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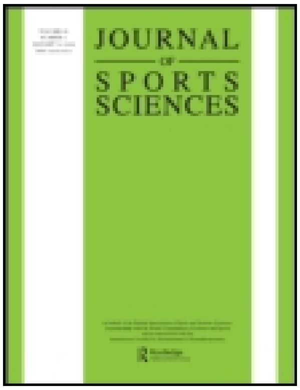

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Does the individual zones of optimal functioning model discriminate between successful and less successful athletes? A meta-analysis

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According to the individual zones of optimal functioning (IZOF) model, an athlete's performance is successful when his or her pre-competition anxiety is within or near the individually optimal zone. When anxiety falls outside the optimal zone, performance deteriorates. The model also suggests that skilled athletes are aware of, and are able to accurately recall and anticipate, their pre-competition anxiety. A meta-analysis of 19 studies from 1978 to 1997 (146 effect sizes based on 6387 participants) was conducted to examine the validity of the assumptions regarding the in–out of the zone notion and the accuracy of recalls and anticipatory measures of anxiety. The findings provide fairly good empirical support for the IZOF anxiety model, with an overall effect size (d) for the in–out of the zone notion of $d = +0.44$ (41 effect sizes, $n = 3175$). In other words, the performance of athletes who were within their individually optimal zones were almost one-half a standard deviation unit better than that of athletes who were outside their zones. Furthermore, both effect sizes (r_w) for accuracy of precompetition anxiety measures, recall ($r_w = +0.71$, 24 effect sizes, $n = 369$) and anticipatory ($r_w = +0.69$, 81 effect sizes, $n = 2843$), exceeded the 'large effect' suggested for correlations by Cohen. The implications for future research extending the IZOF model to a wider range of positive and negative emotions are discussed.

Keywords: anxiety, effect size, individual zones of optimal functioning model, performance.

Introduction

Different approaches have been used in sport psychology to examine anxiety–performance relationships, mainly from a nomothetic (group-oriented) perspective. However, there is a growing body of research of the validity and practical utility of alternative assumptions formulated from individualized perspectives, such as the individual zones of optimal functioning (IZOF) model (Hanin, 1978, 1986, 1989, 1995, 1997a). This model was developed in the naturalistic setting of elite sports and combines intra- and inter-individual analysis of athletes' emotional experiences related to successful and poor performances. Recently, this framework, initially used to study individually optimal precompetition anxiety in top athletes, was extended to the analysis of positive and negative emotions related to performance (Hanin, 1993, 1995; Hanin and Syrjä, 1995a,b).

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As applied to precompetition anxiety, the IZOF model contends that each athlete has an individually optimal level (high, moderate and low) and intensity zone of anxiety associated with enhanced performance. It is assumed, therefore, that there is a large inter-individual variability in optimal anxiety in different samples of athletes. Furthermore, it is predicted that individually successful performance, particularly in tasks of short duration (Hanin and Syrjä, 1996; Hanin, 1997a), occurs when an athlete's precompetition anxiety is near or within the previously established optimal zones. However, when precompetition anxiety falls outside these optimal zones (i.e. higher or lower), performance deteriorates.

The notion of individually optimal anxiety and the in–out of the zone principle are proposed in the IZOF model to conceptualize and identify functionally optimal (or dysfunctional) intensity effects of anxiety upon individual performance. Additionally, in the assessment of subjective emotional experiences that are related to performance, it is assumed that skilled athletes are

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aware of, and thus are able to recall and anticipate accurately, their pre-competition anxiety, especially in important competitions (Hanin, 1978, 1986, 1989, 1995; Orlick, 1986; Loehr, 1994; Hanin and Syrjä, 1995a,b, 1996). Specifically, during recall, athletes rate their emotional states based on past experiences of most successful ('best ever') or poor ('worst ever') performances. Thus, patterns of emotional response during the pre-performance stage of activity are identified. In the prediction of emotional states, athletes rate their anticipated feelings based on their perception of the forthcoming performance and similar past experiences. The recalled and anticipatory ratings are then compared with actual assessments to derive an index of accuracy that reflects an athlete's awareness of subjective emotional experiences related to performance. Hanin (1995, 1997a) recommends determining individually the optimal level and zones of anxiety based on an athlete's past performance history using recall methods, with subsequent refinement and validation of self-rating accuracy in actual (real-time) and anticipatory (expected) assessments.

Research, initially using Spielberger's State–Trait Anxiety Inventory (Spielberger *et al.*, 1970), has shown that skilled athletes are accurate in recalling their anxiety before successful and unsuccessful competitions. For instance, the high accuracy of two-day recall in female ($r = 0.97$) and male ($r = 0.96$) track and field athletes was not influenced by their relative success (Harger and Raglin, 1994). Also, significant correlations (0.75–0.89) were found between actual and recalled pre-competition anxiety when the interval between assessments was 3–4 months (Hanin, 1986; Raglin and Turner, 1993; Raglin and Morris, 1994). Furthermore, other standardized scales, such as the Competitive State Anxiety Inventory-2 (CSAI-2), Profile of Mood Scales (POMS) and the Body Awareness Scale, have been used successfully to identify retrospectively optimal pre-competition affect (Raglin *et al.*, 1990a; Prapevessis and Grove, 1991; Gould *et al.*, 1993; Krane, 1993).

Other research contrasting anticipated and actual self-ratings also demonstrated that skilled athletes in different sports were able to predict quite accurately their anticipated emotions and performance. Significant correlations (0.49–0.98) were found between anticipatory and actual measures of pre-competition anxiety using time intervals of 24 h and 2–3 weeks (Hanin, 1986; Raglin *et al.*, 1990b; Salminen *et al.*, 1995). Additionally, irrespective of the instruments used, the findings provide empirical support for the validity of the individual-oriented and multidimensional conception of anxiety–performance relationships (Hanin, 1995, 1997a). Thus, theoretical and practical utility of the 'in–out of the zone' concept for predicting individual performance has also been demonstrated.

Several advantages of the IZOF anxiety model have been demonstrated: it is intuitively appealing and realistic (Weinberg, 1990; Gould and Krane, 1992; Jones, 1995); it predicts precisely at which level of anxiety optimal performance will occur; and it is empirically based with all research conducted in naturalistic field settings, making it an ecologically valid model (aimed at top athletes and coaches). Furthermore, an idiographic and longitudinal design is advocated, a methodology for precisely defining an individual's optimal range of anxiety has been developed, the validity of the basic assumptions can be examined directly through hypothesis-testing, and explanations of anxiety–performance relationships are based on empirical study of the function of subjective emotional experiences in performance (Hanin, 1997a). Finally, the model is heuristic in that it helps to generate new hypotheses. It is also important to realize that the model is an inductive, idiographic, qualitative and sport-specific framework that focuses on the structure and functions of subjective emotional experiences in skilled performers. Therefore, one of the main strengths of the model at present is its consistent emphasis on accurate description of the effects of anxiety (and other emotions) upon athletic performance as a precondition for the development of a grounded theory explaining the dynamics of emotion–performance relationships.

