Int. J. Sport Psychol., 2004; 35: 232-245

Dart performance as a function of facets of practice amongst professional and amateur men ana women players

LINDA J. DUFFY, BAHMAN BALUCH* and K. ANDERS ERICSSONt

* *Middlesex University, Great Britain*
t *Florida State University, USA*

A modified version of Ericsson, Krampe and Tesch-Romer's (1993) semi-structured interview schedule was employed to examine the relationship between gender, level of professional standing and facets of practice amongst men and women professional and amateur dart players. Players accumulated number of practice hours were classified at four periods duringtheir sporting history, namely; at years 3, 5, 10 and 15 in relation to engaging in playing league darts, playing for fun, playing in competitions, engaging in solitary deliberate practice and deliberate practice with a partner.

KEY WORDS: Dart.

The sample were 12 professional male dart players, mean age 41.7 years, (S.D = 6.27), 12 amateur level male dart players, mean age 41 years, (SD = 6.95), 6 professional female dart players, mean age 36.6 years, (SD = 6.15) and 6 amateur female level dart players, mean age 42 years, SD = 5.51. All participants were right-handed throwers. The main criteria for both male and female professional level players was to have attained international level of performance, at least one singles win at World level and five singles wins at International Open Championship level, and to be ranked in the top 16 of the World rankings for at least 75 % of their playing career. The criteria for both male and female Amateur was to have no attainment of international level of performance and to have played county darts for a duration of at least 15 years.

Address for correspondence: Dr. Linda]. Duffy, School of Health and Social Science, Middlesex University, Enfield, EN3 4SF, England. Email l.duffy@mdx.ac.uk.

The results showed superior dart performance being related to the accumulated number of hours engaged in various types of deliberate practice, independent of gender, or vary according to player's ratings of level of enjoyment, concentration or physical effort involved in practice. Implications of these findings are discussed.

Introduction

There is now a growing body of research examining factors such as implicit and explicit memory and its contribution to achieving professional level of expertise in various sporting activities (Ward & Williams, 2003, Zoudji & Thon, 2003). Whilst cognitive skills may be considered to be a significant factor in certain sports, such as soccer, they are comparatively less important to other sports, for example playing darts may be minimal (Duffy & Steinberg, 1996). Indeed, in a sport like darts the key contributing variable may be argued to be the quality and quantity of time spent practice and competitive performance rather purely cognitive skills such as memory (Duffy & Steinberg, 1996; Duffy, Baluch, & Ericsson, 2001).

The aim of the present study is to examine the extent to which Ericsson, Krampe and Tesch-Romer's, (1993) "Theory of Deliberate Practice" may account for dart performance amongst professional and amateur men and women players.

The theory of deliberate practice, as referred to by Ericsson et al. (1993), Ericsson and Charness (1994), Ericsson (1996) and Ericsson and Lehmann, (1996) was originally derived from two studies with violinists and pianists of varying levels of skill. Their approach was to employ semi-structured interviews incorporating an activity chart designed to record taxonomy of weekly activities and to estimate how many hours per week during each individual would engage in each of the activities throughout their careers. In particular one could have a break down of facets of practice as follows: practice with friends for fun, participation in official settings, practice for purposes of improving your performance (alone) and practice for purposes of improving performance with an instructor or partner.

Ericsson et al., (1993) used information derived from the semi-structured interviews and activity charts from the musicians and found evidence suggesting that the accumulated number of hours spent in activities designed purely to improve performance (deliberate practice) were a function of skill level for musicians. Ericsson et al.'s (1993) claim that experts, when compared to novices, do in fact engage in vast amounts of deliberate practice has

now been tested in several sporting activities requiring motor skills (e.g. soccer and field hockey; Helsen, Starkes, & Hodges, 1998; karate; Hodge and Deakin 1998: wrestling: Hodges and Starkes, 1996: figure skating: Starkes, Deakin, Allard, Hodges, & Hayes, 1996 and on long distance Canadian runners, Young and Salmela, 2002).

