EUJAPA

Article

The use of psychological skills in Deaflympic sport

Alon Markov-Glazer [1,2]*, Anne-Marie Elbe [1] and Rainer Schliermann [2]

Received: 8th May 2024; Accepted: 25th October 2024; Published: 30th May 2025

Abstract: This study explores the use of psychological skills among Deaflympic athletes and aims to provide initial insights into sport psychology practices in this overlooked population. To this end, the frequency of psychological skills' usage, usage patterns, and differences between subgroups were examined within this population. The Test of Performance Strategies (TOPS) was administered to 84 German Deaflympic athletes (mean age = 28y; 27% female) along with biographical questions (e.g., hearing status). The findings indicate that Deaflympic athletes regularly utilize psychological skills in training and competition, displaying similar usage to that of Olympic athletes. However, only a minority of Deaflympic athletes train their skills with professional consultants. Additionally, relaxation techniques were employed rarely in comparison to the other investigated skills. This study's findings contribute to the foundation of sport psychology research with Deaflympic athletes and underscore the need for a differentiated approach in tailoring interventions for this population.

Keywords: psychological skills training; Deaf culture; TOPS; Deaflympian

Introduction

In the last few decades, significant advances have yielded valuable insights into the use of applied sport psychology with athletes with physical disabilities (Hanrahan, 2015; Martin, 2015). Athletes with hearing impairments, however, have been largely overlooked in this context. In fact, Clark and Sachs (1991) highlighted this issue over 30 years ago, stating that sport psychology literature serving this particular group of athletes was virtually non-existent. Emphasizing the unique characteristics of elite athletes with hearing impairments in comparison to hearing athletes and athletes with physical disabilities, these researchers called for the involvement of sport psychologists in both research and practice to address this gap. Yet, despite Clark and Sachs' findings, little to no progress has been made in this field. Limited media publicity, low public exposure and poor funding still hinder the development of research opportunities in Deaf sport (Clark & Mesch, 2018; Markov-Glazer et al., 2023; Schliermann, 2015). Consequently, our understanding of the use of sport psychological skills by athletes with hearing impairments and the training of these skills is very limited.

Psychological skills training (PST) refers to the structured training of psychological skills and techniques to enhance performance, increase self-satisfaction, and to achieve healthy well-being (Weinberg & Gould, 2023). Psychological techniques include specified practical methods such as self-talk and imagery. The objective of these techniques is to enable athletes to systematically develop the skills necessary to reach the aforementioned goals (Vealey, 2007). Literature supports PST's effectiveness in improving performance (Beckmann & Elbe, 2015; Brown & Fletcher, 2017; Weinberg & Gould, 2023). For example,

multiple studies have documented the effectiveness of the techniques self-talk and imagery on various parameters such as motivational outcomes, motor skills development and athletic performance (Hatzigeorgiadis et al., 2011; Lange-Smith et al., 2023; Park & Jeon, 2023; Simonsmeier et al., 2021). Further, it was found that athletes participating in elevated levels of competition or achieving Olympic medals exhibit a greater propensity to employ psychological skills, in contrast to their peers in lower classifications or those who have not been awarded medals (Eberspächer et al., 2005; Frey et al., 2003; Gould et al., 2002; Taylor et al., 2008). Accordingly, PST has been widely in use in Olympic as well as increasingly in Paralympic sports (Hanrahan, 2015). However, the application and research of psychological skills and their training among athletes with hearing impairments remains poorly developed.

Athletes with hearing impairments compete in an independent sports movement known as Deaflympic Sport. The Deaflympics, sanctioned by the International Olympic Committee (IOC), are held every four years, independent of the Olympic and Paralympic Games (Harrison, 2014). Deaflympic athletes form a diverse collective. For example, they differ in the way they perceive their hearing condition. Deaf individuals (referred to with a capital D) do not perceive deafness as a disability but rather consider themselves members of a distinct Deaf culture that is separate from the dominant hearing culture. This group of athletes tends to utilize sign language as its primary mode of communication. In contrast, deaf individuals (referred with lowercase 'd') generally consider their hearing impairment as a disability and tend to utilize spoken language whenever feasible (Holcomb, 2012; Kurková et al., 2011; Leigh & Andrews, 2016; Stewart et al., 1991). In addition, some Deaflympic athletes are able to process auditory information. A minimum 55 dB hearing threshold in the better ear determines eligibility to participate in Deaflympic sports. This means that hard-of-hearing (HH) athletes with some level of auditory perception also compete alongside D/deaf athletes. These factors, combined with other socio-biographical determinants, can influence the array of employed communication modalities, socialization tendencies and personal identification of Deaflympic athletes (Mesch & Clark, 2023; Padden & Humphries, 1988; Stewart, 1991).

Despite the heterogeneity among Deaflympic athletes and differences to Paralympic and Olympic sports, limited research has explored the use of psychological skills in this population (Clark & Sachs, 1991; Markov-Glazer et al., 2023). This gap is significant because many Deaflympic athletes use unique communication and cultural codes, which may affect the use and training of psychological skills (Schinke & Hanrahan, 2009). Notably, it is unclear how much D/deaf athletes rely on techniques that require music or spoken instructions like relaxation and imagery. Also, differences in the use of psychological skills between D/deaf and HH athletes remain unexplored. Consequently, fundamental research of PST practices tailored to this diverse population is lacking. Therefore, our study first aimed to explore how widely psychological skills are used in Deaflympic sports, in both training and in competition. Subsequently, we analysed the relationship between frequencies of psychological skills use in training and competition, with the aim of identifying patterns or tendencies. Lastly, the study delved into the potential variances in skills usage among subgroups within the Deaflympic athlete community. In particular, we tested whether D/deaf athletes use psychological skills at a different rate than HH athletes. Drawing on the existing literature on Olympic athlete populations, we additionally examined whether rates of use of psychological skills differ between athletes competing at international levels and their counterparts in lower classifications.