There are certain limitations to the IZOF anxiety model that need to be addressed. First, the main focus initially was on optimal anxiety (level and zones), not on average and poor performance correlates of anxiety. Secondly, a method of establishing the optimal level and the zones was based on single recall of anxiety before personal best performance in the past. The stability of such measures was not systematically determined either intra-individually or inter-individually. Thirdly, the 'in–out of the zone' notion is based on the distinction of two qualitatively different performance categories: success and failure. Therefore, the shape of anxiety–performance relationships across the range of intensity is not predicted. Finally, the main emphasis of the model was on optimal pre-competition anxiety rather than temporal patterns of optimal anxiety before, during and after a performance.

Some of these concerns – especially the conceptual, methodological and explanatory aspects of the framework – were addressed in the IZOF emotion model extended to positive and negative emotions (Hanin, 1997a). With a growing body of literature and empirical studies that test the validity of the model-based predictions of relationships between anxiety and athletic performance (in–out of the zone notion), and investigate athletes' accuracy to recall and anticipate their pre-competition mood, there is a need to integrate these

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literatures. Several narrative reviews have examined the validity and practical utility of the IZOF model as applied to pre-competition anxiety (Hanin, 1978, 1986, 1989, 1995, 1996; Morgan and Ellickson, 1989; Weinberg, 1990; Raglin, 1992; Jones, 1995; Gould and Tuffey, 1996). Each of these reviews, however, focused only on selected aspects of the model and did not try to integrate the rapidly growing body of empirical research within the IZOF framework. For instance, Gould and Tuffey (1996) focused mainly on the in–out of the zone notion, whereas Raglin (1992) examined studies of the accuracy of recall and anticipatory measures. Furthermore, while previous narrative reviews have been conducted on this literature, they have been unable to determine the strengths of any noted effects in an objective (quantitative) manner. In addition, a rationale to examine statistically emerging research sub-questions might be useful. Therefore, there is a need to evaluate and integrate available IZOF anxiety research using meta-analysis.

Meta-analysis (Glass, 1976) is an integration method that quantifies research information related to a specific topic or theory and arrives at a synthesis of the study findings. A standard metric used is the effect size. Effect sizes can be based on probabilities, comparisons between two groups (effect size d) or correlational data (effect size r). An advantage of meta-analysis compared with narrative review is that, in addition to quantifying the size of the overall effect, the impact of separate study variables can be examined. For this purpose, the coding of study characteristics becomes essential. The method is more objective than the traditionally used narrative review, in which subjective decisions are made with respect to the selection of studies to be included and how to weight their results. In a meta-analysis, the selection procedure of studies is governed by the inclusion criteria established at the beginning of the procedure.

Several studies have used meta-analysis in sport and exercise psychology. Among other topics, these have examined the effect of anxiety on performance (Kleine, 1990; Rowley *et al.*, 1995) and the effect of exercise on anxiety (Petruzzello *et al.*, 1991; Schlicht, 1994; Long and van Stavel, 1995). Specifically, Kleine (1990) combined 50 empirical studies published between 1970 and 1988 and included 77 independent samples with $n = 3589$. An overall meta-analysis for the total sample yielded a weighted mean of all correlations between anxiety and sport performance of $r = -0.19$. Although differences in effect size existed, none of the population effect sizes were in the positive range; that is, research conducted within the framework of nomothetic orientations (such as the inverted-U hypothesis) revealed consistent, although relatively small, negative relationships between anxiety and performance. Recently, Rowley *et al.* (1995) conducted a meta-analysis of 33 studies to examine the predictive power of one specific (mental health) model based on the Profile of Mood States (POMS) 'iceberg' profile, with six mood subscales, including tension/anxiety, anger, confusion, vigour, fatigue and depression. A relatively small but positive overall effect size ($d = 0.15$) was found across these group-oriented studies that used the POMS to discriminate between successful and less successful athletes.

Thus, with a growing body of literature on anxiety (emotion)–performance relationships, a meta-analysis focusing either on one specific framework or contrasting multiple models seemed a promising alternative to explore. The aims of this study were two-fold. First, to examine the predictive power of the IZOF-based in–out of the zone notion. We hypothesized that athletes who were within their individually optimal anxiety zones would perform better than athletes who were out of their optimal zones. Secondly, we examined the accuracy of recall and anticipatory measures of athletes' pre-start anxiety. We expected skilled athletes to be reasonably accurate in both the recall and prediction of their pre-competition anxiety.

Methods

Selection of studies and coding

A literature search from 1978 to 1997 was conducted both manually and using computer databases (PsycLIT, Sport, SpoLIT, Socio, Social Science Citation Index, Eric) to locate appropriate IZOF anxiety studies. To be included in the meta-analysis, a study had to meet the following criteria: (1) an application of the IZOF approach to state anxiety; (2) measurement of state anxiety by self-report scales; and (3) sufficient quantitative information for the calculation of effect sizes (means, standard deviations, or transformations of F, t or r values).

Typical IZOF-based anxiety studies usually focus on inter-individual variability of optimal anxiety (a range from high to low intensity in the sample), the accuracy of recall and anticipatory measures, or the validity of the in–out of the zone notion in the prediction of individual performance. As to the utility of the in–out of the zone notion, it can be tested by contrasting successful and less successful performances either in the same athletes (intra-individually) or across different athletes (inter-individually).

Nineteen of the 43 IZOF-based investigations identified met the established criteria and were included in the meta-analysis. Of these, seven had tested the in–out of the zone notion predicting individual performance,

Table 1. Coding characteristics

Participant	Activity	Measurement
Age	**Sport**	**Scale used**
College age		STAI
Under college age	**Performance measure**	CSAI-2
Unclear/other	Criterion-referenced	BAS
	Self-referenced	
Sex	% best	**Assessment time**
Males	% average	(recall measures)
Females		48 h post-performance
Combined	**Subjective ratings**	Less than 1 year
	Coach's ratings	22 months
Skill	Athlete's ratings	
Elite		**Assessment time**
Pre-elite	**Competition importance**	(anticipatory measures)
Non-elite	Important	Less than 1 week
	Not important	More than 1 week
	Competition difficulty	
	Easy	
	Difficult	
	Performance outcome	
	Successful (above average)	
	Less successful (below average)	

Abbreviations: STAI = State–Trait Anxiety Inventory, CSAI-2 = Competitive State Anxiety Inventory-2, BAS = Body Awareness Scale.

