Int. J. Sport Psychol., 2020; 51: 359-382
doi: 10.7352/IJSP.2020.51.359

Exploring the phenomenological, environmental, and task-related aspects of the Yips in Tennis, Miniature Golf, Darts, and Archery

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In two studies of paradoxical performance in sports, we examined the appearance of yips-like phenomena and movement disturbances in four vulnerable sports and analysed the sensory demands and constraints of the affected actions. Groups of athletes (Study 1, N = 1,248) and experts (Study 2, N = 66) completed online surveys. Results revealed a prevalence rate of currently yips-affected athletes of 6% in tennis, 59% in miniature golf, 32% in darts, and 34% in archery. The yips-affected athletes had more experience in their sport than the non-affected, except in tennis and reported disturbances support the notion of the yips being a context-conditioned reaction or dynamic stereotype. Therefore, in study 2, affected actions and motor skills were put in vignettes and rated by experts regarding sensory demands and constraints. Comparisons between tennis, miniature golf and archery revealed that only kinaesthetic demands and time pressure differed. Overall, results add to a deeper understanding of environmental and task-related components of yips-susceptible actions in different sports.

KEY WORDS: Action-theoretical framework, Movement disturbances, Online questionnaire, Paradoxical Performance.

Introduction

The yips is a task-specific movement disorder that manifests as involuntary movements during the execution of a fine-motor skill (McDaniel, Cum-

Study 1 was funded by the German Research Foundation (http://www.dfg.de) and was part of a larger project called "Focal Dystonia in Musicians and Athletes".

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mings, & Shain, 1989). In this regard, the yips has been associated with choking under pressure (Beilock & Carr, 2001). Choking under pressure was originally defined as "the occurrence of suboptimal performance in pressure situations despite high skill and motivation" (Baumeister, 1984). Lately, Mesagno and Hill reviewed definitions in the field and proposed a more detailed definition. They understand choking under pressure as "an acute and considerable decrease in skill execution and performance when self-expected standards are normally achievable, which is the result of increased anxiety under perceived pressure" (Mesagno & Hill, 2013, p. 273; for review also see Gröpel & Mesagno, 2019). This relates to a perceived mismatch between individual resources and external demands of the situation, resulting in a significant drop in motor performance (Hill, Hanton, Fleming, & Matthews, 2009). Along with the lost-move syndrome, understood as an anxiety disorder caused by a traumatic experience in which formerly automated movements can no longer be performed (Bennet, Hays, Lindsay, Olusoga, & Maynard, 2015), yips indeed belongs to a group of paradoxical performance phenomena that result in a sudden decrease in an athlete's performance despite intending and striving for superior performance (Baumeister & Showers, 1986; Lobinger, Klämpfl, & Altenmüller, 2014).

Previous research on the yips has focused mainly on golf, where the putting yips occurs in the wrist and lower arm normally of the dominant arm shortly before hitting the ball, which often results in missing the putt (Klämpfl, Lobinger, & Raab, 2013a; Sachdev, 1992). Prevalence rates of the yips in golf have been reported to range between 17% and 48% depending on the diagnostic method (kinematic evaluation or self-reports; Philippen, & Lobinger, 2015; McDaniel et al., 1989; Smith et al., 2000). Self-reported prevalence rates (McDaniel et al., 1989; Smith et al., 2000) are likely to be overestimated compared to those derived by kinematic analysis, being a more objective measure (Klämpfl et al., 2015).

The cause of the yips is unclear and currently believed to be multi-etiological (i.e., Clarke, Sheffield, & Akehurst, 2015; Lobinger et al., 2014). Smith et al.'s (2003) continuum model postulates that neurological and psychological mechanisms can cause the development of the yips. According to this continuum model, the yips is either a task-specific focal dystonia (Smith et al., 2000) similar to the musician's cramp (Adler et al., 2011) or a chronic and severe form of choking under pressure resulting from consciously controlling an automated movement (Bawden & Maynard, 2001; Masters & Maxwell, 2008). Lately, Clarke, Sheffield, and Akehurst (2019) investigated the yips as well as choking experience in golfers and archers applying a broad range of self-report personality scales. They could show, that in yips-affected

athletes, yips was associated with traits related to social sources, like self-consciousness or fear of negative evaluation, whereas choking was associated with social traits as well as perfectionism and anxiety.

The majority of yips-affected athletes might show both neurological and psychological symptoms (Clarke et al., 2015). Therefore, the extended two-dimensional continuum model suggested by Clarke et al. (2015) includes a third type, incorporating neurological and psychological symptoms. Concerning psychological factors, anxiety seems to play a key role in developing the yips or at least in exacerbating the symptoms (Sachdev, 1992; Smith et al., 2003). Whereas Roberts, Rotheram, Maynard, Thomas, and Woodman (2013) found higher perfectionism values in yips-affected athletes, no empirical support for differences in anxiety and perfectionism between yips-affected and non-affected amateur golfers was found by Klämpfl et al. (2013a). The authors concluded that features more related to sensorimotor mechanisms than to psychological factors might contribute to the etiology of yips. In this regard, the yips can also be seen as a context-conditioned reaction (Klämpfl et al., 2015; Marquardt, 2009) or as a so-called dynamic stereotype (Lobinger et al., 2014), that is, as a type of integral activity performed by the brain that manifests in a fixed or stereotyped succession of reflexes (Windholz, 1996). Lately, this classification was supported by a study comparing musicians affected with musician's cramp (see Altenmüller & Jabusch, 2010, for a review) to golfers showing yips (Ioannou et al., 2018). Based on cluster analyses, covering participants' characteristics like age, handedness and experience, and psychodiagnostics assessing perfectionism, anxiety and coping with stress, the authors identified five subgroups in golfers with movement disturbances. The dominant characteristics of the subgroups were reported to be a) jerking symptoms (in novices), b) performance anxiety c) dynamic stereotype, d) dystonic cramps, and e) focal dystonia (Ioannou et al., 2018). Psychological comorbidities related to choking under pressure were found in group b), c), and d), but not in a), and e). Regarding motor origins of yips, research has revealed sensorimotor triggering factors like demanding motor coordination, and biomechanics (Adler et al., 2005), that vary across sports. Additionally, the yips might be caused by the interference of conflicting motor programs (Marquardt, 2009) and previously learned skills in other sports (Klämpfl et al., 2015). In their study, Klämpfl et al. (2015) found that yips-affected golfers were more likely to have previously played a racket sport such as tennis. Therefore, the sports biography (i.e., other sports played) of athletes might matter in the development of the yips given motor programs were acquired which hinder proper motor control in putting. In aiming to profile affected golfers, McDaniel et

al. (1989) found that yips-affected golfers had significantly more golfing experience in years compared to non-affected golfers. In contrast, a similar study (Smith et al., 2000) did not find any difference in demographic variables, which included age, performance level, and golfing experience, supporting the idea of yips being a movement stereotype based on the interaction of psycho-neuromuscular factors.

