhancement and academia. Except for the doping-specific application from Vargo et al. (2015), these studies, these studies were not included in the qualitative synthesis, or meta-analysis.

5.2 Quality Assessment of Included Studies

The included 82 studies were assessed for quality with a modified version of the QATSO tool. Sixty studies achieved a satisfying result, 5 were good and 17 were rated as poor. Notably, no study was rated with a score of 0 or 1, and no study achieved the perfect score of 9 (see Supplementary material 1: Table B). Most of the studies used a sports-related and representative sample for data collection. Randomly assigned people were very unlikely to be involved. Additionally, the evaluated studies were very consistent in reporting internal consistency reliability (Cronbach's alpha) for their respective samples. Controlling or testing for social desirability among the included studies was rare, and a clear statement about which language version used was missing in several studies.

5.3 Bias Assessment within Studies

Studies were checked for bias with a modified version of the Cochrane risk of bias tool for randomized controlled trials (Higgins et al., 2011). In particular, four domains were assessed as explained in the methods section. A complete overview over the bias check is presented in Supplementary material 1: Table H. Only three studies were identified for selective reporting (Candela et al., 2014; Desalegn et al., 2016; Soltanabadi et al., 2015), just like only seven studies indicated high risk for correlation biases (Campian et al., 2018; Kavussanu et al., 2016; Mudrak et al., 2018; Nicholls et al., 2019; Ogama et al., 2019; Sukys & Karanauskiene, 2020 and Wang et al., 2020). High risk for socially desired responding style was identified in the vast majority of the studies. Only four studies (Gucciardi et al., 2010; Kavussanu et al., 2016; Whitaker et al., 2014 and Wolff et al., 2015) actively checked for socially desired response tendencies with an additional questionnaire. Handling of incomplete data remained unclear in many cases due to insufficient information.

5.4 Performance Enhancement Attitude Scale Versions

An overview over the existing versions of the Performance Enhancement Attitude Scale is presented in Supplementary material 1: Table I. In total, ten different PEAS versions have been used and published in the scientific literature. Notably, there are two different types of the 11- and 8-item version each. In general, there is no item that was included in every version. Though, item 3 and 17 can be found in 9 of 10 versions. One study added three new items to the full PEAS: "*Given opportunity I would use a performance enhancing substance if assured of winning / Given opportunity I would use a performance enhancing substance if assured of winning, even if I am made aware of negative health consequences / I would advise my trainees to use performance enhancing substances*" (Rintaugu & Mwangi, 2020). Because these items tap into a different aspect of doping attitude if any (general attitude vs. attitude about one's own doping related action) and because item level data were not presented to re-instate the 17-item original scale, the study was excluded from meta-analysis.

5.5Year of Publication

An overview over the years of publication of the 82 studies included is presented in Figure 2. With the PEAS being developed in 2000 as dissertation research and initial publication of the PhD thesis in 2002 is took several years for the first studies using PEAS to be published (2007 and 2008). The peak of 13 annual publications in 2014 can be attributed to multiple studies being published by Morente-Sánchez's research group (e.g., Morente-Sánchez & Zabala, 2014). Since then, more diversity regarding authorship among PEAS publications can be observed.

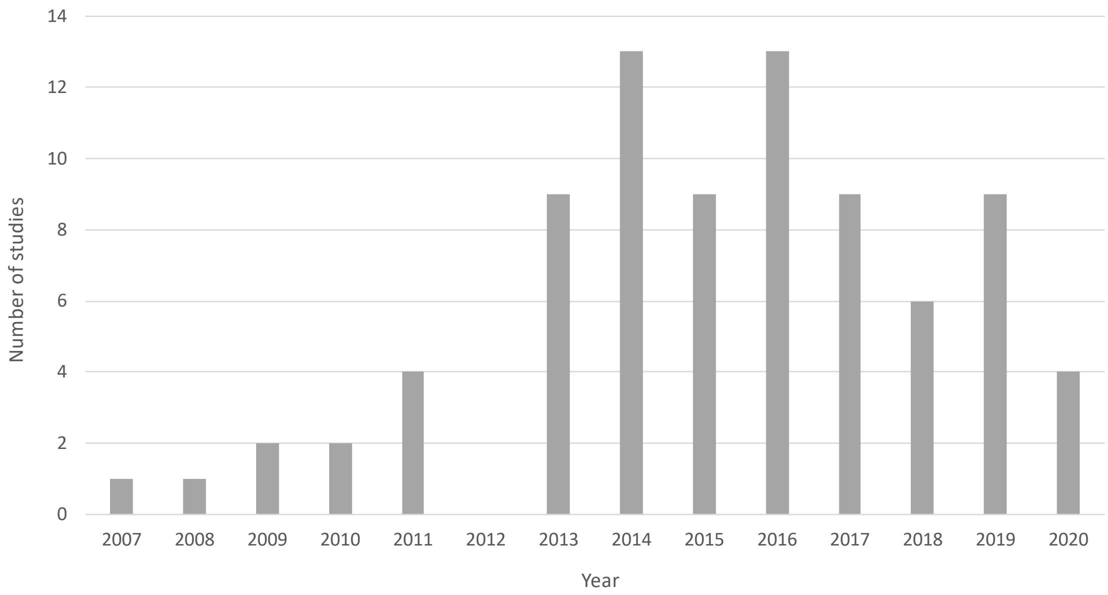

Figure 2: Number of studies with PEAS by year.

5.6 Linking Doping Attitude to other Doping-Related Social-Cognitive Factors

Thirty-six studies in this systematic review used correlation-based analysis with PEAS. In total, these contain information for 120 unique bivariate pairs with PEAS. Overall, the other doping-related social-cognitive factors studies have linked to doping attitude fall into three categories: Personality measures (N = 8) such as narcissism (N = 4, r = -.09 to .53), and perfectionism (N = 4, *r* = -.08 to -.04), moral disengagement (N = 3, *r* = .42 to .75), and doping behavior related outcome measures (e.g., doping intention, use, likelihood and susceptibility; N = 8; *r* = .09 to .89).

