Investment patterns in the careers of elite athletes in East and West Germany

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Abstract: Some components of the former GDR sport were conserved or relaunched in East Germany after German reunification. They exhibited large costs, but not equivalent outcomes. This study assessed the effectiveness vs. efficiency orientation of the investment patterns in individual athletic careers one decade after reunification based on questionnaires from 695 national squad members. The Eastern athletes specialised earlier in one sport, participated less in other sports, performed much more specialised training during youth and adulthood, and used athlete services more intensively. They attained greater early success during youth, but not greater senior success. Characteristics of the training career and athlete support did not distinguish more and less successful Eastern athletes. Among Western athletes, more successful careers were characterised by a larger variability of involvement in various sports and a rather decelerated athletic development during youth. The economic inefficiency at the collective level of many sport organisations is apparently mirrored in lower efficiency of investment at the individual level of Eastern athletic careers. In contrast, Western world-class careers were characterised by a stronger orientation towards efficiency. The findings are discussed with regard to path dependence and functionality at the individual and collective level.

Keywords: high performance, training, social structure, effectiveness, efficiency

Introduction

Developing international success in high-performance sports requires the investment of voluminous time and other resources over many years (e.g. effort, the athlete’s body, equipment, facilities, personnel, money) (Güllich & Emrich, 2012a; b). The investment patterns leading to outstanding success remain, however, a subject of debate in the international literature (cf. Güllich & Emrich, 2012a; Vaeyens, Güllich, Warr, & Philippaert, 2009; for reviews). There is uncertainty about the question how much total time to spend on sport during which age periods and on which sporting activities, e.g. physical game play, exercise, competitions, in one sport or in diverse sports (Côté, Baker, & Abernethy, 2007; Güllich & Emrich, 2012a).

The present study evaluates the patterns of time investment in athletic careers in Eastern and Western Germany one decade after the German reunification. First, we outline the role of time and of decisions about the allocation of time from an economic perspective, and we describe relevant characteristics of the sport systems...
in West Germany and in former GDR. We then specify the problem and describe the study methods. A comparison between East and West German athletes is provided with respect to volume and degree of specialisation of their athletic training, involvement in athlete support programmes, and their achieved senior success. Finally, we discuss costs and outputs of individual investment patterns with reference to differences in path-dependent social structures in the sport systems in both regions, and implications for future research are reflected.

Economy of the allocation of time in the athletic career

*Time* is essentially considered as a critical input resource in the athletic career and time is principally *scarce*. The total time period for one’s athletic career is limited and other pursued utilities also require time, e.g. meals, sleep, education, leisure time with friends and family. The athlete cannot be playing volleyball and sleep or do chemistry homework or go out dancing at once. The decision for spending time on one activity implies the decision against using this time for other activities.¹

*Scarcity* of goods constitutes the ground for acting *economically* (Weber, 1980 [1921], 17, 199). Regarding successful athletic careers from an *economic perspective* requires the consideration not only of the attained output in terms of performance and success, but also of the *opportunity costs* generated by the time spent in sport, i.e. the lost benefit from the (not chosen) alternative way of spending this time (for example the lost utility the athlete could have gained, instead, from studying or leisure with friends). Thus, economic acting signifies decisions about competing ends (e.g. sporting success vs. good school marks) and scarce means (e.g. limited time and other resources) and the individual intention to maximise utilities is constituted of decisions about alternative activities in time (Becker, 1965, 1992).

*Economic effectiveness* expresses the degree of achievement of the set objectives – irrespective of the costs – while economic *efficiency* expresses the ratio between input and output (Drucker, 1963). *Efficiency* considers the *costs* of the invested resources and the value of the produced commodities (more strictly speaking, the value of the utilities gained from the consumption of the goods or services; Ferguson & Gould, 1975, 11), i.e. it considers the question whether a reallocation of resources would lead to greater utility. Improved efficiency is attained by either (1) greater output with equal input or with under-proportionally increased input or (2) equal output with reduced input of resource investment (Koopmans, 1975); strictly speaking, (3) decreased output with over-proportionally reduced input would also lead to a more positive ratio of output per input.