Regarding musician's cramp Altenmüller and Jabusch (2010) described the interplay between predisposition (heredity), intrinsic (i.e., personality and need for control) and extrinsic (i.e., social, temporal, and spatial sensorimotor constraints) triggering factors. They found that the type of musical instrument seemed to influence the likelihood of developing the musician's cramp, potentially due to the spatial and temporal constraints of playing the instrument. Pianists and guitar players are more likely to experience the phenomenon. Research in sports so far lacks comparable analyses of task-specific, extrinsic constraints. Thus, it is likely that in the sports domain, the type of sport - including the demands and constraints of sport-specific actions and its specific equipment (i.e., golf club or dart arrow) -would predetermine the likelihood of developing the yips.

Although yips-like phenomena have already been reported in several sports, there has not yet been established a sufficient model to explain causes of the phenomenon's occurrence incorporating common yips features across different types of sports. Cases similar to the yips as a task-specific focal dystonia have been reported in tennis (Mayer, Topka, Boose, Horstmann, & Dickhuth, 1999), pistol shooting (Sitburana & Ondo, 2008), table tennis (Le Floch et al., 2010), running (Wu & Jankovic, 2006), and petanque (Lagueny et al., 2002). Bawden and Maynard (2001) found that yips in cricket players was characterized by the inability to release the ball while bowling as a result of tension in the hand. They also claimed that the yips in darts, or "dartitis," exhibits similar characteristics. In archery, the yips-like phenomenon is called "target panic," which is characterized by a conditioned premature release or hold (Kidwell, 2004). Weiss and Reber (2012) denominated "the sudden loss of ability of baseball players to throw accurately" (p. 171) "Steve Blass disease", paying tribute to the famous pitcher losing his ability to throw the ball accurately. In tennis, only one dystonia case has been reported so far, in which the player exhibited involuntary movements in the shoulder and arm when ball contact was anticipated in the forehand, backhand, and especially in the serve stroke (Mayer et al., 1999). The affected player exhibited an inability to coordinate the swing movement, especially in serving, where abrupt, interrupting movements occurred and the player was unable to lift the racket behind his head (Mayer et al., 1999). In contrast to most yips-

affected athletes, this exceptional case may have had more neurological causes, as the symptoms were very impairing and moved from one arm to the other after changing the playing arm (Mayer et al., 1999).

Even though these studies provided initial insights into the occurrence of the yips phenomenon, there is still a lack of investigation of several yips-vulnerable sports to shed further light on the yips by examining both sport-specific and common yips features that are independent of the type of sport (Clarke et al., 2015). Following suggestions by Lobinger et al. (2014), and Nitsch and Hackfort (2016), yips phenomena might be synthesized across different sports based on person-related components (i.e., perfectionism, sports biography), environment-related components (i.e., location and conditions), and task-related components (i.e., sensorimotor demands in manipulation of the golf ball towards a hole using a club). Whereas person-related factors are well researched, as seen in the aforementioned internal triggering factors like age, experience and handedness, environmental and task-specific components were paid less attention to.

According to Gentile's taxonomy of motor skills (see Adams, 1999 for an overview), actions can be classified according to the body orientation (stability or transport) and manipulation being absent or present (Gentile, 1987). Regarding yips-affected sports, Gentile's taxonomy of motor skills is not sufficient. While e.g. darters or archers are confronted with stable environmental conditions during the skill execution, other affected sports like tennis demand to perform movements while being in motion. Golf, snooker and dart players do not change the body position during the movement. But athletes of yips-prone sports are often required to handle an instrument or tool to manipulate an object. These complex skills are highly demanding in motor control and motor execution in time and space. Regarding temporal and spatial sensorimotor constraints, analysing task-specific coordinative demands might be promising. Neumaier`s coordinative demands profile (2006), which is embedded in an action theoretical framework (Lobinger et al., 2014; Nitsch & Hackfort, 2016) allows for assessing sports actions according to their sensory-motor demands and pressure conditions. Sensorimotor demands are (a) visual, (b) acoustic, (c) tactile, (d) kinaesthetic, (e) vestibular, and overall stability/ balance. The constraints or pressure conditions are (a) precision, (b) time pressure and speed/ movement velocity, (c) complexity, (d) situational pressure, and (e) psychophysiological stress (Neumaier, 2006).

To sum up, it appears that there are various types of the yips across different sports, but there is a lack of reports about the prevalence and distinctive features of the yips in sports other than golf. Moreover, little is known about the affected movements, actions and motor skills beyond single case studies.

Therefore, a deeper insight into the characteristics of yips-affected athletes across sports and concomitant yips-vulnerable actions could contribute to a better understanding of the phenomenon in general (Clarke et al., 2015).

Consequently, we conducted two studies. The aim of Study 1 was to get a deeper insight into the prevalence and characteristics of yips, yips-similar phenomena and affected athletes in different sports. As the sports should require skills and tasks demanding temporal and spatial coordination including object manipulation and tool-use as well as competitive settings, we chose tennis, archery, darts, as well as miniature golf. The aim of Study 2 was to examine environmental and task-related components of the identified yips-vulnerable actions and motor skills by using the coordinative demands profile (Neumaier, 2006) to outline sensory demands and constraints. Ethical clearance to conduct the studies was provided by the authors' university ethics board.

Study 1

Method

In line with previous yips studies (McDaniel et al., 1989; Smith et al., 2000), we used the self-report approach, despite the lower reliability in discovering yips-like phenomena, but due to it being the most economical way to obtain a large sample. Therefore, an online survey was created for each sport separately via Unipark (Questback GmbH, Hürth, Germany).