Of these 36 studies, 13 studies showed correlations above *r* = .50 between doping attitude and other doping related social-cognitive factors. Within these studies 21 individual correlations above r = .50 were reported. The highest correlation, *r* = .977, was reported by Ogama et al. (2019) for the impact of doping attitude and athletes' knowledge about doping on self-reported behavior. Unfortunately, the paper offered no sufficient details to gain insight into this uncharacteristically high correlation between predictors and doping behavior. Another very high correlation was found between participants' brief PEAS score and their results in the

Implicit Association Test (IAT), which Petróczi et al. (2010) reported at r = .942 for 'self-reported users' and at r = -.951 for 'deniers'. The latter cases are to be interpreted with caution because they represent a specific case where implicit association tests were carefully crafted as implicit measures to match the explicit doping attitude. Occasional high correlations (r > 0.8) were also found for doping likelihood (r = 0.97 and r = 0.89, Sekulic et al., 2016) and necessity of doping (r = 0.90, Sukys & Karanauskiene, 2020), but none of these were replicated in other studies independently. A complete overview over the correlations is presented in Supplementary material 1: Table E.

5.7 Diversity by Geographical Location

The PEAS has been used in studies worldwide. However, of the 82 studies included in the synthesis more than half are from Europe (53.7%, see Figure 3). Among the 44 publications from Europe, Great Britain (13) Spain (9) and Germany (6) dominate. About a quarter of the study sample is from Asia (22%). Here, most publications are from Iran (7). Oceania, America and Africa all represent less than 9% of the overall sample with South American athlete samples being non-existent in PEAS research so far. Two studies used multinational samples. To assist future detailed analysis, the by country grouping of the 82 studies included in this review is displayed in Table 2

Table 2

Eligible Studies Included in the Qualitative Synthesis by Country (in Alphabetical Order)

Country	Number of studies	References
Australia	6	Chan et al. (2015), Chan et al. (2018), Gucciardi et al. (2010), Gucciardi et al. (2011), Mazanov et al. (2014), Yager & O'Dea (2014)
Canada	2	Sullivan & Razavi (2017), Wilson & Potwarka (2015)
China	2	Chen et al. (2017), Wang et al. (2020)
Czechia	1	Mudrak et al. (2018)
Ethiopia	1	Desalegn et al. (2016)
Germany	6	Baumgarten et al. (2016), Brand et al. (2014), Elbe & Brand (2016); Pöppel & Büsch (2019). Pöppel et al. (2020), Wolff et al. (2015)
Hungary	4	Petróczi et al. (2008), Petróczi et al. (2010), Petróczi et al. (2011), Uvacsek et al. (2011)
India	2	Hooda & Kumar (2016), Hooda et al. (2018)
Iran	7	Bahrami et al. (2014), Divkan et al. (2013), Ismaili et al. (2013), Manouchehri & Tojari (2013a), Manouchehri &

		Tojari (2013b), Manouchehri et al. (2013), Soltanabadi et al. (2015)
Italy	2	Candela et al. (2014), Zucchetti et al. (2015)
Kenya	4	Kamenju et al. (2016), Mwangi et al. (2019), Ogama et al. (2019), Rintaugu & Mwangi (2020)
Korea, Republic of	4	An et al (2015), Bae et al. (2017), Choi et al. (2019), Kim & Kim (2017)
Kosovo	1	Sekulic et al. (2016)
Lithuania	1	Sukys & Karanauskiene (2020)
Malaysia	1	Chiang et al. (2018)
New Zealand	1	Hodge et al. (2013)
Norway	1	Sagoe et al. (2016)
Poland	1	Sas-Nowosielski & Budzisz (2018)
Romania	2	Nica-Badea (2014), Nica-Badea (2016)
Russia	1	Bondarev et al. (2009)
Serbia	2	Stojanovic et al. (2017), Stojanovic et al. (2019)
Spain	9	Morente-Sánchez & Zabala (2014), Morente-Sánchez & Zabala (2015), Morente-Sánchez et al. (2014a) Morente-Sánchez et al. (2015), Morente-Sánchez et al. (2013a), Morente-Sánchez et al. (2013b). Morente-Sánchez et al. (2014b), Morente-Sánchez et al. (2019), Zabala et al. (2016)
Sri Lanka	1	Uduwana & Madushani (2014)
Switzerland	1	Hauw et al. (2016)
Uganda	1	Muwonge et al. (2015)
United Kingdom	13	Allen et al. (2014), Backhouse et al. (2013), Dimeo et al. (2011), Hurst et al. (2019), Kavussanu et al. (2016), Madigan et al. (2016). Madigan et al. (2019), Matosic et al. (2016), Nicholls et al. (2017a), Nicholls et al. (2017b), Nicholls et al. (2019b), Vargo et al. (2014), Whitaker et al. (2014)
United States	3	Campian et al. (2018), Hale & Kollock (2018), Petróczi (2007)
Multinational	2	Lazuras et al. (2017), Petróczi & Aidman (2009)