The present study extends the examination of the relationship between facets of practice and professional performance among British dart players (see below for a description of the sport of darts). The question pursued is whether there is a difference between professional and amateurs in their accumulated number of hours engaged in various facets of practice. Moreover, to examine if there is a difference between dart players ratings for practice as function of their skill level. In particular, the study examines the possibility that higher enjoyment ratings of practice by professionals might explain why they engage in more deliberate practice than less skilled players.

Also incorporated in the present study is the issue of possible difference due to gender on dart performance. There is now universal agreement that in tasks incorporating motor skills and, in particular dart throwing, there is a significant male superiority (e.g. Thomas & French, 1985, 1987; Feingold, 1993) although there is less consensus as to why such differences exist. Some researchers maintain that biological/genetic factors are influential predictors of throwing skills between males and females (e.g. Janowsky, Chavez, Bambi, Zamboni, & Orwoll, 1998). Others (e.g. McKenzie, Alcaraz, Sallis, & Faucette, 1998) argue that environmental factors are the more crucial contributors to gender differences in throwing. The interesting position, however, is that gender differences in dart throwing have been demonstrated for both naive (Thomas & French, 1985) and world professional dart players (Duffy, 2002). Indeed, in a recent study Duffy, Baluch and Ericsson (in prep) found that, when investigating performance between genders, the magnitude of differences in accuracy of target throwing is the same for both naive and professional dart players. In other words, the extent of differences (in millimetres) to which a naive female dart player deviates from her male counter part in accuracy of dart throwing is the same as the extent to which a professional female dart player deviates from the target compared to her male counter part. This suggests that whilst there has been significant improvement in accuracy of dart throwing for women as a result of professional dart playing, there nevertheless remains a gap between the genders which is comparable to the differences seen for naive participants. Furthermore, it was found that male professional players of lower levels of ranking scored significantly higher than women dart players of a higher ranking, even though physical factors namely; height and arm length were

controlled for (Duffy, et al, 2001). In the present study facets of dart practice and its relationship between genders will also be examined in an attempt to shed more light on gender differences in target/dart throwing.

FEATURES OF DART PLAYING

Darts is a non-contact target sport with universal playing rules. Championship matches are played over a pre-designated number of legs; each leg starts at 501 points and must be finished on a double segment. Each player throws in turn and deducts each score thrown until they have completed 501. The aim is to complete each leg before your opponent, i.e., by hitting the winning double first. In addition to recording wins and losses, level of performance can be measured using the single dart average which is calculated by dividing the original number of points required to complete a leg by the number of darts used by a player to complete the leg. For example, if a player takes 15 darts to complete a leg of 501 (501/15) the single dart average equals 33.40. Alternatively, if a player takes 16 darts to complete a leg of 501 their single dart average would be 31.31 which is less than 33.40. Due to the nature of the scoring system one can reliably assume that superior players will record a higher single dart average. Based on dart finishing averages and number of looses and wins dart players have been ranked in their professional standing and level of skill as intermediate, county level (amateur) and International (professional). Each dart player has an updated single dart average that is a reflection of their current standing. In the present study single dart averages has been used as a measure of player's performance (see also British Darts Organisation Year Book, 2002).

RESEARCH QUESTIONS

First, to examine the ratings given by players on various aspects of practice. In line with previous studies extending Ericsson et al's (1993) claim (e.g. Young & Salmela, 2002) one would expect that dart players ratings for enjoyable aspects of practice to be different from aspects requiring concentration and physical effort. This is because dart may be seen more as a fun game or a game played in social settings. Secondly, to examine if there would be a difference in accumulated number of hours engaged in various facets of practice in relation to levels of professional/amateur ranking. Moreover, whether the accumulated number of hours engaged in various facets of practice cor-

relates with actual dart performance, namely single dart averages (as explained above).