Drucker (1963) pointed out that increased efficiency does not necessarily facilitate achievement of set objectives. For example, production processes may be

¹ This applies equally within athletic training because the athlete cannot be playing table tennis and skiing at once, and also within one sport the amounts of time spent on exercising technical skills, speed, strength or endurance compete among each other.
highly efficient but may not produce what the market demands. He concluded that effectiveness requires “doing the right things” and efficiency requires “doing things right” (1963, 2) and essentially economic performance requires doing the right things right. Clearly, whenever production resources are limited, productive effectiveness is a function of efficiency.

According to the concept of expected utility (von Neumann & Morgenstern, 1944), the young athlete is supposed to take decisions on how much time to invest in sports and in other activities (widely) rationally based on the comparison between each alternative of different distributions of the use of time with respect to its future consequences in terms of subjectively expected utilities and opportunity costs. However, the individual’s decision is not completely based on (very complex, partly ambiguous, uncertain and unforeseeable) factual consequences, but he or she has to take decisions based on limited information, i.e. based on subjectively imagined future consequences (Vickers, 1994). For example, large periods of the athletic career are located within youth age and early adulthood, where increasing time demands from sport are paralleled by increasing time demands from education (school, vocational training, or academic study).² The commonalities between both realms are that (1) they constitute initial investments in expected long-term future utilities, and (2) they are characterised by some uncertainty of the relationship between time currently invested (means) and success attained in the future (ends). Athlete support systems in high-performance sports aim at expanding the athlete’s time investment in sports and at the same time at intensifying the invested time (sport-related extensive and intensive time economy; Sombart, 1987, 928-930).³ From an individual perspective, the question of interest is whether involvement in athlete support programmes leads to extended, unchanged, or reduced individual costs, and whether it leads to higher success with equal or under-proportionally increased individual investment.

We contend that athletes in the high-performance system strive to maximise their individual success and that thus, potential differences in individual investment

² Most athletes will not be able to make a living from sport-related incomes. This is significant with regard to the costs of time investment in sport, as theory of life-cycle economy suggests that earning capacities depend on time allocation on schooling, post-schooling investment in further education, on-job experience, and effort (Ghez & Becker, 1975; Mincer, 1975).

³ Expansion of the time in sports (extensive time economy): Provision of additional training opportunities, coaches, facilities, and equipment; improvement of the athlete’s load tolerability through medical and paramedical services; circumventing or buffering interferences in the training process, such as injuries; coordination between sport-related time demands and time demands projected on the athlete from parties outside of sport; reducing or compensating the athlete’s financial, educational, and health-related costs and risks. Increment of the amount of activity and of the performance gain per invested time unit (intensive time economy): Education and further education of coaches; new training methods; high-profile facilities and equipment, new technology; training monitoring and performance analysis; acceleration of the athlete’s recuperation through medical and paramedical interventions (Güllich & Emrich, 2006, 2012b).
patterns and/or in the relationship between invested time and attained success may be down to differences in the social structure of the sport system. The reunification of both German states in 1989/90 implied the unification of two very dissimilar sport systems embedded in different societal, political and economic systems.

Unification of two dissimilar sport systems

The West German autonomous sport system is organised decentrally in ~70,000 sport clubs. Most of these incorporate both mass sport and high-performance sport. Most sport offers are oriented towards competitive sports (Emrich, Pitsch, & Papathanasiou, 2001) and ~35% of the sport clubs report they are engaging in particular activities for the promotion of high-performance sports (Breuer & Haase, 2006; Emrich & Pitsch, 2001). However, there are no area-wide programmes for talent search. Talent search and talent promotion are principally based on individual private engagement and on individual initiatives of sport clubs and they are supplemented by subsidiary programmes of sport federations, sport aid foundations, Elite Sport Schools (ESS), and Olympic Support Centres (OSC). From an economic perspective, the “production” of sport for members in the clubs by its members is largely based on their own resources (fees, voluntary work). The stimuli for acting economically are similar to a market orientation in so far as reducing “production” costs allows the members either reduction of the required resources (work, facilities, fees) or production of more sport with equal resources for the members.