Participants

The link to the online survey was opened 2,864 times. Participants were 1,280 people who completed the survey (response rate: 44.7%). Thirty-two participants had to be excluded because they did not fulfil the following criteria: (a) Self-reported seriousness in filling out the online survey had to be at least 5 on a 9-point Likert scale ranging from 1 (*absolutely not serious*) to 9 (*absolutely serious*; $n = 12$ excluded). (b) Participants had to be at least 18 years old ($n = 16$ excluded). (c) Participants' age had to be higher than the number of years the respective sport had been played ($n = 4$ excluded). The final sample consisted of 1,248 participants (369 tennis players, 202 miniature golfers, 357 darts players, 320 archers), who on average were 42.3 years old ($SE = 0.4$, range: 17 to 77), had played their sport for 16.8 years ($SE = 0.3$, range: 0.2 to 60), and had practiced their sport 11.3 hours per month ($SE = 0.2$, range: 0 to 50) (see Table II for further details).

Online Survey And Procedure

The survey had the same structure and content as in Klämpfl et al. (2015), being adapted to the investigated sports. Participants were first provided with the purpose of the survey.

They then gave their informed consent by ticking a box. Subsequently, they were asked to rate their seriousness in completing the survey which was repeated after the survey (Reips, 2002). The mean of these two ratings was calculated for the inclusion criterion described above. On the following page, the participants reported their age, sports experience in years, playing frequency per month, and handedness in the sport. Additionally, they were asked about their sports biography, as displayed in Klämpfl et al. (2015). They had to indicate if they currently practiced or had practiced other sports over a long period. The sports were categorized according to Klämpfl et al. (2015) as follows: (a) racket sports (sports that require the athlete to manipulate an object with a racket, club or bat, i.e., squash, tennis, and golf), (b) precision sports (i.e., bowling, archery, and shooting), (c) endurance sports (i.e., jogging and swimming), (d) fitness sports (i.e., working out in a gym), (e) ball sports excluding racket sports (i.e., soccer, basketball, and handball), and (f) other sports that did not fit in the specified categories (i.e., dancing and karate).

Subsequently, participants were provided with a definition of the yips and its phenomenological description in golf putting (Sachdev, 1992; Smith et al., 2000) and asked if they had ever experienced the yips in their sport and if so, if they were currently experiencing the yips. They could answer (a) "yes," (b) "no," or (c) "I do not know," which triggered the next part of the survey. If participants were currently yips affected, they were asked questions about the phenomenological manifestation of the yips including (a) symptoms, (b) affected body part, (c) affected moment during execution, (d) affected situation, and (e) affected sport-specific movement (i.e., particular stroke in tennis). Only symptoms (a) were the same for all sports: cramping, freezing, jerking, shaking and trembling (and 'other' as an open category). Affected body-parts, moment, situation and movement (b, c, d, e) had sport-specific questions. Sport-specific questions were created in consultation with the respective national sports associations and with sports coaches. Participants who indicated they (a) had never experienced the yips, (b) were no longer experiencing the yips, or (c) did not know if they had experienced the yips were directed to the end page of the survey and thanked for their participation. The link to the online survey was distributed partially by direct e-mail to sports clubs and with the help of the respective national sports associations by posting the link on their homepages or sending it to state sports associations to spread the link. Only one participation per Internet protocol (IP) address was possible (marked in yellow).

Data Analysis

Data analyses were conducted for each sub-sample separately (tennis, miniature golf, darts, archery) and overall (all-sports). Only participants who were currently affected (yips) or never affected (no yips) were included in the inferential statistical analysis. To compare yips-affected and non-affected athletes in the continuous variables, a one-way independent ANOVA was conducted with group membership (yips, no yips) as a between-subjects factor. Dependent variables included (a) age, (b) sports experience in years and (c) playing frequency in hours per month. The assumption of homogeneity of variances was tested and found tenable using Levene's test for tennis, miniature golf and archery. Levene's test was found to be significant for age in the darts sample, F (1, 255) = 13.300, $p < .001$, whereas under closer investigation using Welch's test, F (1, 254.710) = 3.073, $p = .081$ it was decided to proceed with the analysis. Similarly, Levene's test was significant for age in the all-sports sample, F (1, 937) = 9,569, $p = .002$. Here again, upon investigation of the Welch test, F (1, 854.306) =

1.756, $p = .185$, it was decided to proceed with the analysis. Upon investigation of the distribution of the data, the dependent variable playing frequency was found to be non-normally distributed for all sports respectively, as well as the variable sports experience for the archery sample. These were transformed according to Templeton (2011), which lead to a normal distribution in all cases. Outliers (1.3%) in the continuous variables were kept in the analysis as they did not change the results. Chi-square tests were conducted to compare the remaining categorical variables (a) gender, (b) handedness, and (c) sports biography, including (a) racket, (b) precision, (c) endurance, (d) fitness, (e) ball, and (f) other sports. Lastly, Chi-square tests were run for each symptom including (a) cramping, (b) freezing, (c) jerking, (d) shaking, (e) trembling and (f) other, to compare the prevalence in different sports. The significance level was Bonferroni corrected ($\alpha = .05/17 = .0029$). Prior power analysis run with the G*Power software (Faul, Erdfelder, Lang & Buchner, 2007) indicated a required sample size of 236 participants when assuming a medium effect size ($f = 0.25$), adequate power ($1\text{-}\beta = 0.80$) as well as the above-mentioned significance level and type of analysis. All analyses were conducted with IBM SPSS Statistics Version 26.

RESULTS

Prevalence rates and yips characteristics. The prevalence of self-reported currently yips-affected athletes was the highest in miniature golf (59%) followed by archery (34%), darts (32%), and tennis (6%). The reported yips characteristics in each sport, regarding symptoms, affected body parts, affected execution moment, affected movement and affected situation are shown in Table I.

The symptoms vary across the four sports: cramping (a) was reported significantly more frequently in tennis (41,2%) and darts (52,9%) compared to miniature golf (21,3%) and archery (20,8%): $X^2(3, N = 535) = 52.201$; $p < .001$.; *Phi* (ϕ) = .318. For the symptom (b) freezing, darts (43,5%) and archery players (46%) reported it significantly more than in the sports tennis (17,6%) and miniature golf (10,3%): $X^2(3, N = 535) = 61.620$; $p < .001$; $\phi = .339$. Next, the symptom (c) jerking was reported more often in the sports tennis (47,1%), miniature golf (48,4%) and archery (40,9%) in comparison to darts (22,4%): $X^2(3, N = 535) = 26.657$; $p < .001$; $\phi = .223$. The remaining symptoms (d) shaking, $X^2(3, N = 535) = 10.668$; $p = .014$, (e) trembling, $X^2(3, N = 535) = 13.409$; $p = .004$, and the open category titled (f) other, $X^2(3, N = 535) = 15.016$; $p = .002$, provided no significant differences in the sample.