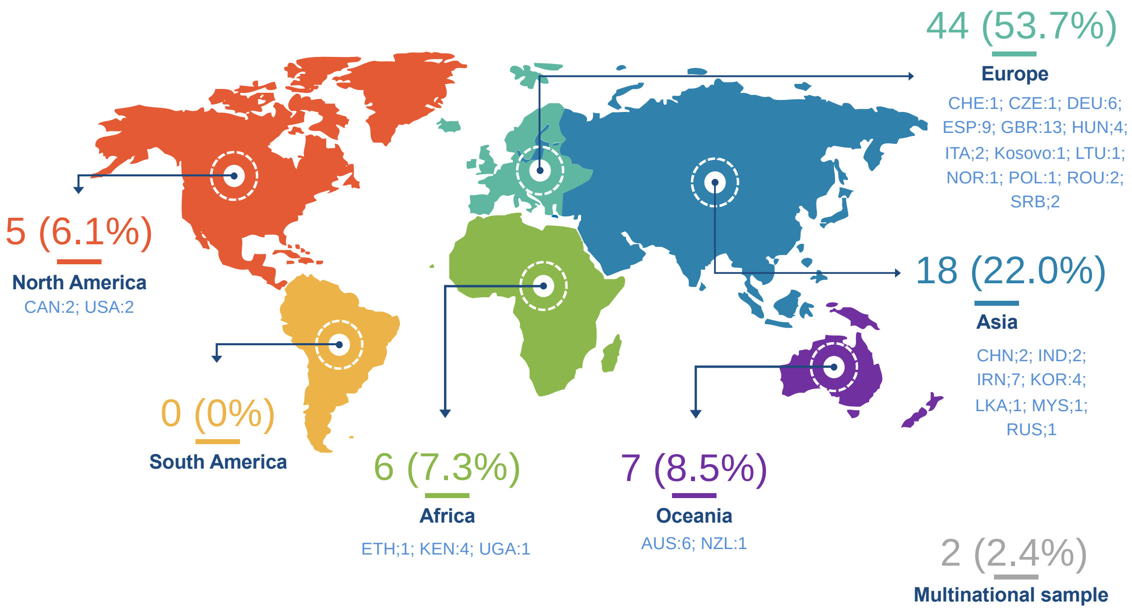

Figure 3: Geographical distribution of studies with PEAS (image created with SlideModel template, country codes are ISO 3166 international standard ALPHA-3 codes).

5.8 Diversity by Sports

Participants involved in studies included in this systematic review represented an extensive spectrum of sports disciplines and forms. Consequently, a majority (46) of the studies was categorized as *multisport*, taking more than one sport into account within the sample, a total of 19 studies did not specify a sport. In contrast, some studies particularly focused on a single type of sports, resulting in seven studies on cycling (e.g., Hale & Kollock, 2018; Morente-Sánchez & Zabala, 2014; Morente-Sánchez et al., 2013a), three studies on bodybuilding and wrestling (Bahrami et al., 2014, Brand et al., 2014; Ismaili et al., 2013), two studies for athletics (Desalegn et al., 2016; Ogama et al., 2019) and three on football or soccer respectively (Morente-Sánchez & Zabala, 2015; Morente-Sánchez et al., 2019; Kavussanu et al., 2016). Additionally, one study incorporated a cohort of Paralympic athletes (An et al., 2015), as well as one study solely considering ultramarathon runners (Campian et al., 2018).

5.9 Diversity of Sport Involvement

With regard to participants' competitive level, there is again a broad range reported in the studies included in the synthesis. Besides the diversity of samples relating to level of sport performance, again, it should be pointed out that any comparison should be interpreted with caution as another confounding factor is the non-existence of a globally applied and encompassing terminology for competitive levels. Yet, 16 studies reported results of athletes competing under the term 'elite', 'professional', 'international athlete' or similar (e.g., Allen et al., 2014; Bae et al., 2017; Elbe & Brand, 2016; Gucciardi et al., 2011). Another frequently appearing sample characteristic was athletes related to high school, college or comparable links to student entities (e.g., Petróczi & Aidman, 2009; Pöppel et al., 2020; Sullivan & Razavi, 2017; Wolff et al., 2015). Other categories found were 'national' (e.g., Kim & Kim, 2017; Morente-Sánchez et al., 2014b) and 'amateur' (Zabala et al., 2016). 37 studies did not provide information on participants' level of sport involvement.

5.10 Differences Between Gender

Eleven studies controlled for differences between male and female results on the Performance Enhancement Attitude Scale (see Supplementary material 1: Table F). Five studies identified a significant difference ($p < .05$) (An et al., 2015; Backhouse et al., 2011; Sekulic et al., 2016; Stojanovic et al., 2019 and Vargo et al., 2015), whereas no significant difference was found in four studies (Hooda & Kumar, 2016; Kim & Kim, 2017; Muwonge et al., 2015 and Petróczi et al., 2011). Morente-Sánchez et al. (2019) as well as Mudrak et al. (2018) did not report any significance level.

5.11 Differences Between Doping User and Non-User

Five studies reported differences between self-reported doping user and non-user (Backhouse et al., 2011; Campian et al., 2018, Petróczi et al., 2011; Uvacsek et al., 2011; Zabala et al., 2016). Expectedly, all of the studies found a significant difference ($p < .05$) between the two groups, with a more lenient attitude towards doping among self-reported drug users (see Supplementary material 1: Table G).

5.12 Meta-Analysis

5.12.1 Internal Consistency Reliability

In total, 44 studies using the Performance Enhancement Attitude Scale yielded 75 Cronbach's alpha results (see Supplementary material 1: Table D). Calculations of the random effects model analysis resulted in an average Cronbach's alpha of 0.81 [95% Confidence Interval: 0.80, 0.83] (see Supplementary material 2). Quantitative analysis of the overall 147 reported individual PEAS descriptive statistics finally indicated an average mean score of 37.16 [95% Confidence Interval: 36.12, 38.20] among the assessed studies.

5.13 Heterogeneity

There was considerable heterogeneity for both the Cronbach's alpha and PEAS scores, i.e., I^2 of 94.75% for the Cronbach's alpha scores, and 98.92% for the PEAS scores. The χ^2 was statistically significant for both ($p < .05$).

5.14 Publication Bias

Egger's regression test suggested possible publication bias for both the PEAS scores ($p = .001$) and Cronbach's alpha scores ($p < .0001$). Similarly, visual inspection of the funnel plots suggested possible publication bias (see Supplementary materials 3 & 4). Therefore, after adjustment using the method of Henmi & Copas (2010), the adjusted summary score for the PEAS was 39.18 [36.68, 41.68] and for Cronbach's alpha 0.85 [0.83, 0.88].