The final aim is to examine whether various facets of practice could also account for gender differences in dart performance and professional ranking. If the latter is true it does imply that at least one factor accounting for the male superiority effect in dart throwing is practice related. If, however, male and female dart players do not show any obvious differences on accumulated hours in facets of practice, it might imply that perhaps something of a more fundamental nature e.g. biological (Janowsky, et al, 1998) differences, play a key role.

Method

SAMPLE

The sample targeted in this study were 12 professional male dart players, mean age 41.7 years, (SD = 6.27), 12 amateur level male dart players, mean age 41 years, (SD = 6.95), 6 professional female dart players, mean age 36.6 years, (SD = 6.15) and 6 amateur level dart players, mean age 42 years, SD = 5.51. All participants were right-handed throwers. Handedness was determined on the basis of which hand the participants claimed to be their dominant hand for dart throwing. The criteria for both male and female Professional level players was as follows; i) to have attained International level of performance, ii) to have professional status recognised by the sports governing body, iii) at least one singles win at World level and five singles wins at International Open Championship level, and iv) to be ranked in the top 16 of the World rankings for at least 75 % of their playing career. The criteria for both male and female Amateur level players was as follows; i) no attainment of International level of performance, ii) to have amateur status as recognised by the sports governing body and iii) to have played county darts for a duration of at least 15 years. Due to the strict nature of selection criteria for the group of professional level players it was difficult, if not impossible, to select more than 6 women dart players. This determined that 6 women amateur level players were selected to provide the appropriate match.

PROCEDURE

The data collection procedure for all four groups of dart players was identical and covered a span of three years from 1998 to 2001. All data was collected during personal interviews with the first author who is a former world champion dart player. Information was recorded and included up to the end of the 1998 dart playing season, hence ensuring the same finishing point of data collection for all participants. Appointments were made with each participant and information regarding the nature and purpose of the impending interview was given to the participant by the author. This enabled each participant to gather relevant information regarding their dart playing careers and gave them a timeframe whereby they could best recall

the timing and nature of activities in which they had engaged during this period. The framework of the interview was similar to that employed by Ericsson et al., (1993) in their interviews with musicians.

MATERIALS

The main materials for the present study consisted of a rating sheet for practice and an activity chart. The subjects were asked to rate using a scale of 0 - 10, where 0 was low, 5 was average and 10 was high as to how much they considered practice to be enjoyable, how much it requires concentration and how much physical effort is required.

The activity chart was designed to enable each participant to record the weekly number of hours spent in engaging in those activities most relevant to dart playing performance. The activity chart was similar to the one used by Ericsson et al., (1993) but was modified to incorporate activities related to dart players. The activities listed were as follows: Playing in competitions, playing for fun, playing in a league, total deliberate practiced), solitary practice and practice with a partner (a copy is available from the first author).

Results

RATINGS AND PRACTICE

Means and standard deviations for the rating of three aspects of practice, namely physical effort, concentration and enjoyable for men and women dart players across two levels of skill are shown in Table I.

As can be seen in the above table there does not seem to be significant differences between participants in their rating of various aspects of practice i.e. physical, concentration and enjoyable. Formal analysis of the data by way of Multivariate Analysis of Variance (MANOVA). Pillais criterion indicated no significant main effect for level of skill (i.e. professional vs amateur) $F(3,30) = 1.59$, gender $F(3,30) = .38$, and no significant interaction, $F(3,30) = .99$, NS,

TABLE I

Means, With Corresponding Standard Deviations in Brackets, for the Ranking of Three Aspects of Practice, Namely Physical, Concentration and Enjoyable for Men and Women Dart Players Across Two Levels of Skill

	Professional men	Amateur men	Professional women	Amateur women
Physical	6.25 (2.34)	5.33 (2.81)	6.00(3.68)	7.17 (2.48)
Concentration	8.75(1.54)	6.33 (3.23)	8.00 (2.52)	8.17 (1.60)
Enjoyable	5.67 (2.57)	7.17 (3.43)	6.33 (4.03)	8.17 (2.23)

(*)Total deliberate practice is solitary practice and practice with a partner added together.