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seven had examined the accuracy of optimal anxiety recall and 12 had investigated the accuracy of anticipatory measures. Of the studies not included in the meta-analysis, some examined anxiety from other perspectives, such as interpersonal and intra-group anxiety, and intra-individual variability in arousal in best, usual and worst performances. Others used flawed methods, either by inappropriately combining recall and actual measures (Randle and Weinberg, 1997) or by calculating optimal zones for actually observed average (but not personally best) performance (Thelwell and Maynard, 1998). In some cases, calculation of the deviations (distances from the zones) was based on the assumption of curvilinear relationships between anxiety and performance, which were never stated in the model. Other studies did not report sufficient information to calculate effect sizes; two studies replicated the data in an investigation already included in the meta-analysis.

Finally, it was not possible to include another 10 studies which examined positive and negative emotions (rather than anxiety) and focused on more recent developments in the extended IZOF model. These new aspects included multidimensionality, the content of performance-related positive and negative emotions, and functional interpretations of emotional impact upon performance (Hanin, 1997a). As well as the sources otherwise cited, we also included in the meta-analysis data from Annesi (1997), Turner (1993) and Wilson (1993), as well as unpublished data from Salminen, Liukkonen and Hyvönen.

Studies were coded on three groups of variables that were expected to be potential moderators of the effects investigated. These variables included participants, activity and measurement characteristics (Table 1). Following the recommendations of Hanin (1992, 1997a) and Raglin (1992), the performance measures were divided into criterion-referenced (inter-individually based), self-referenced (intra-individually based) and subjective ratings of performance. Criterion-referenced rating was coded when an athlete's performance was compared to a standardized external reference, for example International Amateur Athletic Federation (IAAF) or National Collegiate Athletic Association (NCAA) tables. In a self-referenced rating, performance was converted to an attained percentage of an athlete's personal best or personal average performance.

In meta-analysis, inter-coder reliability is usually assessed by comparing similarity of coding between two independent coders in 20–30% of studies randomly selected from those included. In the present study, the first author coded all 19 studies, five of which (26.3%) were selected for independent coding. Similarity in coding (84.5%) was acceptable.

Meta-analytical procedures

A single study often reports more than one research finding. Therefore, the unit of analysis in this meta-analysis was an effect size for a single study finding. If, for example, effect sizes for both the sexes from one study were included in the analysis, then the total sample effect size was excluded to eliminate multiple effect sizes. If the research findings in an original study were reported in a format that was not possible to apply directly to the calculation of the effect size, then the format was transformed following the recommendations of Schwarzer (1989). Altogether, 19 studies were used, yielding 146 effect sizes based on 6387 participants. The meta-analysis computer program developed by Schwarzer (1989) was used in running separate analyses for three different data bases (k = number of effect sizes, n = sample size): (1) in–out of the zone notion ($k = 41$, $n = 3175$), (2) accuracy of recall ($k = 24$, $n = 369$) and (3) accuracy of anticipatory measures ($k = 81$, $n = 2843$).

Meta-analysis 1: The in–out of the zone notion

To examine the in–out of the zone notion, the mean performances of athletes with anxiety within their individually optimal zones (in the zone condition) were compared with performances of those who were out of their optimal zones (out of the zone condition). In comparing 'in the zone' and 'out of the zone' athletes, the effect sizes were calculated using the formula based on Hedges and Olkin's (1985) extension of Glass's (1976) original technique. The in–out of the zone principle provides a basis to identify the specific effect intensities that distinguish between qualitatively different (successful and poor) performance categories. It is important to note that the earlier IZOF anxiety model focused mainly on the level of anxiety and the zones and, therefore, did not predict the shape of anxiety–performance relationships along the working range of intensity (Hanin, 1997b, 1999). Therefore, the exact distances from the zones (the magnitude of deviations from the mid-zone point) were not considered (see Gould *et al.*, 1993).

Most studies in the present meta-analysis reported information for the calculation of effect sizes inter-individually, although repeated within-individual comparisons are preferable. A positive effect size indicates more successful performance of the 'in the zone' athletes compared with their 'out of the zone' counterparts, whereas a negative effect size indicates the opposite. To avoid biased effect sizes of studies with small sample sizes, each effect size was corrected for sample size using the formula of Hedges and Olkin (1985). It is important to highlight here that the meta-analysis corrected for sampling error and not for other artifacts, such as measurement error or restriction of range. This is because if future meta-analyses correct for more artifacts, inconsistency between the findings of meta-analyses may result.

Separate effect sizes were combined into one overall effect size and the degree of homogeneity was established using Hedges' Q-test. As the overall effect size was heterogeneous, further analyses were run to test for moderators. The following variables were included: performance measure, scale used, and 'in the zone' and 'out of the zone' athletes (above or below zone deviations).

Because of the relatively small number of studies contributing to the computation of some of the population effect sizes, how many unlocated studies with null effects would be needed to reduce the effect size to a zero-order or minimal level is relevant here (see Rosenthal, 1979; Hunter and Schmidt, 1990). Thus, a fail-safe sample size (Orwin, 1983) was calculated to determine the number of studies needed to reduce the obtained effect size down to the critical value, such as $d = 0.20$ (or $r = 0.10$), that we would consider theoretically and practically important. A conservative formula proposed by Hunter and Schmidt (1990) was used. The fail-safe sample sizes reported in Tables 2, 3 and 4 suggest that some of the results of the meta-analysis must be considered with caution.

Meta-analyses 2 and 3: Accuracy of recall and anticipatory measures

To examine the accuracy of athletes' self-ratings, the recall and anticipatory measures were compared with actual assessments using retest. The effect sizes for the accuracy analyses were based on correlations and were integrated using the Schmidt-Hunter procedure (Hunter *et al.*, 1982). The derived population effect size is the weighted average of single correlations.

The data were considered homogeneous if the variance accounted for by sampling error was at least 75% (Hunter *et al.*, 1982). As the data in both accuracy analyses were heterogeneous, separate analyses in the examination of recall accuracy measures were run for sex, recall measurement time, scale used, performance assessment and age. For accuracy of anticipatory measures, separate analyses were conducted for sex, anticipatory measurement time, scale used, age and competition assessment. Additionally, fail-safe sample sizes were calculated. Second-order sampling error was treated by the calculation of z-tests using the Hunter and Schmidt (1990) formulae. As most of our moderators were binary (Tables 2, 3 and 4), z-tests seemed appropriate to establish the significance of differences between effect sizes.