5.15 Gender Difference

For subgroup differentiations, quantitative analyses revealed an average PEAS mean score of 40.84 [95%CI 37.12, 44.57] for male and 39.65 [95%CI 36.38, 42.91] for female participants. Random effect model results for males ($Q = 633.77$, $df = 10$, $p < 0.001$; $I^2 = 98.0\%$) and females ($Q = 251.62$, $df = 10$, $p < 0.001$; $I^2 = 95.7\%$) indicate that a high proportion of the observed variance reflects variance in true effect sizes rather than sampling error. Although males showed a slightly more lenient, but still negative doping attitude compared to females (mean PEAS = 2.40 vs. 2.33, respectively), the difference is not statistically significant ($p = .636$). For the forest plot and details, see Supplementary material 5.

5.16 User vs. Non-User Difference

Regarding self-reported drug use, there was a mean score of 45.38 for users and 35.88 [95%CI 36.12, 38.20] for non-users. Random model effect results for subgroups were as follows: $Q = 32.44$, $df = 4$, $p < 0.01$; $I^2 = 82.1\%$ for user and $Q = 187.68$, $df = 4$, $p < 0.01$; $I^2 =$

95.8% for nonuser subgroups. High proportion of true variance in the studies is evidenced. The forest plot and details are presented in Supplementary material 6. The difference showing more lenient but still negative attitude expressed by admitted users and nonusers (with mean PEAS of 2.67 vs. 2.11, respectively) was statistically significant ($p < .001$).

6 Discussion

The primary purpose of this study was to systematically review the use of the Performance Enhancement Attitude Scale (PEAS) in scientific literature since its first publication by Petróczi in 2002, to determine the scope of its application, to examine the different variations that emerged over time (i.e., language and items) and to assess its psychometric properties with the view of exploring aspects in need for improvement. As such, the review was purposefully limited to the PEAS, and doping attitude as assessed via the PEAS. Internal consistency reliability for adult athlete population was evidenced by estimating the summary values of Cronbach's alpha. Using qualitative and quantitative synthesis, we examined known-group differences (user vs. nonusers); and relationship with other doping-related scales (e.g., moral disengagement; sport orientation) as well as intention and behavior to examine the degree of support for the validity of PEAS. Specifically, content and face validity are discussed via PEAS variants and the recommended short form. Criterion (concurrent and divergent) validity is explored via correlations with other social cognitive measures. Predictive validity is explored via known-group differences (user vs. nonuser) and relationship between PEAS scores and intention, willingness and admitted doping behavior.

6.1 Overview of PEAS Use

To date, the scale has been translated into more than 20 languages and used in 82 empirical studies in 24 countries. In total, 31,326 people completed the PEAS (duplication excluded where multiple use of the same sample was evident). The majority of the respondents were athletes (n = 31,051; 99.12%) with the remaining sample comprised of coaches (n = 198; 0.63%) and general public (n = 77; 0.25%). Athletes competitive level ranged from amateur athletes, student-athletes and sport science students to elite level, representing a wide range of sports.

The PEAS was used to assess attitude toward doping in combination with personality and other social cognitive factors to predict doping intention or behavior. The PEAS also served as basis for an attitude measure toward cognitive enhancements in three studies. PEAS has been applied to study the impact of demographic factors such as gender, age, competition level, type of sport or athlete, as well as self-admitted engagement in doping or nutritional supplementation.

6.2 PEAS Variants

An important part of the qualitative analysis was the identification of existing versions of the PEAS differing in item selection. To this date and our knowledge, ten different types of the scale were used in scientific literature. Besides the original 17-item scale, internal consistency analyses among a variety of samples lead to the exclusion of different items, so that multiple versions are available now (see Supplementary material 1: Table I). Nevertheless, the 17-item version remains the most utilized one by far with 45 identified applications. Notably, there are two different types of the 11- and 6-item version each. Gucciardi et al. (2010) and Allen et al. (2014) respectively presented results for 11 items, whereas Elbe and Brand (2016) and again Gucciardi et al. (2010) reported use of two different 6-item versions. Further versions are known for including 13, 10, 9, 8, or 5 items. Remarkably, no item presented in the original PEAS version from Petróczi (2002) sustained in every identified scale version. Frequent implementation was figured out particularly for item 3 (*The risks related to doping are exaggerated*) and 17 (*There is no difference between drugs, fiberglass poles, and speedy swimsuits that are all used to enhance performance*). To date, two comparative studies were conducted to test all variants (Nicholls et al., 2017a; Choi et al., 2019). These studies only found empirical support for construct validity for the 8-item version (items are marked in Table 1) for adults but not for adolescents.

Nevertheless, the existence of such a broad variety of modified PEAS versions indicates a need for revision of the PEAS, in order to develop a master version that is used consistently. As shown in the methodology of this meta-analysis, quite a number of studies were not included in the summary measure based on the missing of a common feature of the same PEAS version. A general attitude comparison is simply not possible to achieve based on this variety. A revised, potentially shorter version of the Performance Enhancement Attitude Scale is both recommended and necessary to reduce attitude testing with the scale on a common denominator. Based on this review, the eight items marked with an asterisk in Table 1 are potentially good candidates for a short form.

6.3 Group Differences

Two major difference tests were administered in some of the included studies, focusing on either gender or self-reported drug user vs. non-user differences between descriptive results of the PEAS. Some studies explored differences by age or sports but owing to inconsistencies in these arbitrary groups, no sizeable set of data was available for meta-analysis.

6.3.1 Gender

Differences between male and female participants were assessed in eleven studies. Five studies (An et al., 2015; Backhouse et al., 2011; Sekulic et al., 2016; Stojanovic et al., 2019; Vargo et al., 2015) reported a significant difference in terms of gender. Among these studies, a consistent more lenient attitude towards doping was identified in male athletes, whereas female participants showed more negative attitudes. However, four studies (Hooda & Kumar, 2016; Kim & Kim, 2017; Muwonge et al., 2015; Petróczi et al., 2011) did not find any significant differences here, so that the findings are not in line with further scientific literature by Windsor and Dumitru (1989) and Petróczi and Naughton (2008), assuming that males are generally more susceptible for using prohibited substances. The performed meta-analysis in this paper supports this ambiguity, considering the non-significant difference (p = .636) between male and female participants. In addition to that, a rigorous analysis shows that the male mean among the mentioned studies ranged from 34.9 (Backhouse et al., 2013) to 56.0 (Hooda & Kumar, 2016) on the 17-item PEAS, and therefore did not even reach the theoretical middle-point of 59.5. Thus, a conclusive statement claiming a more positive attitude towards doping among males in general remains controversial.