Demographic Data

Descriptive statistics are provided in Table II. In the following, we only report inferential statistics for significant differences. In tennis, there were no significant differences between yips-affected and non-affected athletes with respect to gender, handedness, age, experience in the respective sport, playing sports and sports biography. Related to the last aspect, there was no association between being yips-affected and experience in racket sports, precision sports, endurance sports, fitness sports, ball sports and other sports. In miniature golf, darts, and archery, the yips-affected athletes differed from non-affected athletes only in the amount of experience in their sport. Yips-affected athletes had significantly more years of experience than the non-affected ones. Across all sports, the yips-affected athletes differed

TABLE I
Frequency Distributions of Yips Characteristics by Sport

Yips characteristic	Tennis (n = 22)		Miniature golf (n = 119)		Darts (n = 115)		Archery (n = 108)	
	Item	%	**Item**	%	**Item**	%	Item	%
Symptom[a]	**Cramping**	**59**	Cramping	23	**Cramping**	**54**	Cramping	19
	Freezing	9	Freezing	15	Freezing	38	**Freezing**	**41**
	Jerking	36	**Jerking**	**50**	Jerking	20	Jerking	8
	Shaking	36	Shaking	28	Shaking	14	Shaking	27
	Trembling	36	Trembling	13	Trembling	11	Trembling	40
	Other	0	Other	19	Other	10	Other	9
Affected body part	Lower arm	68	Lower arm	58	Lower arm	58	Upper arm	53
	Hand	50	Hand	46	Hand	52	Shoulder	41
	Shoulder	32	Upper arm	24	Upper arm	37	Lower arm	37
	Upper arm	23	Shoulder	23	Shoulder	18	Hand	28
	Leg	0	Leg	5	Leg	4	Finger	21
	Other	0	Other	5	Other	3	Leg	4
							Other	7
Affected execution moment	Ball impact	73	Not available		Before dart release	65	While aiming	69
	Forward swing	50			During dart release	53	Arrow release	43
	Follow through	23			While aiming	21	Anchoring	21
	Backswing	0			After dart release	65	Loading	10
							Drawing	3
							Pre-drawing	2
Affected movement	Forehand	82	Long straight putts	89	Throws on doubles	64	Not available	
	Backhand	23	Short straight putts	23	Throws on triples	61		
	Service	18	Long putts via boards	17	Throws on singles	61		
	Forehand volley	18	Short putts via boards	5	Throws on bull's-eye	35		
	Backhand volley	5	Other	6	Other	9		
	Other	14						
Affected situation	League games	77	Tournaments	87	Pressure situations	70	Tournaments	78
	Pressure situations	55	Pressure situations	48	Tournaments	54	Training session	62
	Practice games	46	Practice rounds	16	Training sessions	49	Practice games	29
	Training sessions	36	Training sessions	13	Practice games	39	Pressure situations	21
	Tournaments	32	Other	1	Other	5	Other	0
	Other	5						

[a] Symptoms are displayed in equal order across sports, highest frequencies per sport are marked in bold.

from the non-affected athletes in gender, endurance sports and ball sports. Yips-affected athletes were significantly less likely to have performed endurance and ball sports.

TABLE II
Demographic Data of Currently Yips-Affected (Yips) and Never-Yips-Affected (No yips) Athletes

Characteristic	Tennis			Miniature golf			Darts			Archery			Across sports		
	Yips	**No yips**	**Total**	**Yips**	**No yips**	**Total**	**Yips**	**No yips**	**Total**	**Yips**	**No yips**	**Total**	**Yips**	**No yips**	**Total**
Number	22	290	312	119	35	154	115	142	257	108	108	216	364	575	939
Gender (%)															
Female	18	27	26	13	26	16	9	18	14	24	24	24	15	24	21
Male	82	73	74	87	74	84	91	82	86	76	76	76	85	76	79
Handedness (%)															
Right-handed	86	89	89	69	69	69	88	92	90	86	87	87	81	88	85
Left-handed	14	11	11	31	31	31	12	8	10	14	13	13	19	12	15
Mean age in yrs (SD)	44 (15)	48 (15)	47 (15)	46 (11)	42 (12)	45 (12)	38 (8)	36 (11)	37 (10)	43 (14)	43 (13)	43 (14)	42 (12)	44 (14)	43 (13)
Mean experience in yrs (SD)	26 (11)	23 (13)	23 (13)	24 (11)	16 (13)	22 (12)	14 (8)	11 (8)	12 (8)	12 (9)	9 (9)	10 (9)	18 (11)	17 (13)	17 (12)
Mean playing frequency in hrs per month (SD)	9 (5)	10 (5)	10 (5)	9 (6)	10 (6)	9 (6)	15 (8)	14 (8)	14 (8)	11 (5)	10 (5)	10 (5)	11 (7)	11 (6)	11 (6)
Sports biography[a] (%)															
Racket sports	41	27	28	29	21	25	30	21	25	19	17	18	27	23	24
Precision sports	5	10	10	37	21	31	31	20	25	21	14	18	28	14	19
Endurance sports	64	50	51	26	33	25	21	22	21	40	46	43	31	42	37
Fitness sports	41	33	34	31	24	27	21	18	19	26	30	28	27	28	27
Ball sports	55	42	43	28	48	31	43	44	44	14	19	16	31	39	35
Other sports	23	28	28	20	30	21	23	29	27	31	32	32	25	29	27

[a] Other sports performed

Comparison Of Yips Affected And Non-Affected Athletes

In miniature golf, non-affected athletes had less experience in their sport ($M = 16$; $SD = 13$) than yips-affected athletes ($M = 24$; $SD = 11$), $F(1, 152) = 14.111$, $p < .001$, $\omega^2 = 0.078$. In darts, yips-affected athletes ($M = 14$; $SD = 8$) were more experienced in the sport than their non-affected colleagues ($M = 11$; $SD = 8$), $F(1, 255) = 11.850$, $p = .001$, $\omega^2 = 0.041$. Finally, yips-affected archers ($M = 12$; $SD = 9$) had more experience in archery than non-affected archers ($M = 9$; $SD = 9$), $F(1, 213) = 0.375$, $p = .002$, $\omega^2 = 0.037$ (see table 3 for overview). The omega squared (ω^2) values indicate a small to medium effect in the case of darts and archery and a medium to large effect in the case of miniature golf (Kirk, 1996).