RESULTS OF ACTIVITY CHART

For clarity the results of the activity chart are presented separately in two tables. Table II includes the facets of practice related to competitions, playing for fun and playing in a league. Table III presents facets of practice related to total deliberate practice, solitary practice and practice with a partner.

Each facet of practice was analysed separately in relation to gender, professional ranking (professional, amateur) and in four distinctive years of the players career namely (3,5, 10 and 15) using Multivariate Analysis of Variance (MANOVA). Pillais Criterion was also employed as there were unequal groups (men vs women). Post-hoc analysis was also employed by way of Roy-Bargman step down F-tests (applying Bonferroni correction) as this method addresses the problem of dependent variables which are correlated. This is done by a method analogous to the testing of several Independent Variables in Multiple Regression via Hierarchical Analysis. The Highest priority

TABLE II
Mean Accumulated Number of Hours Engaged in flaying in Competitions, Playing for Fun, and Playing League Darts, with Corresponding Standard Deviations in Brackets, at Year 3, Year 5, Year 10 and Year 15 into the Careers of Men and Women Dart Players Across Two Levels of Skill Namely; Professional and Amateur

	Professional men	Amateur men	Professional women	Amateur women
Playing in	161.33	327.17	156.00	442.00
competition at year 3	(198.61)	(413.99)	(135.60)	(657.55)
Playing in	412.67	676.00	385.67	736.67
competition at year 5	(347.58)	(695.89)	(279.26)	(1047.48)
Playing in	1255.67	1614.17	1200.33	1317.33
competition at year 10	(536.63)	(1406.99)	(625.82)	(1217.14)
Playing in	2180.83	2545.83	1940.33	1627.67
competition at year 15	(808.64)	(1971.16)	(897.95)	(1002.04)
Playing for fun at year 3	1323.83	1018.33	1169.33	390.00
	(1554.38)	(486.52)	(577.92)	(274.67)
Playing for fun at year 5	2221.83	1737.67	1984.00	632.67
	(2705.13)	(810.59)	(932.73)	(474.79)
Playing for fun at year 10	3595.50	3202.33	3499.00	1170.00
	(4817.52)	(1320.82)	(1908.94)	(813.43)
Playing for fun at year	3944.33	4237.00	4105.00	1394.67
	(5030.85)	(1759.94)	(2344.71)	(1015.56)
Playing League at year 3	368.33	1003.17	832.00	962.00
	(283.48)	(548.35)	(518.96)	(845.38)
Playing League at year 5	788.67	1869.83	1456.00	1638.00
	(410.55)	(836.16)	(846.82)	(1364.25)
Playing League at year 10	1707.33	3852.33	3206.67	2981.33
	(843.69)	(1356.26)	(1603.98)	(2212.95)
Playing League at year 15	2383.33	6042.83	4402.67	3267.33
	(1240.46)	(1495.54)	(1732.67)	(2010.84)

Dependent Variable is tested in a Univariate Anova (using the appropriate adjustment for alpha) and the remaining Dependent Variables are tested in a series of ANCOVA's. Furthermore, Pearson's Product Moment Correlation Coefficients were used to examine the relationship between single dart averages with accumulated number of each facet of practice.

PLAYING IN COMPETITION

There were no significant main effects for number of hours engaged in playing in competitions for gender $F(4, 29) = .93$, or for level of skill (professional vs amateur) $F(4, 29) = .88$, and no significant interaction $F(4, 29) = .36$, all p values greater than 0.05.

There was also no significant relationship between the number of accumulated hours spent playing in competitions and single dart averages.

PLAYING FOR FUN

There were no significant main effects for number of hours engaged in playing for fun for gender $F(4, 29) = .75$ and for level of skill (professional vs amateur) $F(4, 29) = .75$, and there was no significant interaction $F(4, 29) = 1.81$ all p values greater than 0.05.