6.3.2 Self-reported User vs. Non-User Status

Based on five studies where user vs. nonuser breakdown of PEAS score was available (Backhouse et al., 2011; Campian et al., 2018; Petróczi et al., 2011; Uvacsek et al., 2011; Zabala et al., 2016), a consistent significant difference (p < .05) between self-reported doping users in comparison to self-declared clean athletes was found. As expected, attitude towards performance enhancement was significantly more lenient among drug-users in comparison towards clean athletes. The present meta-analysis was able to support these findings by showing a significant difference (p = .0001) between self-reported users and clean participants. Assuming correctness and veracity in answering the question of performance-enhancing drug use, these results strongly support the general validity of the PEAS. However, PEAS scores for both users and nonusers remained on the negative side of the spectrum with self-admitted users only exhibiting less negative attitude than their nonuser counterparts. A further limitation for drawing any practically relevant conclusion for PEAS' discriminatory power for doping use is the fact that all but one study used self-reported doping behavior. Thus, all we can say with any level of confidence is that those athletes who admitted doping use also expressed a more lenient attitude. The only study with external validation of doping use via hair analysis (Petróczi et al. 2010; 2011) showed that athletes who used but denied doping reported the most negative attitude toward doping. In practice it means that the observed PEAS scores by self-declared non-users could be contaminated with deliberately manipulated responses to PEAS attitude items to an unknown degree.

6.3.3 Level of Sport Involvement

Athlete population in the included studies ranges from local club to elite competitive levels. In the absence of clear and uniform definition of sport involvement and competitive levels, meta-analysis of the PEAS scores for differences by sporting levels was not advisable. Notably in many studies, athlete population was loosely defined and included sport science students based on the assumption that they are, typically, at least amateur club level athletes (Supplementary material 1: Table C) and have a good level of understanding regarding doping in sport. Overall, 45.1% of the included studies did not report level of athletes' sport involvement. Within the diverse range of samples, a prominent category was that of studies reporting PEAS scores for 'elite', 'professional' or 'international' athletes (N = 16; 13.1%).

6.4 Use of PEAS Outside Adult Athlete Population

By large, PEAS has been used, as intended, for assessing doping attitudes in adult athletes. Sagoe et al. (2016) used PEAS with high-school aged students (n = 202). Comparative studies by Nicholls et al. (2017a) and Choi et al. (2019) with adult and adolescent athletes concluded that the PEAS showed poor structure validity and internal consistency reliability in the adolescent sample (n = 470 and n = 102, respectively). This outcome is no surprise. The PEAS has been developed and used for adults with no version for younger population (e.g., adolescents) offered. Doping and judgement around doping use in different settings is conceptually complex. Therefore, neither the language nor the item content of the PEAS was deemed suitable for adolescents. Instead of fitting PEAS items for adolescents, a bespoke psychometric tool is needed to assess doping attitude among young athletes.

One study used the scale with 69 coaches (Pöppel & Büsch, 2019) and four studies contain data from coaches and physical trainers alongside that of athletes: n = 40 (Petróczi & Aidman, 2009), n = 30 (Nica-Badea, 2014; 2016), n = 59 (Matosic et al., 2016) and n = 169 (Morente-Sanchez & Zabala, 2015). Two studies by Morente-Sánchez & Zabala (2014, 2015) also included data from team managers in cycling (n = 112) and technical staff in football (n = 68) but further analysis was not possible. The available number of studies and small combined sample size at this stage do not warrant meta-analysis on doping attitude assessment via PEAS among coaches. Comparison to other studies and athletes within the same study reports good internal consistency reliability with Cronbach alpha when reported and a consistently negative attitude toward doping.

6.5 Cultural Diversity

Sample composition and ethnicity is not always reported in these studies which makes it impossible to judge the degree of ethnical diversity within each study. Based on the geographical locations of the eligible studies, (see Figure 3) athletes from all continents are represented in the overall sample included in the systematic synthesis. However, the vast majority of studies report PEAS scores for athletes from Europe (53.7%), followed by Asian athletes (22%). Athletes from Oceania (8.5%), Africa (7.3%) and North America (6.1%) are represented in only a small number of eligible studies. Interestingly, while two studies reported using multinational samples, no study so far focused on South American athletes.

6.6 Relationships with Behavior, other Social-Cognitive Factors and Personality Traits

Owing to a large degree of variety, drawing any meaningful conclusion about how PEAS is conceptually related or not related to other social cognitive factors or linked to personality traits or demographics is not feasible. We also noted that Pearson product moment correlations were reported for categorical variables such as gender (Male/Female), supplement use (Yes/No) or sport level. The inclusion of other social cognitive or personality variables was theory driven in some (e.g., Theory of Planned Behavior; Prototype/Willingness model; The Dark Triad) but not in all studies. Because of the diversity of the construct and the different PEAS variants, meta-analysis was not feasible for any construct or group of constructs.

6.6.1 Doping Attitude and Morality

Two studies conducted as part of the WADA funded social-science project by Skinner and colleagues (2012) used the PEAS to examine the relationship between morality and performance enhancing drugs (PEDs) attitude. Specifically, they found a relationship between moral functioning in young athletes and their attitudes toward PEDs in their study based on the morality model proposed by Rest (1984). Interestingly, the authors also found a clear link between attitudes to doping and moral disengagement, as originally conceptualized by Bandura (1991). Both studies supported the notion that morality and attitudes are closely linked, regardless of the theoretical underpinnings adapted. Athletes with higher scores for moral functioning had more negative attitudes toward doping; and athletes that showed higher levels of moral disengagement justified use of PEDs more strongly. This notion is also supported by the strong correlation (r = .75) reported by Kavussanu et al. (2016) between scores on their Moral Disengagement in Doping Scale (MDDS) and PEAS 6-item scale, and the correlation of r = .52 found by Hodge and colleagues (2013) between the 17-item PEAS measures and the scores on the MDDS-S scale. The high correlation between PEAS and MDS suggests that these two constructs, albeit not the same, are conceptually related. This is further supported by the PEAS items which – by large – are about cheating, fairness, justifiability/justification of levelled playing field.