Materials and Methods

Sample

Active German Deaflympic athletes who met the criteria for participation in the Deaflympics were eligible to take part in the study. Their active membership and eligibility were confirmed by the German Deaf Sport Association (DGSV). The DGSV oversees 16 elite sport departments, which include approximately 160 Deaflympic athletes. A total of eight departments, including athletics, beach volleyball, bowling, golf, handball, shooting, soccer, and table tennis, were selected for this study. All athletes within these departments were invited to participate and took part in the study. The final analysis excluded a single athlete due to insufficient proficiency in German.

Measures

The validated German version of the Test of Performance Strategies (TOPS-D1; Schmid, et al., 2010; Thomas et al., 1999) was implemented in order to explore athletes' use of psychological skills and techniques during training and competition. It should be noted that this version was validated exclusively on hearing athletes. TOPS-D1 is a self-report instrument aimed at assessing athletes frequency of use of established skills and techniques in a variety of sport situations. It contains 64 items, which are classified into 16 subscales, 8 for training and 8 for competition settings. The subscales contain four items each and represent the following psychological techniques and skills: activation, relaxation, imagery, goal setting, self-talk, automaticity, emotional control, negative thinking (only in the competition setting) and attentional control (only in the training setting). In all subscales (except for Negative Thinking), higher scores within the subscales signify a more pronounced use of a psychological skill or technique within the corresponding context. TOPS-D1 items demonstrate statements referring to the use of the mentioned skills and techniques. Participants are asked to rate the frequency of the interventions' application to each statement using a 5-point Likert scale ranging from 1 ("never") to 5 ("always"). For example, to assess the technique relaxation: "I am able to relax if I get too nervous at competition".

In addition to TOPS-D1, a self-constructed questionnaire was administered (available in German at: https://osf.io/7r5bz). Survey construction followed recognized guidelines for the development of scientific surveys (Cohen et al., 2017). The questionnaire contained two sections with questions regarding sociodemographic and sport-related information. In the first section, respondents were asked to provide biographical information (e.g., age, sex, highest educational attainment) as well as information regarding their hearing impairment (e.g., onset, severity). In the second part, respondents' training habits (e.g., How many hours do you train per week?), sport achievements (e.g., Have you ever won medals in the Deaflympics?) and prior experience with applied sport psychology (e.g., Have you ever worked with a sport psychology consultant?) were addressed. In addition, participants were asked about how they communicate during training (e.g., Do you use hearing aid appliances during training?, how do you communicate with your coach?). Both TOPS-D1 and the self-constructed questionnaire were pretested, assisted by a sign language interpreter, with five active athletes in the DGSV, who exhibited varying severities of hearing loss. Among the participants, two were native sign language users and three were native spoken language users. The athletes identified several items that might pose comprehension challenges for native signers. These items were subsequently highlighted to ensure careful consideration during the preparation and data collection phases. Beyond these adjustments, no substantial changes were made to the questionnaire after the pre-test phase.

Procedure

We adhered to APA ethical guidelines during our study (American Psychological Association, 2017). Recruitment was carried out in cooperation with the DGSV. In the first step, eight of the association's sports divisions were selected for data collection, including athletics, beach volleyball, bowling, golf, handball, shooting, soccer, and table tennis. The divisions' selection process in individual and team sports aimed for relatively equal representation of participants from both types of sport, mirroring the athlete distribution in the DGSV. Data collection was conducted during divisional training camps in 2019, and followed a standardized procedure. The study's first author conducted all data collection sessions accompanied by a sign-language interpreter, as proposed by Clark and Sachs (1991). Certified sign language interpreters with expertise in sports and experience working with the DGSV were selected to guarantee familiarity with the population of D/deaf athletes and sport-specific terminology. The interpreters received comprehensive explanations about the TOPS-D1 and study procedures to ensure they were optimally prepared.

In each training camp (n = 8), the national coach or division manager allocated a quiet location and a training-free time slot. The study's first author informed participants about the study objectives and data collection procedures in spoken language with simultaneous translation into sign language. Anonymous and voluntary participation in the study were explicitly assured in communications to all participants. Participants had the opportunity to ask questions about the study and provide their consent to participate in the study in their preferred language. After obtaining informed consent, the questionnaires were administered. Prior to participants beginning the completion of the questionnaires, the study's first author provided thorough explanations regarding the content of the items identified as challenging during the pre-test phase as well as explanations of sport psychology terms appearing in the questionnaire. Throughout the completion of the questionnaires, participants could ask for clarifications in either spoken or sign language. Additionally, the study's first author, accompanied by an interpreter, actively assisted participants and addressed their questions during the entire session. Participants were allowed as much time as they needed to complete the questionnaire. The mean time for completing the questionnaire was approximately 35 minutes.