There was also no significant relationship between the number of accumulated hours spent playing darts for fun and single dart averages.

PLAYING IN A LEAGUE

There was a significant main effect for number of hours engaged in playing league for gender $F(4, 29) = 3.97$, $p < 0.05$ i.e. women have played more in league than men. There was also a significant interaction between gender and level of skill (professional vs amateur) $F(4,29) = 10.28$, $p < 0.0001$. However, there was no significant main effect for level of skill $F(4, 29) - 2.22$. p value greater than 0.05. This implying that professional men have played less in a league (and more in competition) than amateur men but the same is not true for women. Post-hoc analysis by way of Roy-Bargman stepdown F tests, applying Bonferroni correction, found significant interaction effects at year 15 into career $F(1,29) = 28.71$, $p < 0.0001$ and a significant effect for gender at year 15 into career $F(1,29) = 12.37$, $p < 0.001$.

There also was a significant negative relationship between the number of accumulated hours spent playing league darts and single dart averages at year 3, r = -.39, p < 0.05, at year 5, r = -.35, p <0.05 and year 10, r = -.35, p <0.05 into career. This negative interaction is expected as the higher a person has a dart average (e.g. professionals) the less he/she is likely to play in a league (more preference to play professionally).

TOTAL DELIBERATE PRACTICE

There was no significant main effect for number of hours engaged in total deliberate practice for gender F (4, 29) = 1.43, however, there was a significant main effect for level of skill (professional vs amateur) F (4, 29) = 5.36, p < 0.01. The interaction between gender and skill was not significant

TABLE III
Mean Accumulated Number of Hours Engaged in Total Deliberate Practice, Solitary Deliberate Practice, and Deliberate Practice with a Practice Partner, with Corresponding Standard Deviations in Brackets, at Year 3, Year 5, Year 10 and Year 15 Into the Careers of Men and Women Dart Players Across Two Levels of Skill Namely; Professional and Amateur

	Professional men	Amateur men	Professional women	Amateur women
Deliberate practice at year 3	1931.50 (1773.70)	663.00 (703.66)	1196.00 (1241.92)	372.67 (462.09)
Deliberate practice at year 5	3573.00 (2812.204)	1304.33 (1410.80)	2097.33 (1872.20)	702.00 (778.79)
Deliberate practice at year 10	8366.83 (4906.82)	2331.33 (2302.97)	5009.33 (2701.13)	1282.67 (1121.40)
Deliberate practice at year 15	12838.83 (7779.57)	3269.50 (2916.43)	6491.33 (3298.69)	1612.00 (1430.14)
Solitary practice at year 3	1574.00 (1759.74)	533.00 (642.30)	650.00 (601.72)	364.00 (467.43)
Solitary practice at year 5	2853.67 (2841.47)	1109.33 (1366.53)	1256.67 (850.91)	606.67 (759.03)
Solitary practice at yearlO	6265.17 (4589.86)	1958.67 (2197.17)	3076.67 (981.36)	1144.00 (1116.25)
Solitary practice at year 15	9419.83 (6532.48)	2684.50 (2754.87)	3934.67 (1118.50)	1456.00 (1451.59)
Practice with a partner at year 3	357.50 (534.47)	130.00 (236.22)	546.00 (652.59)	8.67 (21.23)
Practice with a partner at year 5	719.33 (786.38)	195.00 (386.68)	840.67 (1050.56)	95.33 (169.03)
Practice with a partner at year 10	2101.67 (2261.36)	372.67 (763.54)	1932.67 (1892.81)	138.67 (214.82)
Practice with a partner at year 15	3419.00 (3594.68)	585.00 (1101.78)	2556.67 (2488.28)	156.00 (243.90)

[1] Total deliberate practice is solitary practice and practice with a partner added together.