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Table 2. The in–out of the zone notion with respect to performance measures, scale used and being in, above or below the zone

	k	n	Effect size d	95% confidence intervals	% accounted for by sampling error	Fail-safe n of 0.20
Overall e ect size	41	3175	+0.44	+0.32 to +0.55	57%	49
Performance measures						
Criterion-referenced	14	1201	+0.61	+0.49 to +0.73	100%	29
Self-referenced	8	599	+0.27	−0.09 to +0.63	23%	3
% best	6	480	+0.45	+0.08 to +0.81	29%	8
% average	2	119	−0.27	−0.64 to +0.09	100%	1
Subjective ratings	6	443	−0.04	−0.23 to +0.15	100%	*
athlete's rating	3	141	+0.28	−0.07 to +0.62	100%	2
coach's rating	3	302	−0.18	−0.41 to +0.05	100%	*
Scale used						
STAI	33	2440	+0.41	+0.28 to +0.54	50%	35
CSAI-2	8	735	+0.56	+0.39 to +0.73	100%	15
cognitive	2	231	+0.37	+0.06 to +0.67	100%	2
somatic	4	280	+0.64	+0.34 to +0.95	100%	9
Zone						
In *vs* above the zone	3	374	+0.60	+0.37 to +0.82	100%	6
In *vs* below the zone	3	326	+0.41	+0.04 to +0.78	61%	4

Note: k = number of effect sizes, n = sample size, Fail-safe n of 0.20 = number of studies with an effect size of 0 that is required to bring the mean effect size d down to a critical value of 0.20. STAI = State–Trait Anxiety Inventory, CSAI-2 = Competitive State Anxiety Inventory-2.
* The fail-safe n in these cases does not apply, since the effect sizes are below the critical value.

Results

Descriptive data

Most of the studies included had been published: 13 in scientific journals, one in a book and one in congress proceedings. Two of the unpublished studies were masters theses and two were doctoral dissertations. The participants were mainly non-elite athletes aged 9–72 years, most college-age athletes. Sports included track and field, gymnastics, swimming, skating, volleyball, field hockey, soccer and ten-pin bowling. The scales used included the State–Trait Anxiety Inventory (Spielberger *et al.*, 1970), the State–Trait Anxiety Inventory for Children (Spielberger, 1973), the Competitive State Anxiety Inventory-2 (Martens *et al.*, 1990) and the Body Awareness Scale (Wang and Morgan, 1987; Koltyn and Morgan, 1997). Most studies adopting the CSAI-2 used only the cognitive and somatic subscales, not the self-confidence subscale. In the meta-analysis, CSAI-2 subscales were used separately.

-.4	1
-.3	
-.2	3
-.1	3679
-.0	6
+.0	9
+.1	5
+.2	117
+.3	7
+.4	07779
+.5	2445667
+.6	01389
+.7	055
+.8	134
+.9	0
+1.0	55
+1.1	99
+1.2	

Fig. 1. Stem and leaf display for 41 effect sizes in the data set 'in–out of the zone notion'.

Meta-analysis 1: The in–out of the zone notion

Figure 1 shows effect sizes for the total sample, which ranged from $d = -0.41$ to $d = +1.19$, with 83% of effect sizes in the positive direction. The overall effect size for the comparison between athletes in the zone and those out of the zone was $d = +0.44$ ($k = 41$, $n = 3175$). In other words, athletes who were within their individually optimal anxiety zones performed almost one-half a standard deviation unit better than athletes who were outside their optimal zones (Table 2). Hedges' Q test

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of 85.95 ($P < 0.01$) indicated that the data set for the overall effect size was heterogeneous. Therefore, Table 2 reports effect sizes of further meta-analyses for performance measure, scale used and the direction of the deviations from the optimal zone (above and below).

The predictive power of the in–out of the zone notion was higher when criterion-referenced performance measures (effect size $d = +0.61$, $k = 14$, $n = 1201$) were used instead of self-referenced (percent best or average performance) measures. Specifically, when athletes' performances were contrasted with their best, effect size d was +0.45 ($k = 6$, $n = 480$), whereas when percent of individually average performance was the criterion, effect size d was −0.27 ($k = 2$, $n = 119$). This finding is further supported by the lack of overlap in the 95% confidence intervals for these effect sizes ($z = 2.77$, $P < 0.05$). The effect size for subjective ratings of performance by athletes was positive and in the predicted direction ($d = +0.28$, $k = 3$, $n = 141$), whereas the effect size for coaches' ratings was $d = -0.18$ ($k = 3$, $n = 302$). Again, there was little overlap in the 95% confidence intervals for these effect sizes ($z = 2.16$, $P < 0.05$).

The effect sizes for the Competitive State Anxiety Inventory-2 ($d = +0.56$, $k = 8$, $n = 735$) were higher than for the State–Trait Anxiety Inventory ($d = +0.41$, $k = 33$, $n = 2440$). However, because of the comparatively large overlap in the 95% confidence intervals, we cannot infer that either of these measures has any noticeable advantage in the assessments ($z = 1.37$, $P > 0.05$). These findings mirror the results of Kleine (1990), who contrasted different state and trait anxiety measures. However, for the Competitive State Anxiety Inventory-2, the somatic subscale ($d = +0.64$, $k = 4$, $n = 280$) showed some advantages over the cognitive anxiety subscale ($d = +0.37$, $k = 2$, $n = 231$), since the confidence intervals displayed considerably less overlap ($z = 5.57$, $P < 0.01$).

In terms of the direction of deviation from the zone, a somewhat higher effect size was obtained when the in and above the zone conditions ($d = +0.60$, $k = 3$, $n = 374$) were contrasted with the in and below the zone conditions ($d = +0.41$, $k = 3$, $n = 326$). However, again the confidence intervals displayed considerable overlap and, therefore, we cannot infer that the effect sizes for these conditions differed ($z = 0.85$, $P > 0.5$). Additionally, the fail-safe sample size for these variables (Table 2) indicates that the number of null studies required to bring the obtained effect size down to the 0.20 effect size is quite small in some cases. When the data set is split according to additional study characteristics, the number of effect sizes and the sample size decrease simultaneously, whereas the sampling error increases, the confidence interval becomes larger and, therefore, the probability of a Type II error is greatly increased (Hunter *et al.*, 1982). A factor that contributes to large confidence intervals in subset meta-analysis is second-order sampling; moderator analysis reduces the number of effect sizes (k) and the sample size (n) dramatically, with an increased second-order sampling error.