6.6.2 Relationship between Admitted Doping Use and PEAS

As evidenced by the reported correlations and regression weights, we have weak support from the PEAS data for the validity of using doping attitude as a proxy measure for doping behavior. This is also in line with the meta-analysis on personal and psychosocial predictors of doping use by Ntoumanis et al. (2014). This outcome points in the same direction as the results from a Q-sort study (Gatterer et al., 2019), where internal factors such as attitudes (9/10 items used from PEAS), goal orientation and sportspersonship together were weaker predictors of doping behavior compared to external factors. One possible explanation for this is that reasons and not global motives (attitudes, social norms) impact behavior intention and actual behavior (Westaby, 2005; Petróczi et al., 2017)

Reasons, operationally defined as “subjective factors people use to explain their anticipated behavior” (Westaby, 2005, p.100), are important ingredients of decision making. Reasons are distinguished as ‘reasons for’ and ‘reasons against’. Yet, as outlined before, ‘reasons for’ are not the opposites of ‘reasons against’ (Richetin et al., 2011). Rather, reasons form two sets of motives with each unique to the predicted behavior (e.g., doping or clean sport behavior). Following this argument, we propose that strong negative doping attitude could predict clean sport behavior, but more lenient (yet mostly still negative doping attitude) only have a weak link to doping use.

6.7 Internal Consistency Reliability

The secondary goal of this paper was to meta-analyze the reported descriptive statistics (M; SD) and internal consistency reliability of the PEAS. Considering the assessment of χ^2 test and I^2 statistic, results indicated a statistically significant (p < .05) and considerable heterogeneity among the analyzed studies in both PEAS scores (98.92%) and Cronbach's alpha (94.75%). Diverse influencing factors like individual sample characteristics, type of sport, level of performance or study design might explain this result. In the vast majority, participants were actively involved in sport, but displayed a high variance in performance level ranging from amateur to elite athletes. Besides, and as already described in the qualitative analyses, PEAS results differed significantly depending on gender and self-reported doping use, with both as possible explaining factors for heterogeneity. Counteracting this, inclusion for the meta-analysis was restricted to studies using the 17-item version answered on a 6-point Likert-type scale. Even though the study design was coherent in using this particular format of the Performance Enhancement Attitude Scale, in some studies, the surveys included a battery of psychometric scales assessing traits or characteristics alongside doping attitude, which might have influenced individual subscale results. Following the recommended random effects model, the quantitative analyses revealed an overall PEAS score of 39.18 and a Cronbach's alpha of .85.

Based on Gliem and Gliem's (2003) interpretation guidelines for Cronbach's internal consistency reliability coefficient, the present summary measure of .85 is evaluated as good (> .8). Thus, internal consistency of the scale receives confirmation. Admittedly, there was a slight asymmetry identified through visual inspection of the funnel plot in Supplementary material 3, but in reference to Terrin et al. (2005) empirical statement on issues accompanying visual inspections only, Egger's regression test was performed to estimate possible publication bias. A significant result (p < .0001) suggested a summary score adjustment with the Henmi and Copas method. An overall conventionality of the PEAS is still assumed, with no possible explanations for publication bias discussed here.

6.8 Data Quality and Bias

Following the PRISMA guidelines, database search and cross-referencing resulted in an inclusion of 82 studies. These were assessed for quality by seven criteria implemented in a self-administered version of the ‘Quality Assessment Tool for Systematic Reviews for Observational Studies’ (QATSO). Since the majority of the studies achieved a good (6) or satisfying (61) result, with only 17 studies evaluated as bad, an overall appraisal eventuated in a sufficient content quality. In particular, studies show good sampling methods on the basis of representative samples for determining attitude towards doping among athletes. Another criterion of QATSO was to assess the use of statistical validations among the used PEAS versions. It is well-known that the original 17-item English version has passed tests for validity sufficiently in the past (Petróczi & Aidman, 2009; Nicholls et al., 2017a). However, to this date, there is no summary of the translated and applied versions, although a worldwide application and adjustment to other languages is in an ongoing progress. To our knowledge, explicit and in-depth statistical analyses of the 17-item or other versions through e.g., confirmatory factor analyses of the PEAS is available for the French (Hauw et al., 2016), German (Elbe & Brand, 2016), Hungarian (Petróczi & Aidman, 2009), Iranian (Divkan et al., 2013), Lithuanian (Sukys & Karanauskiene, 2020), Polish (Sas-Nowosielski & Budzisz, 2018) and Spanish (Morente-Sánchez et al., 2014a) versions. Further translations of either the 17-item or any other version have been identified for the Albanian (Sekulic et al., 2016), Chinese (Chen et al., 2017), Greek (Lazuras et al., 2017), Hindi (Hooda et al., 2018), Italian (Baumgarten et al., 2016), Persian (Soltanabadi et al., 2015), Korean (Kim & Kim, 2017), Norwegian (Sagoe et al., 2016), Romanian (Nica-Badea, 2014), Russian (Bondarev et al., 2009) and Serbian (Stojanovic et al., 2019) language. In reference to Behling & Law (2000), back-translations, as they were used in multiple studies, do not display adequate equivalence between the original and translated language despite their high popularity in common research practices. Therefore, additional statistical testing for all back translated only PEAS versions is highly recommended to ensure appropriate methodological foundations.