F (4, 29) = .44, p value greater than 0.05. Post-hoc analysis by way of Roy-Bargman stepdown F tests, applying Bonferroni correction, found a significant effect for level of skill with professional players reporting a higher number of hours engaged in deliberate practice at year 10 into their career F (1,30) = 12.21, $p < 0.001$. Pearson's Product Moment Correlation Coefficient revealed a significant positive relationship between single dart averages and the number of accumulated hours spent engaged in total practice (solitary deliberate practice and practice with a partner) at year 3, $r = .33$, $p < 0.05$, at year 5, $r = .38$, $p < 0.05$, year 10, $r = .48$, $p < 0.01$ and year 15 $r = .53$, $p < 0.001$ into career. Significantly, the relationship between single dart averages and total deliberate practice becomes stronger as career span progresses.

SOLITARY PRACTICE

There was no significant main effects for solitary practice for gender F (4, 29) = 1.23, and no significant interaction between skill and gender F (4, 29) = .715. However there was a significant main effect for level of skill (professional vs amateur) F (4, 29) = 4.21, $p < 0.01$. Post-hoc analysis by way of Roy-Bargman stepdown F tests, applying Bonferroni correction, found a significant effect for level of skill with professional players reporting a higher number of hours engaged in deliberate practice at year 10 into their career F (1, 30) = 12.32, $p < 0.001$. There was a significant positive relationship, by way of Pearson's Product Moment Correlation Coefficient, between single dart averages and the number of accumulated hours spent engaged in solitary deliberate practice at year 3, $r = .34$, $p < 0.05$, at year 5, $r = .38$, $p < 0.05$, year 10, $r = .47$, $p < 0.01$ and year 15, $r = .53$, $p < 0.001$ into career.

PRACTICE WITH A PARTNER

There was no significant main effect for deliberate practice with a partner for gender F (4, 29) = .543, and no significant main effects for level of skill (professional vs amateur) F (4, 29) = 2.40, and for interaction between level of skill and gender F (4, 29) = .798. p values greater than 0.05. There was no significant relationship between single dart averages and the number of accumulated hours engaged in deliberate practice with a partner.

Discussion

The key research questions were as follows:

- Is there a difference in professional and amateur men and women dart players ratings of practice as being enjoyable, effortful and requiring concen tration?

professional and amateur men and women dart players?

- Is there a relationship between accumulated facets of practice and sin gle dart averages (a measure of professional ranking)?

The ratings on various aspects of practice showed no significant differences. This was somewhat surprising as playing darts seems to be a sport whereby, for amateurs at least, the main aim is enjoyment and social interaction (Duffy, 2002). It thus appears that for men and women professional and amateur players there is no significant difference in how much they rate practice as enjoyable, or requiring physical effort or requiring concentration. Generally all ratings (0-10) were accumulated on the higher end of the ratings (above *5)* and this may have accounted for lack of significant within category differences. Similar trends in these ratings have also been found in previous research. For example; the requirement of high concentration for practice, was strongly supported by Martial artists Hodge and Deakin (1998), Musicians (Ericsson, et al., 1993), Figure Skaters (Starkes et al., 1996) Wrestlers (Hodges & Starkes, 1996) and Soccer and Field Hockey players, (Helsen, et al., 1998). More recent work by Young and Salmela (2002) reported that, according to runners, the most effortful activities were also viewed as the most enjoyable.

These findings have been viewed as contrary to the tenets of Ericsson et al's. (1993) theory (see Cote, Ericsson, & Beamer, 2004, for an extended discussion). Nevrtheless, the critical issue is whether the superior players would view solitary deliberate practice activities as more enjoyable than other players which might explain the professionals' more extensive engagement in deliberate practice. However, the current study did not find higher enjoyment ratings for the professionals compared to the amateurs, if anything, the amateurs' ratings tended to indicate higher enjoyment.

The engagement of the dart-related activities differed between groups for three types, namely playing in league darts, solitary practice and total deliberate practice. The latter two findings were in line with prior expectations namely; the more an individual engages in deliberate practice (particularly solitary practice) the more proficient their performance is likely to be. This

finding supports one of the main tenets of Ericsson et al.'s (1993) theory whereby expertise is acquired through a vast number of hours spent engaging in activities purely designed to improve performance, i.e., deliberate practice.