Meta-analysis 2: Accuracy of recall measures

As predicted by the IZOF model, the correlations in the data set for all 24 effect sizes were in a positive direction and ranged between $r = +0.25$ and $r = +0.98$ (Fig. 2). The weighted population effect size ($\bar{r}_w$) between inter-individually assessed actual and retrospective anxiety was +0.71 ($k = 24$, $n = 369$), with a confidence interval of +0.41 to +1.00. Based on this result, there would be a substantial association between actual and retrospective self-ratings. This finding is not particularly reliable, however, because only 41% of the observed variance in effect sizes was explained by sampling error and a residual variance of 59% remained unexplained. Therefore, because of heterogeneous data, separate analyses were run, and better results were obtained when studying differences in sex, age, scales used, time interval between performance and recall, and performance assessments (Table 3).

Males seemed to be able to recall their pre-competition anxiety more accurately ($\bar{r}_w = +0.75$; $k = 2$, $n = 58$) than females ($\bar{r}_w = +0.67$; $k = 16$, $n = 240$); however, this difference was non-significant ($z = 0.50$, $P > 0.05$). Similarly, recall accuracy is higher at 48 h ($\bar{r}_w = +0.72$; $k = 17$, $n = 252$) and 22 months ($\bar{r}_w = +0.77$; $k = 2$, $n = 67$) than for less than 1 year ($\bar{r}_w = +0.58$; $k = 5$, $n = 50$); again these differences were non-significant ($z = 0.75$, $P > 0.05$). Therefore, some of our findings should be treated with caution; on the one hand, there was a large overlap in the 95% confidence intervals ($z < 1.64$), but on the other, the fail-safe sample sizes were quite large for all effect sizes. Additionally, the variance accounted for by sampling error was quite low in the subsamples based on sex and in all three measurement time subsamples. Thus, the samples are

+.0	
+.1	
+.2	56
+.3	
+.4	59
+.5	359
+.6	1579
+.7	1459
+.8	005
+.9	466778

Fig. 2. Stem and leaf display for 24 effect sizes in the data set 'accuracy of recall measures'.

Table 3. Accuracy of recall measures with respect to sex, measurement time, scale used, performance assessment and age

	k	n	Effect size $\bar{r}_w$	95% confidence intervals	% accounted for by sampling error	Fail-safe n of 0.10
Population e ect size	24	369	+0.71	+0.41 to +1.01	41%	147
Sex						
Female	16	240	+0.67	+0.46 to +0.89	63%	92
Male	2	58	+0.75	+0.52 to +0.98	33%	13
Recall measurement time						
48 h	17	252	+0.72	+0.46 to +0.98	47%	106
Less than 1 year	5	50	+0.58	+0.25 to +0.92	60%	25
22 months	2	67	+0.77	+0.53 to +1.01	25%	14
Scale used						
STAI	12	189	+0.79	+0.40 to +1.19	17%	84
CSAI-2	12	180	+0.62	+0.62 to +0.62	100%	63
cognitive	4	60	+0.55	+0.55 to +0.55	100%	19
somatic	4	60	+0.64	+0.64 to +0.64	100%	22
self-confidence	4	60	+0.67	+0.67 to +0.67	100%	23
Performance assessment						
Low or below average	4	54	+0.84	+0.69 to +0.98	55%	30
High or above average	4	51	+0.65	+0.65 to +0.65	100%	22
Age						
University age	11	181	+0.80	+0.39 to +1.21	15%	77
Under (9–17 years)	12	180	+0.62	+0.62 to +0.62	100%	63

Note: k = number of effect sizes, n = sample size, fail-safe n of 0.10 = number of studies with an effect size of 0 that is required to bring the mean effect size down to a critical value of 0.10. STAI = State–Trait Anxiety Inventory, CSAI-2 = Competitive State Anxiety Inventory-2.

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clearly heterogeneous. Athletes of university age ($\bar{r}_w$ = +0.80; k = 11, n = 181) were more accurate at recalling their anxiety than younger athletes ($\bar{r}_w$ = +0.62; k = 12, n = 180), but the difference was not significant (z = 0.86, $P > 0.05$). Finally, that the confidence intervals for all these effect sizes did not include 0 indicates that the relationship was positive.

Meta analysis 3: Accuracy of anticipatory measures

As predicted by the IZOF model, the correlations in the data set for all effect sizes were in a positive direction and ranged between r = +0.21 and r = +0.98 (Fig. 3). The weighted population effect size between anticipatory (prospective) and actual (current) anxiety assessments was $\bar{r}_w$ = +0.69 (k = 81, n = 2843), with confidence intervals of +0.45 to +0.93. Based on this result, there would be a substantial association between anticipatory and actual self-ratings. This finding is not particularly reliable, however, because only 35% of the observed variance in effect sizes could be explained by sampling error and a residual variance of 65% remained unexplained. Therefore, because of heterogeneous data, separate analyses were run and the results are reported in Table 4.

+.0	
+.1	
+.2	178
+.3	014689
+.4	1145599
+.5	000899
+.6	0556666799
+.7	001111233344455555666666677788999
+.8	000122789
+.9	3555678

Fig. 3. Stem and leaf display for 81 effect sizes in the data set 'accuracy of anticipatory measures'.

Males appear to be more accurate than females at anticipating pre-competition anxiety (males: $\bar{r}_w$ = 0.75, k = 18, n = 458; females: $\bar{r}_w$ = +0.63, k = 27, n = 478); however, this difference was not significant (z = 0.76, $P > 0.05$). Moreover, the effect sizes were higher for anticipatory measures taken less than 1 week ($\bar{r}_w$ = +0.74, k = 57, n = 1675) before competition than assessments taken more than 1 week before competition ($\bar{r}_w$ = +0.62, k = 24, n = 1168) (z = 0.74, $P > 0.05$). As expected, based on age, the effect size for university athletes' anticipation ($\bar{r}_w$ = +0.75, k = 36, n = 1430)