Data Analysis

Descriptive statistics were computed to explore the participants' sport-biographical background. Prior to engaging in subsequent inferential statistical analyses, preliminary examination of the dataset was performed for outliers through Boxplots and descriptive analyses. During this process, five outliers were identified and subsequently excluded from the dataset. Then, Cronbach's alpha reliabilities were computed on the refined dataset (N = 79) to assess internal consistency for the TOPS-D1. In accordance with Loewenthal and Lewis's (2001) suggestion regarding subscales containing four items, TOPS-D1 subscales with alpha coefficients <.6 were excluded in further analyses. In total, 7 of 16 subscales were excluded. The TOPS-subscales Relaxation, Self-Talk and Goal setting (training context) as well as Activation, Automatization, Relaxation, Self-Talk, Goal setting and Negative Cognition (competition context) were included in further analyses.

First, participants' TOPS-D1 profile was descriptively assessed to determine the frequency of psychological skills use by Deaflympic athletes during training and competition. Then, Pearson coefficients were utilized to examine the associations between participants' use of psychological skills in competition and practice contexts. These analyses were conducted exclusively using subscales that met the Cronbach's alpha threshold described above. Thereafter, one-way multivariate analyses of variance (MANOVAs) were

conducted in each context separately to assess group differences. Group differences were tested between D/deaf athletes (with severe hearing loss ≥ 90 dB) versus HH athletes (with more moderate hearing loss < 90 dB) and between athletes competing at national versus international levels. Prior to the analyses, Box's M and Levene's tests were used to test the assumptions of homogeneity in the variance–covariance matrices in the dependent variables and the equality of variances, respectively. The tests' outcomes demonstrated non-significance, thereby affirming the acceptance of these assumptions. Pillai's Trace statistic was calculated due to its robustness against violations of assumptions (Tabachnick & Fidell, 2013). A significant alpha was set at 0.05. Finally, follow-up univariate analyses (ANOVAs) were performed to further explore significant multivariate effects. A Bonferroni-adjusted alpha level (0.017 for training and 0.008 for competition context) was applied in follow-up univariate tests to minimize Type 1 errors. Effect sizes were calculated by a partial eta-squared and evaluated as small ($\eta 2$ = 0.01–0.058), medium ($\eta 2$ = 0.059–0.137) or large ($\eta 2$ ≥ 0.138; Cohen, 1988).

Results

Participants included 84 (27.4% female) active elite D/deaf and HH athletes in the DGSV (Table 1). A majority of the participants exhibited a profound hearing loss of at least 90 dB (72.3%). Congenital hearing loss was predominant in the sample, and the remaining participants had acquired a hearing loss during the course of their lives. Half of the sample competed in individual sports (e.g., athletics, tennis), and the other half in team sports (e.g., soccer, handball). Nearly all participants train and compete in hearing sports in addition to their participation in competitive Deaf sports. Most participants had experience competing on an international stage and the majority had been awarded international medals in Deaf sports (e.g., Deaf European and World Championships, Deaflympics).

Table 1. Sociodemographic characteristics of participants

Sample Characteristic	*n*	*%*	*M*	*SD*
Age (y)			28.43	9.4
Gender				
Female	23	27.4		
Male	61	72.6		
Hearing loss severity [a]				
Moderate (55-65 dB)	7	8.4		
Severe (70-85 dB)	16	19.3		
Profound (≥ 90 dB)	60	72.3		
Hearing loss onset				
Congenital	50	71.4		
Postnatal	20	28.6		
Years as Squad Member in the DGSV			6.7	6.4
Training also in hearing sports				
Yes	72	85.7		
No	12	14.3)		
Participation in hearing sports competitions				
Yes	78	92.9		
No	6	7.1%		
Competing at international levels				
Yes	69	82.1		
No	15	17.9		
Achieving Olympic medals at international levels				
Yes	52	61.9		
No	32	38.1		

[a] In the better ear

The Use of Psychological Skills and Techniques in Training and Competition

Only a few participants (9.5%; n = 8) had received sport psychology consultation in the past. Table 2 shows the means and standard deviations regarding the sample's use of psychological techniques and skills during training and competition. Focusing solely on the subscales relevant for inference statistics, the sample showed the highest scores in the training setting on goal setting (M = 3.66, SD = .67), signifying that athletes generally employ this skill with a frequency that can be categorized as between "somewhat" (3 on the TOPS' 5-point scale) and "often" (4 on the scale). The participants showed the lowest scores on relaxation (M = 2.58, SD = .81), suggesting use that leans towards "somewhat" on the frequency scale. Likewise, in the competition setting the sample exhibited the highest scores in goal setting (M = 4.06, SD = .54). Negative thinking showed the lowest ranking in this context (M = 2.17, SD = .61), followed by relaxation (M = 3.17, SD = .66). These outcomes indicate Deaflympic athletes engage in the application of psychological skills with a frequency that oscillates between "somewhat" and "often" during training and competition. Additionally, negative thinking during competitions was reported as "rare" (2 on the scale).