Discussion of Study 1

Our first aim was to estimate the prevalence rates of yips-affected athletes in tennis, miniature golf, darts, and archery. The rates in the darts and archery samples are within the range of the estimated prevalence rate in golf, that is, between 25% and 48% (McDaniel et al., 1989; Smith et al., 2000). Nevertheless, these rates have to be interpreted with caution as the representativeness of the whole population of registered active members in the country of the study (approximately: tennis: 1.5 million; miniature golf: 10,000; darts: 11,000; archery: 40,000; German Olympic Sports Confederation, 2012) cannot be guaranteed. Prevalence rates are likely to be overestimated in surveys as more affected than non-affected athletes tend to participate or finish completing the survey once started. The observed response rate of 44.7% in the survey could be seen as an indication, therefore.

The second aim of study 1 was to characterize the yips in tennis, miniature golf, darts, and archery. The findings of the present study show that the yips in tennis was characterized mainly by cramping and jerking. In miniature golf, the most dominant symptom proved to be only jerking. Survey results for archery also showed a high amount of reported jerking, as well as freezing, with darts players reporting cramping and freezing more frequently. Descriptive results showed that in tennis, the cramping and jerking took place in the lower arm and hand during ball contact and the forward swing of the forehand stroke, occurring predominantly in league games, pressure situations, and practice games. In miniature golf, jerking of the lower arm and hand was more frequently reported while performing long straight putts, occurring most often in tournaments and pressure situations. In contrast, the putting yips in golf appears more likely when putting from short distances (McDaniel et al., 1989; Smith et al., 2000). One reason might be that miniature golfers generally try to get the ball in the hole with their first stroke, which generates high personal success expectations

and increases the precision demands, whereas, in golf, long putts are generally used to approach the hole. In darts, the yips was characterized by cramping and freezing of the arm and hand before, during, and after the release in almost every situation, but mostly in pressure situations. This characterization is similar to that found in cricket bowling (Bawden & Maynard, 2001), possibly revealing common features of yips-like phenomena in throwing sports such as darts and cricket bowling. Finally, in accordance with a description of target panic by Kidwell (2004), the yips in archery appeared as freezing and jerking of the whole upper limb while aiming or releasing the arrow and occurred in both tournaments and training sessions. The different phenomenological manifestation of the yips as reported for the different sports (see Table 1) might indicate that sport-specific demands and constraints play a role in the development of the yips, as do the demands and constraints of different instruments in musician's cramp (Altenmüller & Jabusch, 2010). However, there might be slight indications for similarly appearing symptoms of the yips across the reported sports, although distinctive features may be apparent. In line with previous reports in dart players, where yips-related impairments appeared when releasing the dart (Papineau, 2015), our findings showed freezing in archery while aiming and releasing the arrow.

The third aim of study 1 was to outline the demographic characteristics of yips-affected athletes across sports. There was no association between sports biography, where participants had to indicate having experience in racket sports, precision sports, endurance sports, fitness sports, ball sports and other sports, and experiencing the yips across sports (tennis, miniature golf, darts and archery) in the present study. The only demographic parameter that distinguished yips-affected and unaffected athletes in miniature golf, darts, and archery was the amount of experience in each sport. In line with previous research on the yips in golfers (McDaniel et al., 1989), yips-affected athletes had played their sport for a longer time than unaffected athletes. In tennis, there was no difference in experience, possibly due to the low number of yips-affected players in the sample. Yips-affected athletes having extensive experience appear to have a higher chance to develop a yips than less experienced athletes, which may either be related to more complex influences of sophisticated skill or simply attributed to a theoretically growing risk by increasing the number of years.

Study 2

After the determination of the main phenomenological picture of the yips in tennis, miniature golf, darts, and archery in Study 1, we explored the

environmental and task-related components of the described yips-susceptible actions in Study 2 by using the coordinative demands profile (Neumaier, 2006) and including both sensory demands and constraints, such as level of time pressure and situation complexity, among others. In this way, we hoped to gain insight into the common features of yips-susceptible actions, enabling a better understanding of the occurrence of the yips and thus its prevention and possible interventions.

Method

Participants

The link to the online survey (Unipark; Questback GmbH, Hürth, Germany) was opened 212 times. One hundred participants completed the survey (response rate: 47.2%). Thirty-four participants had to be excluded according to the following criteria, 33 for filling out parts of the survey related to golf and squash, both were not the subject of this study, and one whose self-reported seriousness in filling out the online survey was not at least 5 on a 9-point Likert scale ranging from 1 (*absolutely not serious*) to 9 (*absolutely serious*). The final sample consisted of 66 experts in their sports (tennis: 10; miniature golf: 30; darts: 19; archery: 7) who were on average 44.4 years old ($SE = 1.6$). An expert was defined as having experience in either active playing for more than 10 years (Ericsson, 2006) or coaching in the specific sport. We focused only on experts in the respective sport as we considered them to be the best assessors of their sport's demands and constraints. Yips-affected athletes were not taken into account, possibly having a different view on their sport with respect to environmental constraints than their non-affected colleagues, an aspect worth investigating in future studies. A full description of the participants can be seen in Table III. The link to the online survey was distributed with the help of the respective sports associations and by direct e-mail to sports clubs.

Online Survey And Procedure

As in Study 1, participants were first provided with the purpose of the survey and subsequently gave their informed consent and rated the seriousness of their participation before and after the survey (Reips, 2002). On the next page, the participants reported demographics such as (a) age, (b) gender, (c) sports expertise, and (d) type of expertise. They could indicate sports expertise in any of the following sports: tennis, darts, archery, and miniature golf. They specified their type of expertise by reporting they had played actively for more than 10 years or that they were a coach or both. Their choice for sports expertise triggered the sport-specific section of the survey. On the following page, the experts were asked to imagine themselves in a predefined sport-specific yips-vulnerable situation that we created on the basis of the findings of Study 1 These sport-specific actions and situations were created in accordance with the action-theoretical framework (i.e., Nitsch & Hackfort, 2016) with personal, environmental, and task-related components and taking into account the findings of Study 1 about the main phenomenological manifestation of the yips in each sport. Since the yips has been reported to

TABLE III
Statistical Indices of the one-way independent ANOVA and Chi-Square Tests in the Sports Subsamples