Table 4. Accuracy of anticipatory measures with respect to sex, time, scale used, age and competition difficulty

	k	n	Effect size $\bar{r}_w$	95% confidence intervals	% accounted for by sampling error	Fail-safe n of 0.10
Population e ect size	81	2843	+0.69	+0.45 to +0.93	35%	476
Sex						
Female	27	478	+0.63	+0.32 to +0.93	46%	143
Male	18	458	+0.75	+0.75 to +0.75	100%	117
Anticipatory measurement time						
Less than 1 week	57	1675	+0.74	+0.56 to +0.92	46%	364
More than 1 week	24	1168	+0.62	+0.36 to +0.87	32%	124
Scale used						
STAI	76	2783	+0.69	+0.45 to +0.93	34%	447
CSAI-2	3	30	+0.69	+0.69 to +0.69	100%	18
BAS	2	30	+0.63	+0.08 to +1.18	24%	11
Age						
University age	36	1430	+0.75	+0.64 to +0.86	59%	235
Under (9–17 years)	17	205	+0.64	+0.32 to +0.95	53%	91
Competition assessment						
Difficult	18	508	+0.74	+0.56 to +0.91	47%	115
Easy	18	525	+0.68	+0.35 to +1.01	26%	105

Note: k = number of effect sizes, n = sample size, fail-safe n of 0.10 = number of studies with an effect size of 0 that is required to bring the mean effect size down to a critical value of 0.10. STAI = State–Trait Anxiety Inventory, CSAI-2 = Competitive State Anxiety Inventory, BAS = Body Awareness Scale.

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was higher than that of younger athletes ($\bar{r}_w = +0.64$, $k = 17$, $n = 205$); again this difference was not significant ($z = 0.64$, $P > 0.05$). This tendency was also noted when examining the accuracy of recall measures. It is noteworthy that the number of studies needed to reduce the obtained effect sizes to a critical value of 0.10 (fail-safe sample size) was quite high in all cases. At the same time, confidence intervals did not include 0 in any of the effect sizes.

Discussion

The aims of the present study were to use meta-analysis to integrate quantitatively and to evaluate available empirical studies that have tested the validity and practical utility of the individual zones of optimal functioning model. Specifically, we examined if athletes who were within their individually optimal anxiety zones performed better than athletes who were out of their optimal zones. Additionally, the accuracy of athletes' recall and anticipatory ratings of pre-competition anxiety was estimated.

In general, the model discriminates quite well between successful and less successful athletes and the predictive power of the in–out of the zone concept is close to 'moderate' (Cohen, 1988) even at the group level (effect size $d = +0.44$). The results provide support for the validity of the basic assumptions of the IZOF model as applied to anxiety–performance relationships in competitive (non-elite) athletes. Previous meta-analyses based on combined state and trait anxiety data revealed that all population effect sizes within the framework of traditional nomothetic orientations were either in a negative ($r = -0.19$) (Kleine, 1990) or in a small positive ($d = +0.15$, which corresponds to $r = +0.07$) range (Rowley *et al.*, 1995). The present study focused mainly on the state anxiety–performance research within the framework of the IZOF model and did not try to contrast the discriminative power of the idiographic approach model with nomothetic orientations. However, the total effect size in our study ($d = +0.44$ or $r = +0.21$) was positive and in the predicted direction. This appears to indicate that, in describing and explaining anxiety–performance relationships, the IZOF-based notion of 'specific optimal effect' zones (Hanin, 1995, 1997a) is preferable to the notion of individually unspecified intensity used by nomothetic models. In other words, the zone principle identifying specific optimal intensity for each athlete seems to be more appropriate for the prediction of individual performance.

Because of the importance of the assumption regarding large inter-individual variability of optimal anxiety

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Table 5. Studies of inter-individual variability of optimal anxiety

Reference	Sport	Participants	Anxiety measure	Anxiety: Mean ± *s*	Anxiety: Range
Hanin (1978)	Volleyball	82 M	STAI	39.91 ± 8.59	-
		123 F	STAI	40.62 ± 10.41	-
Hanin (1986)	Rowing	46 F	STAI	43.8 ± 12.23	26–67
	Rowing	14 M	STAI	38.6 ± 6.86	-
	Kayaking	11 M	STAI	36.8 ± 6.90	-
Hyvönen (1992)	Running, swimming, gymnastics	66 F/M	STAI	36.5 ± 9.0	20–75
Imlay *et al.* (1995)	Track and field	16 F/M	STAI	42.3 ± 17.6	-
	endurance		STAI	42.4 ± 13.5	-
	anaerobic		STAI	43.4 ± 17.3	-
	power		STAI	43.0 ± 11.3	-
Morgan *et al.* (1987)	Distance running	15 F	BAS	33.7 ± 6.8	-
Morgan *et al.* (1988)	Distance running	14 M	BAS	33.8 ± 6.0	-
Raglin *et al.* (1990a)	Swimming	15 F	BAS	33.7 ± 6.8	-
Raglin and Morris (1994)	Volleyball	9 F	STAI	41.4 ± 10.8	-
Raglin and Turner (1993)	Track and field	29 F	STAI	41.6 ± 5.7	-
		39 M	STAI	39.1 ± 5.2	-
Raglin *et al.* (1990b)	Swimming	17 F	STAIC	31.9 ± 6.6	-
Gould *et al.* (1993)	Middle-distance running	11 F/M	CSAI-2-cog	20.1 ± 6.30	12–32
			CSAI-2-som	18.6 ± 4.30	12–27
Randle and Weinberg (1997)	Softball	11 F	CSAI-2-cog	12.00 ± 3.52	9–21
			CSAI-2-som	13.73 ± 3.26	9–23
Scallen (1992)	Swimming	35 F/M	CSAI-2-cog (M)	22.38 ± 6.19	-
			CSAI-2-cog (F)	17.79 ± 4.52	-
			CSAI-2-som	20.57 ± 5.92	-
			CSAI-2-scon	25.63 ± 5.19	-
			STAI	43.68 ± 9.81	-
Turner and Raglin (1996)	Track and field	67 F/M	STAI	42.2 ± 12.6	22–67

Note: STAI = State–Trait Anxiety Inventory; BAS = Body Awareness Scale; STAIC = State–Trait Anxiety Inventory for Children; CSAI-2-cog, CSAI-2-son and CSAI-2-scon = cognitive, somatic and self-confidence subscales of the Competitive State Anxiety Inventory-2 respectively.

in competitive athletes of varying ability, which is often underestimated in research, it is imperative that we examine the empirical evidence with respect to this question, even though meta-analytical procedures cannot be applied here. In Table 5, several studies are represented, showing means, standard deviations and range of optimal intensity measured by the State–Trait Anxiety Inventory (STAI), the Competitive State Anxiety Inventory-2 (CSAI-2) and the Body Awareness Scale (BAS) using different samples of athletes. It is important to note that, in all cases, large inter-individual variability of optimal anxiety scores is indicated by a high coefficient of variation (standard deviation/mean) for all anxiety scales: STAI = 24.9% (17.8–29.9), CSAI-2 = 27.3% (25.4–31.3) and BAS = 20.6% (17.8–23.9).