The former high-performance sport system of the GDR is often regarded as an example of a successful system as measured for example in medals attained in international championships and Olympic Games. The centralised structure was operated by the state and it was organised hierarchically “top-down” under the comprehensive steering primate of the Socialist Unity Party (SED) and its Central Committee (ZK; cf. Wonneberger, 1982). Striving for international recognition of the state, the SED had started as early as in the 1950s to decouple high-performance sport from mass sport (Reinartz, 1999) and to promote top-level sport in order to use it to internationally demonstrate the socialist superiority over the capitalistic Western system (“Diplomats in Tracksuits”, cf. Holzweißig, 1981; Krüger, 1988). This mobilised extensive governmental expenses and the high-performance sport system developed very high demands on resources and became extremely cost-intensive (e.g. Teichler, 1999a, 87ff., 92-93, 98-104). For example, in the 1980s, ~6,000 full-time coaches

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4 This also implies that high-performance sport is financed mainly based on “solidarity-based redistribution” of resources from older members to younger members and from mass sport to high-performance sport within the sport clubs (Emrich et al., 2001): Fees of members in mass sport and of older members, who pay higher fees than children and youth but whose sport programmes are less expensive, and their voluntary work are shifted to the competitive sport programmes of young members, who pay lower fees and whose sport programmes are more expensive.

5 Pierdzioch, Emrich and Klein (2012) showed that conventional determinants such as popula-
employed (compared to 120 in West Germany; de Marées, 1993; Schaible, 1988). The “Unitary System of Screening and Selection” (ESA) was extended to all primary schools nationwide and included more than 200,000 children annually. A total of ~13,000 selected athletes were concentrated in 31 sport clubs (SC, ASK) with 25 “Child and Youth Sport Schools” (KJS).

Contrast to a market economy, the relationship of costs and benefits was typically trivialised in the enterprises in a centrally directed economy, because the risk of bankruptcy did not exist (Eucken, 1959). In the absence of parameters of scarcity, enterprises simply attempted to produce as much as possible – irrespective of the costs. Published empirical studies assessing the economy of the GDR sport system are scarce; however, a few studies have indicated existing problems of efficiency. For example, 25% of the children recruited into “Child and Youth Sport Schools” were already de-selected again after their first year, which highlights the high fluctuation among the young members (Riecken, Wallberg, & Senf, 1993; cf. Wiese, 2012). Out of 20 female gymnasts in the fifth grade only one reached the tenth grade (Teichler, 1999a). Only ~4% of young wrestlers supported in “Child and Youth Sport Schools” ever reached a national senior championship (Kupper & Wallberg, 1978; further examples of problems of efficiency are listed by Teichler, 1999a, 88-104).

The unification signified that the East German sport system was going to be embedded in an open society and market-oriented economy. However, many officials in the West German sport administration had entertained a longing for a hierarchically structured and centrally governed sport system and they secretly admired the sport system of the GDR (Emrich, 1996; Hackfort, Emrich, & Papathanassiou, 1997). German reunification opened a unique historical “window of opportunity” to West German sport to draw on the personnel, infrastructure, training methods and (assumed) unique know-how of the GDR sport system. These were deemed significant factors for the success of GDR sport, and it was expected that these factors would lead to equivalent success in the unified Federal Republic. The conservation of the “Institute for the Research and Development of Sport Equipments” (FES) and of the “Research Institute of Physical Culture and Sport” (FKS) was determined in the unification treaty. In addition, large efforts were undertaken in the 1990s to conserve or relaunch further elements of the sport system of the former GDR under changed labels: eight East German Olympic Support Centres with 13 satellite branches were designed to constitute functional equivalents of the former sport clubs of the GDR. They took the regional direction and coordination of high performance sport, employed coaches,
provided training facilities as well as multidisciplinary athlete support services and they directed the cooperation between sport and the “Elite Sport Schools”. The 21 Eastern Elite Sport Schools were the follow-up institutions of the former “Child and Youth Sport Schools”.