	Dependent variable					Tennis					Miniature Golf					Darts Archery					Across sports				
	F	ω²	X²	p	Phi	F	ω²	X²	p	Phi	F	ω²	X²	p	Phi	F	ω²	X²	p	Phi	F	ω²	X²	p	Phi
Continuous																									
Age	1.398	.001		.238		2.827	.012		.095		2.921	.007		.089		.030	.005		.862		1.642	.000		.200	
Experience	1.170	.000		.280		14.111	.078		.000*		11.850	.041		.001*		9.375	.037		.002*		.850	.000		.357	
Frequency	1.082	.000		.299		.984	.000		.323		.972	.000		.325		.001	.005		.977		.030	.000		.862	
Categorical[a]																									
Gender			0.80	.371	-.051			3.53	.060	-.151			4.29	.038	-.129			0.00	1	.000			10.79	.001*	-.107
Handedness[b]			0.13	.724	.021			0.01	.994	.009			2.84	.120	.105			3.62	.175	.129			8.73	.021	.096
Racket sports			1.89	.170	-.078			0.45	.505	-.054			2.42	.147	-.097			0.13	.721	-.024			13.97	.015	.122
Precision sports			0.77	.709	.050			0.68	.410	-.066			3.98	.046	-.124			2.04	.153	-.097			34.68	.043	.192
Endurance sports			1.45	.229	-.068			4.93	.026	.179			0.35	.852	.012			0.93	.336	.065			101.87	.000*	.329
Fitness sports			0.51	.472	-.040			0.89	.345	.076			0.44	.508	-.041			0.37	.543	.041			2.09	.148	.051
Ball sports			1.30	.254	-.065			2.36	.124	-.124			0.02	.887	.009			0.85	.356	.063			18.68	.000*	.152
Other sports			0.31	.576	.032			1.67	.196	.104			0.95	.330	.061			0.09	.770	.020			0.06	.802	-.009

[a]*df* = 1; [b]*df* = 2.
*Significance is indicated for two-sided tests.

TABLE IV
Demographic Data of Experts in Study 2

Characteristics	Tennis	Miniature golf	Darts	Archery	Across sports
Number	10	30	19	7	66
Female (%)	30	17	32	57	27
M_{age} (SE) in years	43.7 (4.7)	43.5 (2.4)	43.4 (2.6)	51.7 (2.1)	44.4 (1.6)
Only coach experience (%)	20	3	11	57	12
Only playing experience for more than 10 years (%)	50	53	53	0	47
Coach & playing experience (%)	30	43	37	43	41

occur especially in situations where mental pressure and high precision demands were apparent (see Clarke et al., 2015), the vignettes were created in a way to ensure equally high levels of both demands across sports. The actions and situations for each sport were formulated in collaboration with the respective sports association to ensure face validity and the independence of specific categories within the sports and sports equipment. They are listed in the following:

Tennis. "You are in a league game and the following point determines match ball either for your opponent or for you. The opponent hits the ball from his forehand side cross-court just past the service line. You quickly approach the ball from the centre of the baseline and try to place the ball right on the opponent's baseline by using your straight forehand stroke in order to put him under pressure."

Miniature golf. "You are in a tournament and are currently in a tight match with your opponent. On the last lane (straight putt with offset obstacles), you have the opportunity with your next putt to force extra putts to win the match. You execute the putting movement."

Darts. "You are in a league game and your next dart throw will determine if you finish the game before your opponent, who could otherwise finish the game himself. Therefore, you have to throw a double twenty and you execute your throw movement."

Archery. "You are participating in a tournament and are currently in a tight competition with your opponent. You have the opportunity to force extra shots to win the competition if you shoot into the gold with your next arrow."

Within the above-mentioned vignettes, subjects had to assess firstly the sensory demands and secondly the constraints of the action on a 10-point Likert scale from 1 (*low*) to 10 (*high*) in line with the coordinative demands profile by Neumaier (2006). The items for sensory demands included (a) visual, (b) acoustic, (c) tactile, (d) kinaesthetic concerning the receptors in muscles and joints, and (e) stability/ balance demands. The constraints items were (a) precision pressure, (b) time, (c) simultaneous coordination, (d) gradual coordination, (e) muscle selection, (f) situation variability, (g) situation complexity, (h) physical stress and (i) mental stress. To increase understanding about each item further guidance was provided by short descriptions following the item name. After their assessment, the participants optionally had the chance to leave a justification for their assessment in an open text box.

DATA ANALYSES

Since there were different subsample sizes, and data were not normally distributed, differences and similarities in the ratings of the demands and constraints between sports were

assessed via a nonparametric Kruskal-Wallis test with sport (tennis, miniature golf, darts, and archery) as the between-subjects factor (Finch, 2005). Follow-up analyses were conducted via Mann-Whitney *U* tests with any two pairs of sports as the between-subjects factor. Dependent variables consisted of five items about sensory demands (visual, acoustic, tactile, kinaesthetic, balance) and nine items about constraints or situational pressures (precision, time, simultaneous coordination, gradual coordination, muscle selection, situation variability, situation complexity, physical stress, mental stress). The significance level was Bonferroni corrected (α = 0.05/14 = 0.0035). There were no missing values. Outliers (3.5%) were identified and corrected by replacing the value with the respective median.

Results

With respect to sensory demands, the descriptive statistics can be seen in Figure 1. The ratings of yips-susceptible actions did not differ between sports except for kinaesthetic demands, $H(4) = 18.98$, $p \leq .000$. Follow-up analyses (only the significant ones are illustrated) revealed that miniature golf was rated significantly lower in kinaesthetic demands than darts ($U = 130$, $p = .001$, $r = -.47$) and archery ($U = 31$, $p = .003$, $r = -.49$). Tennis was slightly rated lower than darts ($U = 39$, $p = .009$, $r = -.51$) and archery ($U = 9$, $p = .010$, $r = -.65$).