Additionally, several other studies reported the percentage of athletes performing best when their anxiety was high, moderate or low. The distribution of athletes in these categories was surprisingly well balanced across different studies: 26, 33 and 41% (Hyvönen, 1992); 33, 44 and 42% (Imlay *et al.*, 1995); 30, 22 and 48% (Morgan *et al.*, 1987); 32, 43 and 25% (Raglin and Turner, 1992); 50, 31 and 19% (Raglin and Turner, 1993). It is remarkable that we were unable to identify a single study that demonstrated that different athletes had the same (or similar) optimal anxiety.

Furthermore, we demonstrated that, for athletes with anxiety scores out of the zone, performance appeared to deteriorate more in the 'above the zone' condition than in the 'below the zone' condition. However, this difference was not significant because of a large overlap in confidence intervals ($z = 0.85$, $P > 0.05$). This is important, as it suggests an almost equal probability of non-monotonic (or even drastic) declines in performance when an athlete is either above or below his or her optimal anxiety. The latter is usually underestimated, although low alertness and insufficient focus because of complacency are more likely to impair performance than excessive motivational worry (Hanin, 1997a).

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These results are in line with those of recent studies exploring what is beyond the individual zones of optimal functioning. Specifically, the contingencies of impact of positive and negative emotions upon individual performance in 12 elite Finnish cross-country skiers have been established within working intensity ranges (Hanin, 1997b, 1999; Hanin and Syrjä, 1997). The results suggest that future research should focus more on a detailed description of discontinuity patterns in anxiety–performance relationships (Hardy, 1996; Woodman *et al.*, 1997) rather than on cross-sectional investigation of the 'universal' group-oriented effects of only two components of pre-competition anxiety. It is also important to realize that, 'in its current form, the cusp catastrophe model is not a theory and does not explain exactly how it is that cognitive anxiety and physiological arousal do interact' (Hardy, 1996, p. 152). However, it is our contention that a qualitative analysis of situational discontinuities in individual performance (unexpected uplifts, slumps and catastrophes) holds some promise in providing an empirical basis for a better understanding of anxiety–performance dynamics.

The effect size for the in–out of the zone notion was in the predicted direction irrespective of the scales used. One implication for research and practice in sport psychology is that the zone notion applies not only for one specific modality or content (i.e. as measured by the State–Trait Anxiety Inventory or Competitive State Anxiety Inventory-2), but apparently also to other modalities of subjective emotional experiences. This assumption is in line with the recent developments in the IZOF model extended to positive and negative emotions (Hanin and Syrjä, 1995a,b; Hanin, 1997a,b). Specifically, the content of items generated by athletes in individualized emotion scales was in 85% of cases different from the content of researcher-generated items in several psychometric scales (Syrjä and Hanin, 1997a,b; Hanin *et al.*, 1998). We argue, therefore, that the zone-based predictions might be even more effective if both individually optimal intensity and individually relevant content of emotions are first identified.

Quantification of performance also needs to be researched. Specifically, the 'percent best' measure (effect size $d = +0.45$) was better than the 'percent average' measure (effect size $d = -0.27$) ($z = 4.41$, $P < 0.01$). This calls into question the recommendation to use customary (Klavora, 1979) or median (Sonstroem and Bernardo, 1982) intra-individual performance measures as the criteria for individually optimal (best) performance (Raglin, 1992). These results also support the notion (Hanin, 1995, 1997a; Hanin and Syrjä, 1996) that the current practice of using repeated assessments to identify the zones of optimal functioning is less than effective, as it deals mainly with average performances. An apparent limitation of the earlier IZOF anxiety model was an over-emphasis on identifying only individually optimal levels of anxiety associated with 'best ever' performance, but not performance measures as additional and valid criteria to evaluate real-life performances (both present and future). Therefore, future research should focus on establishing both optimal anxiety (level and zones) and corresponding individual performance ranges.

The accuracy of recall and anticipatory measures exceeded the large effect suggested for correlations (Cohen, 1988) in the sex, age, scale and measurement time subsamples. It should be noted, however, that most of the original samples included in the meta-analysis reported only group-referenced correlations that did not tap individual accuracy. It is important to realize that the test–retest coefficient taps only one aspect of accuracy; it measures whether the rank order within a group remains the same. This is a necessary, but not sufficient, prerequisite of accuracy. What is not contained in correlations is variability and average information. This was addressed in the extended IZOF emotion model by comparing, intra-individually, a set of repeatedly measured individual scores for all scale items to derive an individual index of accuracy for each athlete (Hanin and Syrjä, 1996).

We also showed that the State–Trait Anxiety Inventory was better than the Competitive State Anxiety Inventory-2 for recall (effect size $r = +0.79$ and $+0.62$ respectively) but not for prediction (both effect size $r = +0.69$) (see Tables 3 and 4). This finding, however, should be viewed with caution, owing to a small number of effect sizes derived from the Competitive State Anxiety Inventory-2 studies and a large overlap in confidence intervals. It could be argued that, in the assessment of an emotional response, the content of the State–Trait Anxiety Inventory is more relevant, since it contains a larger and more balanced number of negative affect (emotionality and worry) and positive affect (anxiety-absent, complacency) items. This hypothesis is partly supported by the finding (Table 2) that the somatic subscale of the Competitive State Anxiety Inventory-2 (CSAI-2-som) (effect size $d = +0.64$, which corresponds to $r = +0.31$) was better able to discriminate between successful and less successful athletes than its cognitive subscale (CSAI-2-cog) (effect size $d = +0.37$, or $r = +0.17$). However, the difference between the effect sizes was not significant ($z = 1.22$, $P > 0.05$).

In a previous meta-analysis (Kleine, 1990), no significant differences emerged to favour the State–Trait Anxiety Inventory-state (effect size $r = -0.23$, $k = 37$, $n = 1574$) over the Competitive State Anxiety Inventory-1 (effect size $r = -0.12$, $k = 4$, $n = 272$), CSAI-2-cog (effect size $r = -0.30$, $k = 5$, $n = 161$) or CSAI-2-som (effect size $r = -0.16$, $k = 5$, $n = 161$).