Besides, anonymity for taking part in a sensitive attitude survey was respected in most of the studies. Especially the adherence to guarantee an anonymous and confidential surrounding to the participants was identified for having an enormous influence on the honesty to sensitive questions (Ong & Weiss, 2000). In this light, the reviewed studies were evaluated as good. Moreover, studies were also sufficient in reporting internal consistency of the results. These findings were used in the quantitative part of this study to meta-analyze the overall descriptive statistics and Cronbach’s alpha. Studies were sparse on details about item exclusion in retrospection in order to augment the samples' internal consistency. This finding shows that the scale allows use among multiple data collections, languages and cultures without achieving losses in reliability, and therefore supports the general applicability of the PEAS. Finally, quality was assessed for item order randomization. In case any online tool was used to collect data without personal contact to the participant, these technological options often provide item randomization by default. But since most studies used paper-and-pencil methods, item randomization was not applied, or at least not reported.

In addition to the QATSO score, the criterion of socially desirable responding style was included in both the quality and bias check. Results of the two tests combined revealed an obvious deficit in integrating the impact of social desirability on responding to sensitive questions. In other words: Showing the tendency to give answers that make the respondent look good (Paulhus, 1991), remains an issue in testing sensitive socio-psychological topics. Especially doping was identified for displaying a high potential for an outward refusal, denial and dishonesty, as described by Gucciardi et al. (2010). Further research using the PEAS is highly encouraged to include tests here. In addition, the bias check revealed a consistently low risk for selective reporting and correlation bias respectively with only minor exceptions. At the same time, studies mostly remained unclear about incomplete data handling. Cases of falsely used or incomplete questionnaires are assumed to be omitted, but a definite confirmation was missing here, even though a high risk was not found in any study.

6.9 Guidance for the Interpretation of the PEAS Scores

The PEAS score is a composite score of all items, where a higher score represents a more positive, lenient and permissible attitude toward doping. Dividing the sum score by the number of items, the outcome is interpreted on the same scale as the rating scale (i.e., a six- or five-point Likert scale of agreement). No qualitative evaluative instrument for PEAS has been introduced.

The meta-analysis of the mean PEAS scores shows that the characteristic doping attitude among the athletes sampled is negative. Based on this observation, we propose cut-off points for a qualitative interpretation which reflects the fact that athletes' attitudes toward doping tend to vary within the negative range (i.e., being more or less negative) and not between the polar opposites of negative and positive. It is also important to note here that the PEAS is not a diagnostic tool thus interpretation should only be made at the aggregated group level, not for individuals.

To assist qualitative interpretation, we propose cut-off points (shown in Table 3) based on the observed 147 PEAS means from the 44 studies, using k-means clustering with ensuring no overlap between the five clusters (ANOVA $F(4, 121) = 316.60$, $p < .001$). Based on this interpretation, 46.03% of the observed doping attitude scores fall in the 'negative' range, followed by 23.81% 'somewhat negative' and 24.60% 'very negative', totaling 94.44% of the PEAS scores in the negative range. Only 4.76% of the mean PEAS scores were in the 'somewhat positive' range and only one mean was ≥ 60 (≥ 3.50 on a 6-point scale). The overall highest PEAS means were recorded for bodybuilders (Bahrami et al, 2014; Brand et al, 2014), cyclists (Zabala et al., 2016), or groups of athletes from various sporting backgrounds (Hooda et al., 2016; Petróczi et al., 2008; Petróczi et al., 2011; Sekulic et al., 2016; Uvacsek et al., 2011).

Table 3

Interpretation of PEAS Results (Group Level; Using 6-point Likert type scale)

Version	Doping Attitude				
	Very Negative	Negative	Somewhat Negative	Somewhat Positive	Positive
17-item full scale (PEAS)	17 – 32.9	33– 39.9	40 – 45.9	46 – 59.9	≥ 60
8-item short form (PEAS-8)	8– 14.9	15 – 17.9	18 – 21.9	22 – 27.9	≥ 28
On 6-point scale	1.00 – 1.99	2.0 – 2.35	2.36 – 2.69	2.70 – 3.49	≥ 3.50

6.10 Predictive Power for Doping Behavior

Taken the results together, it appears that PEAS dominantly measures the moral aspects of doping attitude (e.g., "doping is cheating"), not attitude toward self-relevant behavior (e.g., "using doping in the next three months would be beneficial to me"), and therefore it cannot be assumed that PEAS is a reliable predictor of actual behavior. Furthermore, researchers should be mindful of this limitation in interpreting PEAS results.

6.11 Construct Validity

PEAS, especially the recommended 8-item short form, seems to tap into moral aspects that surround doping. In hindsight, and benefitting from a more nuanced understanding of the doping phenomenon, the development of PEAS appears to be in the conjunction between the then dominant views about the doping problem, which in turn are reflected in the attitudinal items (Table 1). Firstly, doping was seen as a specific 'drug problem', linking behavior choices about doping to illicit drug use (items 4, 11 and 12) or deviance (items 5, 15). Simultaneously, and influenced by the theorizing of doping within sport ethics and philosophy, a paternalistic approach to health-protection is detectable in items 3 and 7, whereas doping being against the values and spirit of sport were also captured in items 1 and 2. Reasons for doping was found in the life of an athlete under constant pressure to perform (items 6 and 10), dealing with the demands of competitive sport (items 13, 14, 16 and 17), and under media scrutiny (8 and 9). Together, these items seem to capture the dimensions of the 'rightness' and 'wrongness' of doping from multiple angles, capturing dimensions that were thought to be relevant at the time PEAS was developed. Therefore, it is plausible that PEAS items collectively assess the degree by which doping is considered 'right' or 'wrong' by the respondents, rooted in their beliefs about what is right or wrong in sport and life in general and projected to the use of prohibited substances and/or methods. In other words, PEAS items tap into one's moral conviction about doping in general. If this assumption holds in future empirical enquiries, it could have important implications on the future use of the PEAS. Firstly, a critical evaluation is warranted to ascertain if the dimensions PEAS captures are still both relevant and sufficient. Secondly, moral conviction, which refers to meta-cognition that a particular attitude is a collective reflection of one's fundamental beliefs about what is right and wrong, is a useful concept to consider because moral conviction predicts not only personal behavior choices but also has important social and political consequences (Skitka et al., 2021). For example, one's strong moral attitude against doping is expected to be associated with greater intolerance of leniency toward doping (attitude dissimilarity), more positive legitimacy perception of anti-doping rules and procedures and increased active engagement in anti-doping beyond compliance at the personal level. However, a clear distinction between moral conviction and moralized attitudes is warranted. Moral convictions are fundamental and stable whereas moralized attitudes (as opposed to convicted moral attitudes) are thought to be more malleable to strong opposite moral arguments and personal benefits (Skitka et al., 2021).