Table 2. TOPS-D1 subscales: Means, standard deviations, and Cronbach's alpha coefficients

Intervention	Training			Competition		
	M	SD	α	M	SD	α
Activation	3.17	.56	.30	3.76	.60	.63
Attentional control [a]	3.51	.50	.45	-	-	-
Automaticity	3.37	.56	.43	3.35	.72	.68
Emotional control	3.04	.62	.45	3.04	.46	.58
Goal setting	3.66	.67	.66	4.06	.54	.61
Imagery	3.08	.72	.57	3.48	.64	.53
Negative thinking [a]	-	-	-	2.17	.61	.65
Relaxation	2.58	.79	.77	3.17	.66	.71
Self-talk	3.30	.67	.64	3.42	.72	.69

Note. N = 79. [a] = TOPS-D1 subscale in one setting.

Table 3 presents a comprehensive overview of the correlations between the competition and practice subscales. Within the practice subscales, associations emerged between two of the three examined subscales, specifically between goal setting and relaxation, and between goal setting and self-talk. In this context, no significant association was found between relaxation and self-talk. However, within the competition subscales, an association emerged between relaxation and self-talk, as well as within other competition subscales as well, such as relaxation and activation. Negative correlations within this context were observed between negative thinking and two other subscales: relaxation and automaticity, indicating that higher levels of negative thinking are associated with lower use of relaxation and automaticity. Furthermore, the results revealed an overlap in the use of psychological skills across the competition and practice domains in two of the three examined subscales. Specifically, the use of self-talk in practice exhibited a positive alignment with the same skill in competition. Similar findings were observed for the skill of relaxation, meaning that if athletes use relaxation or self-talk during training, they are also likely to use these skills during competition.

Table 3. Correlations Between Psychological Skills Subscales in Training and Competition

		1	3	5	7	8	9
1.	Activation	-	-	-	-	-	-
3.	Automaticity	.29**	-	-	-	-	-
5.	Goal setting	.21	.23	.05	-	.24*	.26*
7.	Negative thinking	−.20	−.26*	.15	-	-	-
8.	Relaxation	.36**	.18	.14	−.32**	.26*	.18
9.	Self-talk	.38**	−.03	.19	−.02	-	.48**

Note. * = $p < .05$ (two-tailed). ** = $p < .01$ (two-tailed). Correlations within the practice subscales are positioned along the upper right diagonal. Correlations within the competition subscales are positioned along the lower left diagonal. Corresponding subscales are indicated by underlined values. Only subscales with sufficient Cronbach's alpha (≥ .60) were included in the correlation analysis.

Differences among Deaflympic Subgroups

The MANOVA assessing variations in the use of psychological skills between D/deaf athletes (with severe hearing loss ≥ 90 dB) and HH athletes (with more moderate hearing loss < 90 dB) yielded a statistically significant result in the training setting (Pillai's Trace = .15, $F(3, 68) = 4.14$, $p = .009$, $\eta^2 = .15$). Subsequent univariate analyses indicated a statistically significant outcome in the relaxation subscale, with D/deaf athletes utilized relaxation more often than HH athletes (Table 4). Conversely, in the competition setting, no statistically significant results were observed (Pillai's Trace = .09, $F(6, 58) = .95$, $p = .469$, $\eta^2 = .09$).

Table 4. Follow-up One-Way ANOVAs for MANOVA Assessing Differences Between D/deaf (n=51) and Hard of Hearing (n=21) Athletes

Subscale	D/deaf		Hard of hearing		$F(1, 70)$	p	$\eta 2$
	M	*SD*	*M*	*SD*			
Goal setting	3.74	.60	3.45	.82	2.83	.097	.039
Relaxation	2.73	.75	2.12	.64	10.72	.002	.330
Self-talk	3.30	.67	3.31	.57	.001	.973	.000

Note. T = in training context.

The MANOVAs comparing athletes with international experience to their inexperienced counterparts yielded statistically significant results in both the training (Pillai's Trace = .17, $F(3, 68) = 4.8$, $p = .004$, $\eta^2 = .17$) and in the competition contexts (Pillai's Trace = .21, $F(6,58) = 2.51$, $p = .031$, $\eta^2 = .21$). In both cases, athletes with international competition experience were found to utilize psychological skills more frequently than their peers. Within the training context, follow-up univariate tests revealed one significant result in relaxation use, with internationally experienced athletes more frequently utilized than their inexperienced peers (Table 5). Follow-up univariate tests revealed one statistically significant result in competition context as well, namely in the subscale negative thinking, whereby internationally experienced reported higher values in negative thinking than national competitors. However, overall values in both groups ranging from 1.68 to 2.28 can be characterized as low.

Table 5. Follow-up one-way ANOVAs for MANOVAs assessing differences between athletes with (n=60) and without (n=12) international experience

Subscale	With		Without		df_1	df_2	F	p	$\eta 2$
	M	*SD*	*M*	*SD*					
Goal setting (T)	3.72	.65	3.33	.77	1	70	3.43	.068	.047
Relaxation (T)	2.69	.75	1.89	.48	1	70	12.10	.001	.147
Self-Talk (T)	3.30	.65	3.31	.60	1	70	.002	.968	.000
Activation (C)	3.71	.57	3.86	.64	1	63	.605	.440	.010
Automaticity (C)	3.34	.69	3.34	.98	1	63	.000	.995	.000
Goal setting (C)	4.09	.53	3.81	.50	1	63	2.47	.121	.038
Negative-th. (C)	2.28	.61	1.68	.56	1	63	9.93	.002	.136
Relaxation (C)	3.17	.65	3.14	.79	1	63	.031	.860	.000
Self-Talk (C)	4.09	.53	3.82	.50	1	63	.203	.654	.003

Note. (T) = in training context. (C) = in competition context. Th. = thinking.