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These results clearly indicate that more research is warranted into the relevance of the content and context of general and sports-specific scales (both standardized and individualized) (Syrjä and Hanin, 1997a,b). Additionally, the findings are consistent with those of other reviews (Morgan and Ellickson, 1989; Weinberg, 1990; Raglin, 1992) and call into question overstated claims regarding the inaccuracy of self-reports in the analysis of subjective emotional experiences of skilled athletes. However, more research into athletes' awareness of subjective emotional experiences related to individual performances is clearly indicated, if this self-knowledge – critical for the learning of self-regulation skills – is to be explained and enhanced. For instance, future research might assess intra-individual accuracy of recall by repeated assessment of the same past successful and unsuccessful experiences.

Further analyses revealed that athletes' self-ratings were a better predictor of performance than their coaches' ratings ($z = 2.15$, $P < 0.05$). However, how far this conclusion can be generalized is limited because of the relatively small number of effect sizes. Surprisingly, the effect size for subjective ratings of performance was lower than that for either self-referenced or criterion-referenced ratings. This is at odds with the suggestion of Hanin (1986) and Raglin and Morgan (1988) to use subjective rather than objective performance measures. Additional criteria to identify individual successful and less successful performances might be possible, for instance, by developing an 'individual performance range' based on an athlete's past performance history (Hanin, 1995).

Finally, the in–out of the zone notion reflects a specific form of emotion–performance relationships – that is, being in the zone indicates a high probability only of performing well (Hanin, 1995, 1997a). This assumption is consistent with recent empirical findings. For instance, several investigators have noted that, although some athletes were inside their optimal zones, they did not always perform successfully, and that athletes who were outside their optimal zones did not always perform poorly (Jones, 1995; Gould and Tuffey, 1996; Barkoukis *et al.*, 1997). Therefore, the binomial effect size display (Rosenthal, 1984) was used in the interpretation of the overall effect size for the in–out of the zone notion. Specifically, the binomial effect size display aims to identify the success rate of athletes who are within their individually optimal anxiety zones versus athletes who are outside their zones. For instance, the success rate for an effect size of $d = +0.44$ means that, if 61 of 100 within-the-zone athletes perform successfully, then only 39 of 100 'out of the zone' athletes will perform successfully.

Although the present findings and their interpretation should be treated with caution, because of the relatively small number of effect sizes in the subsets, they are relevant in several respects. First, the in–out of the zone notion applied only to anxiety (an important stress-related emotion) is a good predictor of individual performance even at the group level. Secondly, anxiety alone cannot explain all variance in performance and, therefore, other positive and negative emotions experienced by athletes should be considered to enhance predictions of emotion–performance relationships (see Hanin and Syrjä, 1995a,b, 1996; Syrjä *et al.*, 1995a,b; Hanin, 1997a). Thirdly, in future, the in–out of the zone data, both at the level of the individual and of the group, should be analysed using an odds ratio (Hanin, 1997a) defined in logistic regression analysis as the probability of occurrence over the probability of non-occurrence (Munro and Batten, 1997). We also believe that optimal intensity zones can predict not just one specific level of performance, but a range of optimal (close to the best) performances.

Some limitations and methodological concerns with the original studies included in the meta-analysis should be mentioned. The main concern is the inadequacy of performance measures, especially in team sports. Moreover, successful performance is sometimes identified by contrasting an actual performance with an athlete's own average performance (Randle and Weinberg, 1997; Thelwell and Maynard, 1998), which is clearly a violation of the original IZOF (Hanin, 1989, 1995).

In conclusion, the present meta-analysis has resolved several issues in individual zones of optimal functioning anxiety research. These include a large inter-individual variability of optimal anxiety irrespective of the anxiety scale used (see, for instance, Raglin, 1992; Hanin, 1997a). In other words, whatever the modality or component of anxiety (emotion), optimal intensity is individual in all cases and can be high, moderate or low. Empirical support was provided for the validity of the in–out of the zone notion in the prediction of individual athletic performance. Finally, the ability of skilled athletes to accurately recall and predict their pre-competition anxiety was demonstrated. The present findings, which support the validity of the IZOF-based assumptions of skilled athletes' awareness and ability to accurately report their subjective experiences, might have important implications for future research and practice in sport psychology. Specifically, the intra-individual accuracy of repeated recall can be used as a measure of an athlete's current awareness about his or her subjective emotional experiences enhancing and impairing performance. Recall can also be used to examine individual temporal patterns of anxiety before, during and after performance, especially in events of long duration. Self-ratings and the monitoring of anxiety before and during performance might be used

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as an indirect means of self-programming optimal performance states.

Other issues warrant additional research. First, there is a need to develop more precise assessments of individual zones of optimal and dysfunctional anxiety. When skilled performers are involved, a preference should be given to recall measures that can later be validated and refined in subsequent assessments. Instability of self-ratings on several occasions might indicate an athlete's low awareness of helpful and harmful effects of different emotional states. The potential role of these repeated assessments to enhance an athlete's awareness should be investigated more systematically. It is also important to explore the impact of anxiety upon performance over the working range of intensity, including minimum, maximum, typical or customary, optimal and dysfunctional intensities (Hanin, 1997b, 1999). It is also critical to contrast patterns of optimal and dysfunctional anxiety (emotions) in practice and competition. Another important issue related to the dynamics of athletic performance is to describe and explain the patterns of anxiety (or other emotions) during and after the execution of a task. The predominant focus of existing research in sport psychology on pre-competition anxiety implies the static nature of the emotional response before, during and after performance and does not reflect the realities of sporting activity. In other words, future research should focus on the differences in anxiety patterns across all three stages of sporting activity: preparation, execution and evaluation. Finally, we need to determine the effect of applying the IZOF model to team sports (Hanin, 1989, 1992, 1997a). For example, it is important to explain how environmental factors influence lower pre-game anxiety in team players compared with athletes competing in individual sports. The roles of interpersonal and intra-group anxiety and the impact of coaches' and key players' state upon other team members' emotional states (Hanin, 1978, 1989, 1992) are clearly important areas of future research.

The present findings also indicate that there should be a better focus on the development of individualized performance measures and on the assessment of accuracy of recall and anticipatory measures intra-individually (Hanin and Syrjä, 1996). Additionally, combined and interactive effects (Woodman *et al.*, 1997) of a wider range of positive and negative emotions might be a better predictor of emotion–performance relationships (Hanin, 1997a,b). Finally, the validity of the extended IZOF model might be examined in other stress-related emotions, such as anger (Spielberger *et al.*, 1988; Hanin and Syrjä, 1995a), or in a situational analysis of motivation (Vallerand, 1997) as a component of performance-related psycho-biosocial states (Hanin, 1997a).

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(*Note*: Studies included in the meta-analysis are indicated by an asterisk.)

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