The decision to conserve or relaunch components of the GDR system was taken politically, while a scientific evaluation of the applicability and of expectable effects of these components under the different societal and economic conditions of the unified Federal Republic of Germany were lacking. Yet it seems that some aspects of incompatibility were trivialised:

• Some of the “modes of production” were irreconcilable with the appreciation of personal freedom rights in an open society (for example governmental conscription of young athletes during early childhood and – as we know today – governmentally planned and organised doping; Spitzer, 2008; Teichler, 2008).

• Introducing elements of a hierarchically organised sport system embedded in a centrally planned economy into the completely unequal economic and societal conditions of a federal sport structure in a market-oriented economy implied expectable problems of transformation and adaptation.

• The belief in the superiority of the GDR sport system was apparently based on a truncated view of the system narrowed to its effectiveness, irrespective of the immense material and immaterial costs (Emrich & Pierdzioch, 2011).

Problem

Studies in the 1990s demonstrated that East German top officials still clearly evidenced the expectation that the sport system deserved virtually unlimited public resources (Emrich, 1996). Comparing each of sport clubs, Elite Sport Schools, and Olympic Support Centres in Eastern and Western Germany, the Eastern organisations were consistent in exhibiting a substantially lower cost-benefit relation: the sport clubs and Elite Sport Schools expended considerably larger (public) resources, but did not attain more success (Emrich, Fröhlich, Klein, & Pitsch, 2009; Güllich, Anthes, & Emrich, 2005), and the Eastern Olympic Support Centres delivered athlete services at much higher costs per delivered amount of service (Emrich & Pierdzioch, 2011; Emrich & Wadsack, 2005). These findings indicate a perpetuation of an economic pattern oriented towards effectiveness – while trivialising the costs – rather than efficiency.

The present study compares sport-related biographies of top-class athletes at the individual level in Eastern and Western Germany one decade after reunification. It examines

1. To what extent the athletic careers of Eastern athletes manifested aftermaths of the economic orientation of the GDR system and,

2. If yes, to what extent these led to greater success.
Methods

We revisited a data set from an athlete survey study that was initially collected for the purpose of evaluating athlete support programmes in Germany and we conducted complementary analyses for the present study. This study was approved by the German Federal Institute of Sport Science including ethical standards.

Study design

The study involved three steps of analysis: (1) East and West German athletes were compared with regard to the intensity, volume, continuity and specificity of their sporting practice during childhood, adolescence and adulthood, their involvement in athlete support programmes, and to their attained success. (2) We compared more and less successful senior performers within East and West Germany, respectively, and (3) examined whether the region of residence and attained success interacted with regard to characteristics of the sport-related biography.

Participants

A total of 695 members of the German national senior squads in all Olympic sports (above the junior age boundaries in the respective sports; age 24.4 ± 4.8 years (Mean ± SD), 59% male, 41% female) responded to a postal questionnaire in the autumns of 1999 and/or 2002 (response rate 49%). 35% of these squad members had been citizens of the GDR before 1990 and 65% citizens of the Federal Republic of Germany (FRG). Athletes who had migrated from East to West Germany (8%) or vice versa (5%) after 1990 were omitted from the present analysis. The sample was representative of the total population of national squad athletes in Olympic sports regarding the distribution of the region of residence, gender, squad level and type of sport (sports where performance is measured in centimetres, grams or seconds, i.e. cgs sports, game, martial arts, artistic composition and other sports; cf. Güllich & Emrich, 2012a).