Discussion

Examining the use of psychological skills among Deaflympic athletes, it becomes evident that these are actively incorporated into their training and competitive endeavours. A review of TOPS subscales' means within Paralympic and Olympic athlete populations in existing literature suggests that Deaflympic athletes employ psychological skills at a frequency and in patterns comparable to their Olympic and Paralympic counterparts. For instance, in the present study, the mean frequency of using self-talk during training and competition was 3.23 and 3.45, respectively. This aligns closely with reported frequencies of 3.57 and 3.62 among Olympic athletes (Taylor, 2008) and 3.44 and 3.37 among competitive athletes with physical disabilities (Bastos et al., 2012). In addition, findings indicating a heightened application of psychological skills during competition as opposed to training are aligned with previous studies (Frey et al., 2003; Thomas et al., 1999). Furthermore, associations between the use of psychological skills in training and competition were identified, underscoring patterns observed in studies involving Olympic athletes (Gould, 2008; Hardy et al., 2010).

Notably, relaxation was the least utilized psychological skill in training and the second least utilized technique in the competition context. This finding implies a potential lack of awareness or application of relaxation techniques among Deaflympic athletes. Due to the potential absence of music and spoken language instructions in D/deaf athletes' routines, adapted relaxation techniques tailored to this population are indicated. Additionally, athletes might be unaware of relaxation techniques that do not require sound. Vose et al. (2010) advocate for the use of progressive muscle relaxation (PMR; Jacobson, 1938), citing its numerous advantages for Deaflympic athletes, particularly those who are D/deaf. Unlike imaginative relaxation techniques like autogenic training, PMR can be performed with open eyes, and instructors can use sign language for guidance. Furthermore, PMR facilitates effective communication and instructional support through tactile, vibration-based, or light-based stimuli (Hanrahan, 2015; Vose et al., 2010). Given the relatively low use of relaxation techniques in the sample, it is plausible that Deaflympic athletes may encounter challenges in discovering or adopting suitable relaxation methods, potentially hindering their ability to attain optimal arousal levels during both training and competition (Hanin, 2000).

Comparisons between D/deaf and HH athletes revealed a significant difference in training settings. Remarkably, relaxation emerges as a key factor contributing to observed variance, with D/deaf athletes demonstrating a higher frequency of use compared to their HH counterparts. This finding may seem counterintuitive, given the assumption that HH athletes, in contrast to D/deaf athletes, can potentially leverage music for relaxation to a certain extent. However, it is important to note that rapid advancements in hearing aid technologies over the last decades, such as cochlear implants (CI), enable deaf individuals to

perceive spoken speech and music to some extent (Leigh & Andrews, 2016; McDermott, 2004). An intriguing aspect, potentially related to this finding, is that Deaflympic athletes are permitted to train with hearing aids or external cochlear implant aids. Nevertheless, these technologies are prohibited during official Deaflympic competitions (ICSD, 2009). Consequently, Deaflympic athletes using hearing aid technologies may train and compete in different auditory environments. Given the scarcity of research in this area it is unclear how the use of psychological skills is affected during the transition from participating in sport with hearing aids during training to competition settings without these aids.

The MANOVA analyses investigating differences between Deaflympic athletes engaged in higher and lower competition levels yielded significant results. This outcome is aligned with previous studies that link the use of psychological skills and techniques to competitive success (e.g., Dohme et al., 2019; Taylor et al., 2008) and thus, may strengthen the assumption that Deaflympic athletes utilize psychological skills in a similar way to Olympic athletes. Yet, despite the aforementioned potential parallels between Deaflympic and Olympic athlete populations, this study underscores a possible gap in the systematic training of psychological skills through PST. While as early as 2008, approximately 50% of Paralympic elite athletes in Germany had engaged with sport psychologists (Schliermann & Danders, 2010), only 9.5% of currently active German Deaflympic athletes had ever received professional sport psychology consultation. Similar results (13%) were obtained in a survey with a sample of Deaflympic athletes in 2009 (Schliermann & Bourhim, 2010). Given that systematic and guided PST is pivotal for the development and proficient application of psychological skills and techniques (Brown & Fletcher, 2017; Weinberg & Gould, 2023), it prompts inquiry into both how Deaflympic athletes learn to apply psychological skills and into the effectiveness of these skills' implementation. Furthermore, these findings underscore the paucity and poor development of sport psychology services for Deaflympic athletes.

Limitations and Future Research Perspective

Several limitations of the study primarily stem from the observed low internal consistency values, which led to the exclusion of five TOPS-D1 subscales in the training context and two in the competition context. Given the omission of several subscales, our analyses may not fully capture the potential associations between the use of psychological skills, hearing impairments and performance level in Deaflympic athletes. Although relatively low internal consistencies were also found in some TOPS subscales in studies with elite athlete populations without hearing impairments (e.g., Hardy at al., 2010; Schmid, et al., 2010), it is clear that study participants might have faced challenges in comprehending some of the measure's items. This difficulty persisted despite the assistance of sign language interpreters during data collection. In our previous work (anonymized, 2020) we delved into this issue, outlining the complexities associated with administering standardized questionnaires such as TOPS-D1 with simultaneous sign language interpretation among D/deaf athletes. For example, variability in interpreters' skills may lead to differing interpretations of items during data collection und thus to misunderstandings. A second study limitation arises from the exclusive use of quantitative research methods, which limits a more comprehensive understanding of psychological skills use and PST in Deaflympic sports.