Moral attitudes are unique and distinguishable from attitudes which emanate from preferences or conventional beliefs. Whilst attitudes are subjective and reflect matters of choice, moral attitudes are normative, defined or influenced by the relevant authorities (anti-doping organizations at global and local levels) and expected to be adopted by the community (athletes and their entourage). Disagreement in attitudes are more socially accepted and respected as personal preferences than divergence in moral attitudes, which are considered deviant and destructive for what the community values and aims to protect (i.e., clean sport, or integrity of sport). Exploring this in depth is beyond the aim and scope of this review but results (e.g., strong correlation with moral disengagement and consistently 'negative range' in PEAS scores even among admitted doping users), coupled with the content of each PEAS item, raises the question whether PEAS assess morally convicted or moralized doping attitude. The concept of moral or moralized attitudes is used here in the broad sense that encompass a wide range of beliefs and sources of moral convictions against and for allowing doping. As such, moral/moralized doping attitude should not be read as a measure limited to an explicitly moralized view of doping (i.e., 'doping is cheating') but as a composite measure of meta-cognition of doping-related beliefs and values.

6.12 Limitations and Recommendations for Future Research

Although conducting a systematic review and meta-analysis on doping attitude with all forms of assessments is needed to clear up some of the omnipresent confusion around what constitutes 'doping attitude' and to guide future research, this was outside of the scope of the present study. This review was purposefully limited to reviewing studies using the PEAS to assess attitudes. Because the primary aim of this review and meta-analysis was to cumulate evidence for the psychometric properties of PEAS, we did not intend to explore the role of attitude in doping behavior; or decisions made about performance-enhancing practices. Future research should extend the review to doping attitudes, catalogue the exact attitude type and assessment tool to create a nuanced picture of the role of attitude in doping behavior, in context of established or newly theorized behavior models. Furthermore, research is recommended to ascertain whether the way doping attitude is assessed (e.g., PEAS, short PEAS, semantic differential or some other scale) has impact on the differences and relationships established.

The aspect of morality and to what degree (if any) PEAS might be a measurement of moralized or morally convicted attitudes toward doping warrants further in-depth investigation via both qualitative and quantitative explorations as well. Studies exploring the link between doping attitude measured via the PEAS and other formats, and the relationship between such attitude measures and perceived legitimacy of anti-doping, expected obedience, compliance and conformity can help to shed light on the dimension(s) of doping attitude and the construct validity of the full and short forms of PEAS.

Whilst empirical validation of the proposed short 8-item PEAS is warranted, doping attitude and behavior research would also benefit from a holistic view of attitude that takes functional as well as the moral aspects into account. Developing precise definition(s) of the construct(s) and distinguishing between the evaluation of the attitude object (doping) and evaluation of the behavior (engage in doping) would help to refine the role of attitudes in doping and clean sport behavior. If doping attitudes stem from the proposition that doping may not only be seen as a moral choice (cheating) but also as something functional (performance-enhancing) to athletes (Petróczi, 2013), then there is a need for incorporating the functional aspect into doping attitude.

Further limitations arose from delimiting reporting observed in the included studies. Subgroup analyses for gender and doping use were limited to a handful of studies where such breakdown for the PEAS scores was reported. We made attempts to obtain the breakdown from the authors directly, but we can only report limited success for doing so. Because language of PEAS and translation process was not always properly reported, in many cases we assumed the language based on participants' nationality. Subgroup analysis by level of sport involvement was impossible for two reasons. Although several studies used samples from a wide range of sport involvement, breakdown of PEAS score by levels is not reported unless the research specifically aims to compare levels. Inclusion of PEAS scores by gender, sport, sporting levels and user/nonuser profile in the appendix will help future meta-analyses. The second problem is the lack of uniform definition of 'sporting levels'. To facilitate comparison across studies and meta-analyses in the future, we recommend that authors either use the five levels of the Athlete Pathway as set out in the WADA International Standard for Education (see the Guidelines for the WADA International Standard for Education (ISE); WADA, 2021); or map their locally relevant classification to the athlete pathways when they describe their study samples.

Conclusion

This systematic review presents the significant standing and recognition of the Performance Enhancement Attitude Scale in psychometric measurements towards doping in scientific literature. Worldwide use, multiple translations into various languages, an overall high quality and low bias rates identified among PEAS studies, as well as an ascertained good reliability attest its practicability. A need for a common, revised 'master' version of the Performance Enhancement Attitude Scale to facilitate comparison of the results was revealed. Interpretation of the summary measure performed in this meta-analysis challenged literature on the impact of attitude in predicting behavior intention and doping use. At best, only weak evidence is shown for admitted intention or use, which should not be equated to doping behavior *per se*. Further research is necessary to investigate the mediating effect of admission. With a call for empirical verification, the influence of PEAS-assessed doping attitude on the actual behavior - with a potential of this being morally convicted or moralized - is hypothesized to be more influential for clean sport behavior than doping behavior.

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Conflicts of interest

The authors declare no conflict of interest.

Author contribution

Dirk Folkerts (DF):	Formal analysis; Methodology; Investigation; Writing – original draft
Roland Loh (RL):	Formal analysis; Methodology; Writing – original draft
Andrea Petróczi (AP):	Project administration; Methodology; Supervision; Writing – review & editing
Sebastian Brueckner (SB):	Supervision, Writing – review & editing

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