This sample included 329 (97 Eastern and 232 Western) athletes who attained a top ten placing at Olympic Games and/or world championships (these are labelled

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7 This sample was part of a larger survey study including two trans-sectional recordings and a panel design. The data collection is described in detail by Güllich & Emrich (2012a). We submitted questionnaires via postal mailings to a random sample of n=2,000 drawn from the complete population of squad members at t₁ (fall 1999). A total of 776 athletes responded. The sample obtained at t₁ (fall 2002) consisted of all respondents from t₁ as well as an additional 1,232 athletes selected at random. We received responses from 1,034 athletes at t₂ including 244 respondents from t₁. Thus, data collection resulted in a total of 3,232 addressees and 1,566 participants (response rate, 49%). Eight cases were eliminated because of inconsistent responses. Respondents at t₁ and t₂ did not differ significantly in the sample criteria which enabled the pooling of all participants for a single sample (n=1,558). Only senior athletes above the junior age category in their respective sport were considered for the present study (n=695). Among 119 of these athletes who had responded at both times of recording, the data set included in this analysis was selected by random.
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world-class here, WC), of these, 207 were medallists (63 East, 144 West) including 91 Olympic and/or world champions (28 East, 63 West). All other participants had ranked among the top ten in national senior championships (national class, NC).

Measurement of selected aspects of the sport biography
The questionnaire included the retrospective reconstruction of the practice and competition biography of the athletes and their involvement in athlete support programmes. The respondents reported their age of commencement of training and of competitions in their respective domain sport (DS) and also in potentially practiced other sports (OS), the age of cessation of involvements in OS and complete specialisation in their DS, the age of their first participation in international championships, the number of performed training sessions within the age categories of \( \leq 10 \), 11-14, 15-18, 19-21, and \( \geq 22 \) years (in both their respective DS and in OS) and their highest success in each age category. They also provided information as to whether they used athlete support services in the disciplines of sport medicine, physiotherapy, nutritional counselling, sport psychology, career counselling and performance analysis (exercise science, biomechanics, physiology). The users of these services reported from what age and how frequently they utilised the services and whether they used them in an Olympic Support Centre and/or in other organisations.

The athletes recalled age-related “milestones” of their athletic career (0.82\( \leq r_t \leq 1.00 \)), attained levels of success during the various age categories (0.90\( \leq r_t \leq 0.99 \)) and numbers of performed training sessions within each age category (0.80\( \leq r_t \leq 0.98 \)) very reliably (Güllich & Emrich, 2012a).

Statistical analyses
Analyses were carried out in SPSS 20.0. Correlations between the attained success levels at different ages are expressed as Spearman’s coefficient. Group differences were analysed using \( \chi^2 \)-test and independent samples \( T \)-test or – in case of skewed data distribution – \( U \)-Test. Interactions between region of residence (West vs. East) and attained success (WC vs. NC) with regard to variables of the practice history and of the involvement in athlete support services were examined by 2x2 ANOVA. Effect sizes for differences in group means are expressed as Cohen’s \( d \) using pooled variance. All statistical hypothesis testing was two-tailed. The significance level was set at \( p < .05 \).

8 The mean duration of a training session was not reported as consistently across all age categories (0.45\( < r_t < 0.89 \)). No significant differences in the mean duration of a training session were revealed between Eastern and Western athletes or between success groups at any age. Consequently, training volumes were analysed based on the session frequency.
**Results**

Table 1: Age-related characteristics of the sport biography of world class and national class athletes from East and West Germany.