Future research could include a qualitative study design. Employing a complementary qualitative research approach would provide a richer and more nuanced perspective on PST in Deaflympic sports, contributing to a more holistic understanding of this issue. First, the fashion in which D/deaf athletes employ techniques like relaxation, visualization, and self-talk – without the use of music and spoken language – should be investigated. In addition,

further research should explore the effects of training with hearing aids and competing without them on the use of psychological skills. This information would contribute to the development of adapted psychological skills and techniques in Deaflympic sport, where necessary. Further, an inquiry of D/deaf athletes' experiences with sport psychology consultants could contribute to the understanding of a suitable and adapted framework of PST in Deaflympic sport. For example, addressing the issue of communication and rapport between hearing consultants and D/deaf athletes. In addition, low internal consistency values highlight the need for adapted diagnostic measures in Deaflympic sport in future research. We advocate the exploration of innovative adaptations, such as the digitalization of written measures with embedded sign language videos (Mueller et al., 2019), which should then undergo rigorous psychometric testing. This step could address the challenges observed in our study and enhance the accessibility and reliability of sport psychology measures for D/deaf athletes. Furthermore, integrating D/deaf scholars in future research steps is crucial to ensure the accurate and comprehensive understanding of D/deaf issues throughout the conception, implementation, and interpretation of studies about sport psychology in Deaflympic sport.

Conclusions

Our study focused on the use of psychological skills among Deaflympic athletes. Our aim was to explore current trends in the application of sport psychology practices within this unique population, taking into account its diversity and distinctiveness in the competitive sports landscape. Our findings indicate that the use of professional PST with trained sport psychology consultants in Deaflympic sport is limited. However, Deaflympic athletes appeared to employ various psychological skills regularly, potentially exhibiting similar patterns to their Olympic and Paralympic counterparts. Moreover, D/deaf athletes were found to use psychological skills more frequently than their HH counterparts in training, suggesting there may be different usage profiles between Deaflympic subgroups. Based on the study's findings, we believe further research is essential to determine the adaptation of PST procedures for this athlete group, with qualitative research methods providing a more comprehensive understanding of sport psychology practices among Deaflympic athletes. Despite these insights, empirical sport psychology research in elite Deaf sports is still lagging behind. Deaflympic sport risks being overlooked, classified neither as a mainstream nor as a disability sport (DePauw & Gavron, 2005). Consequently, the strength of collaborations should be exploited among Deaf sport stakeholders, advocates, and researchers to propel the development of sport psychology in both practice and research within the Deaflympic sports community.

Perspectives

This study makes a significant contribution in addressing the void in sport psychology research about Deaf sport. Historically, adapted physical activity scholars' engagement with Deaf athletes in the field of sport psychology has been minimal, leading to stagnation in this research area and hindering the implementation of evidence-based practices for this population. By illuminating the frequency with which Deaflympic athletes employ psychological skills—a domain virtually unexplored—this study serves as a crucial foundation for future investigations. Our findings reveal that Deaflympic athletes utilize psychological skills in ways similar to their Paralympic counterparts, although the majority do not train these skills systematically. The similarity in the use of psychological skills found in this study suggests that tailored psychological interventions, specifically designed to meet the unique communication needs of Deaflympic athletes, could enhance their training and competitive performance. Future studies should delve deeper into the effectiveness of such

adapted interventions, further bridging the gap in applied sport psychology research and practice between Deaflympic and Paralympic sports. Such research not only advances the field of sport psychology in Deaf sport but also ensures that the significant insights lead to practical enhancements in the coaching and competition preparation of Deaflympic athletes.

Author affiliations:
[1] Department of Sport Psychology, Leipzig University, Germany
[2] Faculty of Social and Health Care Sciences, Regensburg University of Applied Sciences, Germany
* Correspondence: alon.markov-glazer@uni-leipzig.de; Tel.: +49 341 97-31665

Author Contributions: Conceptualization, A.M-G. and R.S.; Methodology, A.M.-G. and R.S.; Formal Analysis, A.M.-G. and R.S.; Writing-Original Draft Preparation, A.M.-G.; Writing-Review & Editing, A..M-G., A-M.E. and R.S.; Supervision, A-M.E. and R.S.

Funding: This work was supported by the German Federal Institute for Sport Science (BISp) under Grant number ZMVI4-070401/19-20. AMG received a doctoral scholarship from the Ernst Ludwig Ehrlich Scholarship Fund (ELES), supported by the German Federal Ministry for Education and Research (BMBF).

Availability of data and materials: The data that support the findings of this study are available from the corresponding author, AMG, upon reasonable request.

Acknowledgments: We express our sincere gratitude to the study participants for their valuable contributions and to the DGSV for coordinating the data collection process. Additionally, we extend our thanks to the sign language interpreters for facilitating communication throughout the study.

Conflicts of Interest: The authors declare no conflict of interest.