However, the fact that no gender differences or interactions were found for accumulated amount of practice was further evidence in line with Duffy, Baluch and Ericsson's (in prep) findings that the *magnitude* of gender differences in accuracy of dart throwing is the same for university students and professional dart players regardless of years of training. It does seem to be the case that explanations other than total amount of practice must account for gender differences in dart throwing (Duffy, 2002; Duffy, Baluch, & Ericsson, in prep).

Returning to the significant finding for playing league darts, these results indicated a reliable interaction with gender. For female dart players there was no difference between professionals and amateurs, but male amateurs reported having played more in this environment than male professionals from the beginning of their respective dart careers. In fact, accumulated number of hours playing league darts showed a reliable negative relationship with single dart averages. Indeed, mere engagement in many types of activities does not automatically improve performance (Ericsson, 1996, 2003), which may be, in part at least, an explanation for the lack of relation between dart performance and accumulated participation in several activities, such as playing in competitions, playing for fun or practising with a partner.

This lack of relations between participation and dart performance doesn't imply that the players, especially the professional players, do not gain any benefits from participating in certain activities. It is possible that professional and amateur players engage in these activities with different attitudes and level of concentration. For example, in the case of playing in competitions both professional and amateur level dart players would engage in this activity on a regular basis to compete for trophies and/or prize money. However, differences in the level of competition are crucial factors. For example; professional players would play in predominantly world ranked international competitions and fewer national, regional or local competitions, whereas, for amateur players, the reverse would be the case. In view of many of the professional players' attitudes towards competitive play, and its contribution to improving performance, this could be argued to have a significant effect on overall performance. However, it is also possible that participation in competitions might have an indirect influence. Preparations for upcoming competitions for professionals might increase the amount of quality deliberate practice and reviews of their competition performance might motivate professionals to engage in additional solitary practice to make cor-

rections and further improvements. Hence, deliberate practice might be the real cause of the better performance of the professionals. In relation to playing for fun, again it is not surprising that no significant differences were found between groups. Darts has its roots firmly embedded in a social context. Professional dart players are typically introduced to playing darts in an informal social environment, whilst professional performers in other domains, namely; music and most sports, may have their first point of contact with a particular activity in a specifically designed domain-related environment, i.e., a music school, gymnasium or an athletics track. Therefore, professional dart players spend several years, prior to becoming professional, playing darts within a 'social type' framework. Arguably this could go someway towards explaining why there were no differences between groups for practising with a partner. When dart players decide to make a conscious effort to improve their performance beyond their current levels, their preferred method is to become isolated, thereby distancing themselves from the social context to engage in solitary deliberate practice.

In short, the present study revealed that the single major factor contributing to professional level dart playing performance is deliberate practice. Moreover, differences in the total amount of solitary practice were unable to explain the differences in dart performance for men and women. Future research will be necessary to identify the nature and locus of these gender based differences.

REFERENCES

British Darts Organisation Year Book. (2002). *British Darts Organisation, 2,* Pages Lane, Muswell Hill, London, N10 IPS.

Cote, J., Ericsson, K. A. & Beamer, M. (2004). Tracing the development of athletes using retrospective interview methods: A proposed interview and validation procedure for reported information, *journal of Applied Sport Psychology, 16(4).*

Duffy, L. J (2002). *Gender differences in dart throwing amongst professional dart players.* Doctoral dissertation, Middlesex University.

Duffy L. J., Baluch, B & Ericsson. *Gender differences in dart throwing: Evidence from world champion dart players and university students* (manuscript in preparation).