The descriptive statistics of the ratings regarding constraints are shown in Figure 2. The ratings of the yips-susceptible actions significantly differed only in time pressure, $H(4) = 20.16$, $p \leq .001$. According to the follow-up

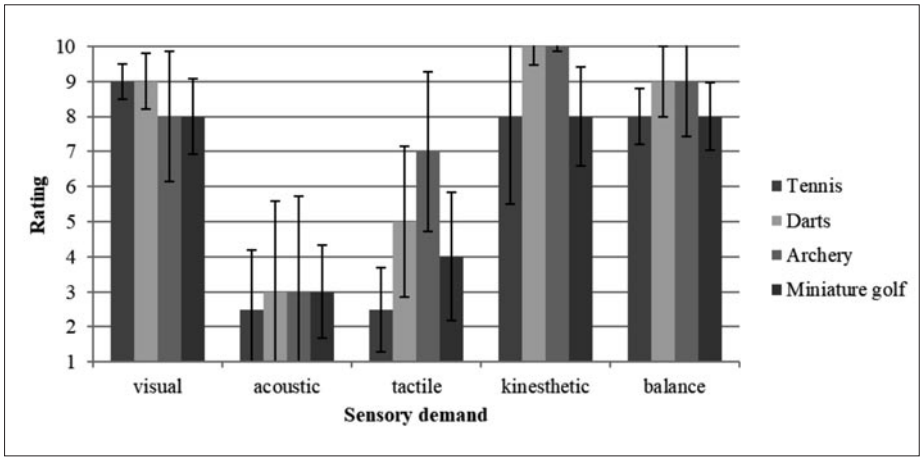

Fig. 1. - Ratings (median and average absolute deviation) of the sensory demands of yips-susceptical actions between sports.

analyses, the tennis action was rated significantly higher in time pressure than darts ($U = 24$, $p = .001$, $r = -.61$), archery ($U = 4{,}5$, $p = .001$, $r = -.73$), and miniature golf ($U = 21{,}5$, $p \leq .001$, $r = -.63$). But due to the imbalanced number of participating experts, the results must be interpreted with caution. Still, given the fact that in tennis the player is moving, aiming to hit the moving ball, which is a very demanding motor skill (see Gentile, 1987), results are as expected.

Discussion of Study 2

The aim of Study 2 was to explore the environmental and task-related features of those yips-vulnerable actions that were characterized in Study 1 by determining their sensory demands and constraints via expert ratings. No yips study has examined the environmental and task-related components before, although identifying common components of yips-vulnerable actions in different sports is essential to advance the understanding of the yips phenomenon. Common features of yips-vulnerable actions potentially indicate why some actions are more vulnerable to exhibiting yips symptoms than others. The results of the present study illustrate that the yips-vulnerable actions in tennis, miniature golf, darts, and archery share many common components with respect to sensory demands and constraints. They share similarly high visual and balance demands, low acoustic demands, and medium tactile demands. Kinaesthetic demands referring to sensory input from receptors in muscles and joints were generally rated high across sports, but lower in tennis and miniature golf compared to darts and archery, indicating a difference between those sports requiring a racket or club to move an object toward a

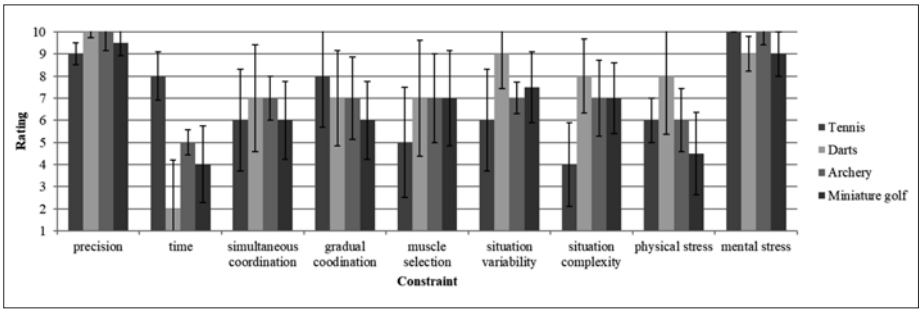

Fig. 2. - Ratings (median and average absolute deviation) of the constraints of yips-susceptical actions between sports.

target area and those that rely solely on the hands or a bow as a tool to release an object to hit a target. Athletes in so-called precision sports such as darts and archery may, therefore, require higher kinaesthetic abilities to produce goal-directed and precise actions.

The yips-vulnerable actions also share similar constraints. Precision pressure and mental stress, which have previously been identified as yips relevant (see Clarke et al., 2015), were rated high in all sports, compared to the other constraints. Regarding the vignettes, they were perceived as addressing mental pressure situations, which could also be interpreted as a manipulation check. Given the latest research comparing choking under pressure and yips (Clarke et al., 2020), vignettes might be a method to systematically identify task-related social factors. Moreover, simultaneous and gradual coordination, muscle selection, situation complexity, situation variability, and physical stress were all rated equally on a medium level. Whether this expert rating would also count for affected athletes stands to be examined in future research.

General Discussion

Within this article, two studies have been presented. The first study with $N = 1{,}248$ participants collected data on the prevalence and characteristics of yips, and affected athletes in tennis ($n = 22$), archery ($n = 119$), darts ($n = 115$), as well as miniature golf ($n = 108$). The second study aimed at outlining sensory demands and constraints of yips-vulnerable actions and motor skills by putting affected actions and motor skills in vignettes and asking $N = 66$ experts to rate them regarding sensory demands and constraints.

The reported prevalence rates were likely to be overestimated, as athletes with the yips might have been more motivated to participate in the study, as may have been the case in studies providing prevalence rates in yips-affected golfers by using self-reports (McDaniel et al., 1989; Smith et al., 2000). In general, self-reports are less reliable than objective parameters such as the observation of the movement disturbances or kinematic measurement of the movement variability in the specific task (Klämpfl et al., 2015). But still, the reported rates for all four sports are much higher than the one in musician's cramp, caused by focal dystonia (1%, Altenmüller, 2003). Therefore, there may be other mechanisms underlying the yips, such as the one proposed by Marquardt (2009) or Klämpfl et al. (2015), who suggested that the yips is a context-conditioned reaction. For example, one might have acquired and practiced specific techniques in the tennis forearm stroke, neg-

atively impacting the swing of the golf club. The yips might therefore occur partially due to the interference of previously learned skills in other sports (Klämpfl et al., 2015). Nonetheless, no significant results for sports biography were found. One reason for this might be the rather superficial approach to capturing sports biography (sports categorization). A more sensitive approach that enables a more differentiated view on the sports biography (i.e., retrieval of more specific sports categorizations or sports without categorization at all) might uncover the influence of sports biography and related motor experience on the yips in the investigated sports as well.

Regarding the symptomatic differences observed, tennis and miniature golf players both use a tool (club or racket) to manipulate a ball (either stable or in motion) towards a target (hole or opposing court). Affected players in tennis and miniature golf reported jerking more often than freezing. On the other hand, dart players and archers reported more freezing. Within their sport, the bow and arrow as well as the dart are not used as a tool to manipulate another object but there is direct skin contact on the hand releasing the arrow or dart. Consequently, more attention should be paid to the specific motor task that is carried out, similar to task specific focal dystonia in musicians (Altenmüller & Jabusch, 2010).