References

American Psychological Association. (2017). *Ethical principles of psychologists and code of conduct*. https://www.apa.org/ethics/code/

Bastos, T. L., Corredeira, R., Probst, M., & Fonseca, A. M. (2012). Preliminary analysis of the psychometric proporties of the Portuguese version of the test of performance strategies (TOPSp) in athletes with disabilities. *European Journal of Adapted Physical Activity*, *5*(2), 7–22. https://doi.org/10.5507/euj.2012.006

Beckmann, J., & Elbe, A. M. (2015). *Sport psychological interventions in competitive sports*. Cambridge Scholars Publishing.

Brown, D. J., & Fletcher, D. (2017). Effects of psychological and psychosocial interventions on sport performance: A meta-analysis. *Sports Medicine*, *47*(1), 77–99. https://doi.org/10.1007/s40279-016-0552-7

Clark, R. A., & Sachs, M. L. (1991). Challenges and opportunities in psychological skills training in deal athletes. *The Sport Psychologist, 5*(4), 392–398. https://doi.org/10.1123/tsp.5.4.392

Clark, B., & Mesch, J. (2018). A global perspective on disparity of gender and disability for deaf female athletes. *Sport in Society*, *21*(1), 64–75. https://doi.org/10.4324/9780429505317-5

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Routledge. https://doi.org/10.4324/9780203771587

Cohen, L., Manion, L. & Morrison, K. (2017). *Research methods in education*. Routledge. https://doi.org/10.4324/9781315456539

ICSD. (2009, September). *Deaflympics – Regulations*. Deaflympics. https://www.deaflympics.com/icsd/deaflympics-regulations#:~:text=deaf%2C%20defined%20as%20a%20hearing,aids%20during%20any%20Deaflympics%20event, 15 February 2024.

DePauw, K. P., & Gavron, S. J. (2005). *Disability sport*. Human Kinetics.

Dohme, L. C., Piggott, D., Backhouse, S., & Morgan, G. (2019). Psychological skills and characteristics facilitative of youth athletes development: A systematic review. *The Sport Psychologist*, *33*(4), 261–275 https://doi.org/10.1123/tsp.2018-0014

Eberspächer, H., Mayer, J., Hermann, H.-D., & Kuhn, G. (2005). Ergebnisse der Olympiasonderförderung Sportpsychologie des DSB/BL [Evaluation of the Olympic sport psychology program sponsored by the DSB/BL]. In G. Neumann (Ed.), *Sportpsychologische Betreuung des deutschen Olympiateams 2004: Erfahrungsberichte, Erfolgsbilanzen, Perspektiven*. Sport & Buch Strauß.

Frey, M., Laguna, P., & Ravizza, K. (2003). Collegiate athletes' mental skill use and perceptions of success: An exploration of the practice and competition settings. *Journal of Applied Sport Psychology*, *15*(2), 115–128. https://doi.org/10.1080/10413200305392

Glazer, A., & Schliermann, R. (2020). Sportpsychologisches Training im deaflympischen Spitzensport: Diagnostische und interventionsbezogene Herausforderungen. [Sport psychological training in elite deaf sport: Diagnostic and other intervention-related challenges]. *Leipziger Sportwissenschaftliche Beiträge*, *61*(2), 86–105.

Gould, D., Dieffenbach, K., & Moffett, A. (2002). Psychological characteristics and their development in Olympic champions. *Journal of Applied Sport Psychology*, *14*(3), 172–204. https://doi.org/10.1080/10413200290103482

Hanin, Y. L. (2000). Individual zones of optimal functioning (IZOF) model: Emotion-performance relationships in sport. In Y. L. Hanin (Ed.), *Emotions in sport* (pp. 65–89). Human Kinetics. https://doi.org/10.5040/9781492596233.ch-003

Hanrahan, S. J. (2015). Psychological skills training for athletes with disabilities. *Australian Psychologist*, *50*(2), 102–105. https://doi.org/10.1111/ap.12083

Hardy, L., Roberts, R., Thomas, P. R., & Murphy, S. M. (2010). Test of Performance Strategies (TOPS): Instrument refinement using confirmatory factor analysis. *Psychology of Sport and Exercise*, *11*(1), 27–35. https://doi.org/10.1016/j.psychsport.2009.04.007

Harrison, R. S. (2014). Same Spirit Different Team. The Politicisation of the Deaflympics. Action Deafness Books.

Hatzigeorgiadis, A., Zourbanos, N., Galanis, E., & Theodorakis, Y. (2011). Self-Talk and Sports Performance. *Perspectives on Psychological Science*, *6*(4), 348–356. https://doi.org/10.1177/1745691611413136

Holcomb, T. K. (2012). *Introduction to American deaf culture*. Oxford University Press.

Jacobson E. (1938). *Progressive Relaxation*. McGraw-Hill.