Duffy, L., Ericsson, K. A., & Baluch, B. (2001). The nature of gender differences in dart performance. In A. Papaioannou, M. Goudas and Y. Theodorakis (Eds.). *In the dawn of the new millenium: Proceedings of the International Society of Sport Psychology 10th World Congress of Sport Psychology,* Vol. 4, (pp. 339-340). Tessaloniki, Greece: Christodoulidi Publications (ISBN 960-7577-34-9).

Duffy, L.J., Steinberg, H. (1996) *Social Facilitation and Individual Performance - an investigation of dart players.* Paper presented at the British Psychological Society Sport and Exercise workshop in Brighton, April 1996.

Ericsson, K, A., Krampe, R. T. Tesch-Romer, C. (1993) The Role of Deliberate Practice in the Acquisition of Expert Performance. *Psychological Review, 100(3),* 363-406.

Ericsson, K. A. and Charness, N. (1994) Expert Performance: Its Structure and Acquisition. *American Psychologist, 49(8), 125-1 Al.*

Ericsson, K. A. (1996) The Acquisition of Expert Performance: An Introduction to Some of the Issues. In K. Anders Ericsson (Ed.), *The Road to Excellence: The Acquisition of Expert Performance in the Arts and Sciences, Sports and Games.* Lawrence Erlbaum Associates, New Jersey, USA.

Ericsson, K. A., Lehmann, A. C. (1996). Expert and exceptional performance: Evidence on maximal adaptations on task constraints. *Annual Review of Psychology, 47,* 273-305.

Feingold, A. (1993) Cognitive Gender Differences: A Developmental Perspective. *Sex Roles. 29(1/2),* 91 - 112.

Helsen, W. F; Starkes, J. L., Hodges, N. J. (1998) Team sports and the theory of deliberate practice. *Journal of Sport and Exercise Psychology. 20(1),* 12-34.

Hodge, T, Deakin, J. M. (1998) Deliberate Practice and Expertise in the Martial Arts: The Role of Context in Motor Recall. *Journal of Sport and Exercise Psychology. 20,* 260-279.

Hodges, N. J., Starkes, J. L. (1996) Wrestling with the Nature of Expertise: A Sport Specific Test of Ericsson, Krampe and Tesch-Romer's (1993) Theory of Deliberate Practice. *International Journal of Sport Psychology. 27,* 400-424.

Janowsky, J .S, Chavez, B, Zamboni, B. D, & Orwoll, E. (1998) The cognitive neuropsychology of sex hormones in men and women. *Developmental Neuropsychology. 14(2-3),* 421-440.

McKenzie, T. L, Alcaraz, J. E; Sallis J. F, & Faucette, F. N. (1998) Effects of a physical education program on children's manipulative skills. *Journal of Teaching in Physical Education, 17(3),* 327-341.

Starkes, J.L., Deakin, J, M, Allard, F, Hodges, N. J., & Hayes, A. (1996) Deliberate Practice in Sports: What Is It Anyway. In K. Anders Ericsson (Ed.) *The Road to Excellence: The Acquisition of Expert Performance in the Arts and Sciences, Sports and Games.* Lawrence Erlbaum Associates, New Jersey, USA.

Thomas, J. R., French, K. E. (1985) Gender differences across age in motor performance: A meta-analysis. *Psychological Bulletin, 98,* 260-282.

Thomas, J. R. & French, K. E. (1987) References for motor tasks - Gender differences across age in motor performance: A meta-analysis. *Perceptual and Motor Skills, 64,* 503-506.

Young, B. W, & Salmela, J. H (2002). Perceptions of training and deliberate practice of middle distance runners. *International Journal Sport Psychology, 33,* 167-181

Ward, P, & Williams, A, M (2003). Perceptual and cognitive skill development in Soccer. The multidimensional nature of expert performance. *Journal of Sport and Exercise Psychology, 25 (1),* 93-111.

Zoudi, B, & Thon, B (2003). Expertise and implicit memory. Differential repetition priming effects on decision making in experienced and in experienced Soccer players. *International Journal of Sport Psychology, 34 (3)* 189-207.

Accepted for publication August 2004.