While e.g. darters or archers are confronted with stable environmental conditions during the skill execution, other affected sports like tennis demand to perform movements while being in motion. Golf, snooker and dart players do not change the body position during the movement. But athletes of yips-prone sports are often required to handle an instrument or tool to manipulate an object. These complex skills are highly demanding in motor control and motor execution in time and space

Shared characteristics in the examined sports, for example, spatial or temporal constraints, might lead to the development of the yips. These sports share the feature of being self-paced and highly demanding in precision. The yips prevalence rate in miniature golf was higher than in golf, potentially because miniature golf consists of only putting, the stroke most affected by the yips in golf (McDaniel et al., 1989). In contrast, the prevalence rate in the tennis sample was lower compared to the other rates. The explanation might be on the level of spatial or temporal constraints. In terms of spatial constraints, tennis has a lower precision demand than the other included sports, given that target areas on tennis courts are larger in comparison to, say, the hole in (miniature) golf or the target in archery. With respect to temporal constraints, the player–opponent interaction speeds up the game and limits self-paced actions (only the tennis serve) in contrast to the other included sports. These temporal constraints may prevent tennis players from reinvest-

ment, respectively from attempting to consciously control the automatized movement and therefore from the appearance of the psychologically-based yips, a chronic and severe form of choking (Bawden & Maynard, 2001; Klämpfl et al., 2013a, 2013b; Masters & Maxwell, 2008). It may also be possible, given self-reports, that tennis players have difficulties noticing a yips-like movement due to these temporal constraints.

In line with previous research (McDaniel et al., 1989), the affected participants in the current study reported experiencing the yips mainly in pressure situations, but not exclusively. The symptoms reportedly also occurred in training sessions or practice games, probably dependent on the level of conditioning of the yips appearance with the task situation (Klämpfl et al., 2015). The more the yips is connected to the sports action (i.e., the trigger is the anticipated ball contact or release of arrow/dart in the sensorimotor system of the affected athlete), the more likely it is that the yips also occurs in situations without obvious pressure. This is supported by previous reports on the disappearance of symptoms during action when the ball was removed (Marquardt, 2009; Mayer et al., 1999). Future research might also investigate the influence of yips type on the yips appearance in various situations. It is conceivable that the neurologically based yips occurs in more situations (i.e., training session) than the psychologically based yips, where pressure plays a key role. As outlined in the introduction, also in the definition by Mesagno and Hill (2013), pressure and consequently anxiety exacerbate the symptoms, making the appearance of the yips more obvious and impairing (Clarke et al., 2015; Ioannou et al., 2018; Marquardt, 2009; McDaniel et al., 1989). As already suggested by Lobinger et al. (2014) for the golf yips, further studies might systematically focus on identifying the conditioned stimulus (i.e.., ball, racket, swing) in yips-affected athletes to remove the yips as a conditioned response by introducing, for instance, the variability of practice as a form of systematic desensitization. By varying the context in the variability of practice, situations can be created, where the yips is not apparent while executing the normally affected sports action providing the affected athlete with an "aha experience" (Gerland, 2015). Subsequently, the varied situation might stepwise approach the normal situation as long as no yips is experienced.

As already assumed in Study 1, in Study 2, time pressure was rated higher in tennis than in the other sports, leading to possible complications for the self-detection of yips-similar phenomena in tennis. In contrast, the rest of the sports actions we investigated are self-paced and therefore simplify the detection of involuntary movements during task execution. Therefore, self-awareness of involuntary movements during the tennis forehand swing might be reduced, likely leading to an underestimation of the preva-

lence rate in Study 1. Alternatively, the time pressure in tennis may prevent the athlete from developing the yips due to reduced available time to interfere with the automated skill by consciously controlling? the swing, when considering the yips as a chronic and severe form of choking (Bawden & Maynard, 2001; Klämpfl et al., 2013a, 2013b; Masters & Maxwell, 2008).

The results of Study 2 indicate task-specific demands and constraints being relevant for the development of the yips, potentially supporting the idea of the yips being a context-conditioned reaction or dynamic stereotype. The results can be used as a first step to characterize extrinsic triggering factors in order to elucidate its causes, such as is available for musician's cramp or dystonia (Altenmüller & Jabusch, 2010). The musician's cramp model illustrates the interplay between predisposition (heredity and male gender) and intrinsic (i.e., personality and need for control) and extrinsic (i.e., social, temporal and spatial sensorimotor constraints) triggering factors in the manifestation of the cramp. The results of Study 2 suggest that extrinsic triggering factors in sports include common task-specific features such as sensory demands (high visual, low acoustic, medium tactile, high kinaesthetic, and high balance demands) and constraints (high precision pressure, high mental stress, and medium task complexity). Skill execution speed and available time after skill execution seem to be crucial for the evaluation of skill and yips detection. Future investigations should therefore further explore the environmental and task-related components of the yips or its extrinsic triggering factors to provide deeper insights into the underlying mechanisms of motor control in yips-affected motor actions and motor skills.

To conclude, the yips appears to occur in different types of sports which deserves more attention in research. The yips characteristics in the analysed sports can be used to both further investigate the phenomenon in each sport (i.e., collect qualitative data such as Bawden & Maynard (2001) for cricket or Philippen & Lobinger (2012) for golf) and assist the practitioner in identifying the yips phenomenon in athletes and subsequently introducing appropriate interventions that still have to be investigated. The analysis of sport-specific demands and constraints of the yips-prone actions revealed similarities between those actions. They might represent sensitive demands and constraints in motor control, which could be regarded as extrinsic triggering factors in the development of the yips. The environmental- and task-oriented approach and investigations integrating different yips-prone sports could potentially offer more insights into the causes of the yips, especially the assumption of the yips being a context-conditioned reaction or a dynamic stereotype. More research in this direction is needed to collect behavioural as well as kinematic and neuroscientific data (Lobinger et al., 2014). Also, the

perspective of analysing the vulnerability of the sports, and demanding motor actions instead of focusing on the vulnerability of affected athletes and their personality, could contribute to a deeper understanding of motor control in movement disturbances. This should lead to analysing motor programs, goal-directed actions and error processing in experimental settings, comparing yips-affected to non-affected athletes.

Acknowledgments

We would like to thank Anita Todd and Julia Eyre for English editing, Dr. Philipp Philippen, Sam Ireland and Katharina Möhlig for their support. We also thank the reviewers for their constructive feedback.

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Manuscript submitted October 2019. Accepted for publication July 2020.