Kurková, P., Válková, H., & Scheetz, N. (2011). Factors impacting participation of European elite deaf athletes in sport. *Journal of Sports Sciences*, *29*(6), 607–618. https://doi.org/10.1080/02640414.2010.548821

Lange-Smith, S., Cabot, J., Coffee, P., Gunnell, K., & Tod, D. (2023). The efficacy of psychological skills training for enhancing performance in sport: a review of reviews. *International Journal of Sport and Exercise Psychology*, 1–18. https://doi.org/10.1080/1612197x.2023.2168725

Leigh, I. W. (2009). *A lens on deaf identities: Perspectives on deafness*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195320664.001.0001

Leigh, I. W., Andrews, J. F. (2016). *Deaf people and society: Psychological, sociological, and educational perspectives* (2nd ed.). Routledge. https://doi.org/10.4324/9781315473819

Lochbaum, M., Stoner, E., Hefner, T., Cooper, S., Lane, A. M., & Terry, P. C. (2022). Sport psychology and performance meta-analyses: A systematic review of the literature. *PLOS One*, *17*(2), e0263408. https://doi.org/10.1371/journal.pone.0263408

Loewenthal, K. M., & Lewis, C. A. (2001). *An Introduction to Psychological Tests and Scales* (2nd ed.). Psychology Press. https://doi.org/10.4324/9781315782980

Markov-Glazer, A., Elbe, A.-M., & Schliermann, R. (2023). Sport psychology consultants' views on mental training with elite Deaf sport athletes. *International Journal of Sport and Exercise Psychology*, 1–16. https://doi.org/10.1080/1612197x.2023.2245422

Martin, J. J. (2015). Determinants of elite disability sport performance. *Kinesiology Review*, *4*(1), 91– 98. https://doi.org/10.1123/kr.2014-0082

McDermott, H. J. (2004). Music perception with cochlear implants: a review. *Trends in amplification*, *8*(2), 49–82. https://doi.org/10.1177/108471380400800203

Mesch, J., & Clark, B. (2023). *Deaf sport*. Routledge. https://doi.org/10.4324/9780367766924-RESS70-1

Mueller, J., Schütz, S., & Brodersen, F. (2019). Jugendforschung inklusiv und digital. Möglichkeiten, Voraussetzungen und Grenzen von Gebärdensprachvideos in digitalen Erhebungen [Inclusive and digital youth research: Possibilities, preconditions and

limits of sign language videos in digital surveys]. *Diskurs Kindheits- und Jugendforschung*, *14*(3), 308–322.
Padden, C. A., & Humphries, T. L. (1988). *Deaf in America: Voices from a culture*. Harvard University Press.
Park, I. & Jeon, J. (2023). Psychological skills training for athletes in sport: Web of Science Bibliometric Analysis. *Healthcare*, *11*(2), 259. https://doi.org/10.3390/healthcare/11020259
Schinke, R. J., & Hanrahan, S. J. (2009*). Cultural sport psychology*. Human Kinetics.
Schliermann, R. & Bourhim, S. (2010). Psychologische Fertigkeiten im Hörgeschädigten-Spitzensport: Analyse des Einsatzes bei Kaderathleten [Psychological skills in elite deaf Sport: Use analysis in national team athletes]. In G. Amesberger, T. Finkenzeller & S. Würth (Hrsg.), Psychophysiologie im Sport – zwischen Experiment und Handlungsoptimierung (p. 161). Hamburg: Czwalina.
Schliermann, R. & Danders, D. (2010). Psychological skills of elite athletes with a disability. In European Congress of Adapted Physical Activity EUCAPA 2010 (Ed.), *Adapted Physical Activity over Lifespan* (p. 117).
Schliermann, R. (2015). Die deaflympische Sportbewegung [The Deaflympic sport movement]. In M. Wegner, V. Scheid, & M. Knoll (Eds.), *Handbuch Behinderung und Sport* (pp. 279–290). Hofmann.
Schmid, J., Birrer, D., Kaiser, U., & Seiler, R. (2010). Psychometrische Eigenschaften einer deutschsprachigen Adaptation des Test of Performance Strategies (TOPS) [Psychometric properties of a German language adaptation of the Test of Performance Strategies (TOPS): An instrument developed to measure psychological skills in sport]. *Zeitschrift Für Sportpsychologie*, *17*(2), 50–62. https://doi.org/10.1026/1612-5010/a000008
Simonsmeier, B. A., Andronie, M., Buecker, S., & Frank, C. (2020). The effects of imagery interventions in sports: a meta-analysis. *International Review of Sport and Exercise Psychology*, *14*(1), 186–207. https://doi.org/10.1080/1750984x.2020.1780627
Stewart, D. A. (1991). *Deaf sport: The impact of sports within the Deaf community*. Gallaudet University Press. https://doi.org/10.2307/j.ctv3006zh7
Stewart, D. A., Robinson, J. A., & McCarthy, D. (1991). Participation in deaf sport: Characteristics of elite deaf athletes. Adapted Physical Activity Quarterly, *8*(2), 136-145. https://doi.org/10.1123/apaq.8.2.136
Tabachnick, B., & Fidell, L. (2013). *Using multivariate statistics* (6th ed.). Pearson Education.
Taylor, M. K., Gould, D., & Rolo, C. (2008). Performance strategies of US Olympians in practice and competition. *High Ability Studies*, *19*(1), 19–36. https://doi.org/10.1080/13598130801980281
Thomas, P. R., Murphy, S. M., & Hardy, L. (1999). Test of performance strategies: Development and preliminary validation of a comprehensive measure of athletes' psychological skills. *Journal of Sports Sciences*, *17*(9), 697–711. https://doi.org/10.1080/026404199365560
Vealey, R. S. (2007). Mental skills training in sport. In G. Tenenbaum, & R. C. Eklund (Eds.), *Handbook of sport psychology* (pp. 285–309). Wiley & Sons.
Weinberg, R. S., & Gould, D. (2023). *Foundations of sport and exercise psychology* (8th ed.). Human Kinetics.