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>World Class</th>
<th>National Class</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>p</td>
<td>d</td>
</tr>
<tr>
<td><strong>East German Athletes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age-related “Milestones” [yr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start training in the DS</td>
<td>10.9 (3.5)</td>
<td>10.9 (3.7)</td>
<td>10.9 (3.3)</td>
<td>ns</td>
<td>-0.01</td>
</tr>
<tr>
<td>Start competing in the DS</td>
<td>12.2 (3.5)</td>
<td>12.2 (3.5)</td>
<td>12.2 (3.5)</td>
<td>ns</td>
<td>0.00</td>
</tr>
<tr>
<td>International debut</td>
<td>17.0 (2.6)</td>
<td>17.0 (2.9)</td>
<td>17.2 (2.1)</td>
<td>ns</td>
<td>-0.08</td>
</tr>
<tr>
<td>Complete specialisation</td>
<td>11.7 (4.6)</td>
<td>11.4 (4.3)</td>
<td>12.2 (5.0)</td>
<td>ns</td>
<td>-0.17</td>
</tr>
<tr>
<td>Start training in OS</td>
<td>9.0 (4.4)</td>
<td>9.2 (4.2)</td>
<td>8.7 (4.9)</td>
<td>ns</td>
<td>0.11</td>
</tr>
<tr>
<td>Duration in OS [yr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training</td>
<td>2.4 (4.3)</td>
<td>2.3 (4.2)</td>
<td>2.6 (4.5)</td>
<td>ns</td>
<td>-0.07</td>
</tr>
<tr>
<td>Competitions</td>
<td>1.7 (3.5)</td>
<td>1.7 (3.7)</td>
<td>1.8 (3.2)</td>
<td>ns</td>
<td>-0.03</td>
</tr>
<tr>
<td><strong>West German Athletes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age-related “Milestones” [yr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start training in the DS</td>
<td>11.1 (4.9)</td>
<td>11.8 (5.1)</td>
<td>9.8 (4.3)</td>
<td>**</td>
<td>0.43</td>
</tr>
<tr>
<td>Start competing in the DS</td>
<td>13.0 (4.7)</td>
<td>13.6 (4.6)</td>
<td>11.9 (4.6)</td>
<td>**</td>
<td>0.38</td>
</tr>
<tr>
<td>International debut</td>
<td>17.9 (4.1)</td>
<td>18.4 (3.8)</td>
<td>17.0 (5.5)</td>
<td>**</td>
<td>0.33</td>
</tr>
<tr>
<td>Complete specialisation</td>
<td>14.1 (6.6)</td>
<td>15.4 (6.8)</td>
<td>11.6 (5.5)</td>
<td>**</td>
<td>0.63</td>
</tr>
<tr>
<td>Start training in OS</td>
<td>9.1 (4.9)</td>
<td>9.3 (5.1)</td>
<td>8.4 (4.3)</td>
<td>ns</td>
<td>0.20</td>
</tr>
<tr>
<td>Duration in OS [yr]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training</td>
<td>5.3 (6.4)</td>
<td>6.5 (7.0)</td>
<td>2.9 (4.4)</td>
<td>**</td>
<td>0.62</td>
</tr>
<tr>
<td>Competitions</td>
<td>3.8 (5.8)</td>
<td>5.3 (6.6)</td>
<td>1.5 (3.1)</td>
<td>**</td>
<td>0.74</td>
</tr>
</tbody>
</table>

**Comparison East and West**

<table>
<thead>
<tr>
<th></th>
<th>East vs. West</th>
<th>Interaction Region • Success</th>
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</thead>
<tbody>
<tr>
<td>Age-related “Milestones” [yr]</td>
<td>p</td>
<td>d</td>
</tr>
<tr>
<td>Start training in the DS</td>
<td>ns</td>
<td>-0.11</td>
</tr>
<tr>
<td>Start competing in the DS</td>
<td>ns</td>
<td>-0.21</td>
</tr>
<tr>
<td>International debut</td>
<td>*</td>
<td>-0.33</td>
</tr>
<tr>
<td>Complete specialisation</td>
<td>**</td>
<td>-0.46</td>
</tr>
<tr>
<td>Start training in OS</td>
<td>ns</td>
<td>-0.04</td>
</tr>
<tr>
<td>Duration in OS [yr]</td>
<td>p</td>
<td>d</td>
</tr>
<tr>
<td>Training</td>
<td>**</td>
<td>-0.58</td>
</tr>
<tr>
<td>Competitions</td>
<td>**</td>
<td>-0.44</td>
</tr>
</tbody>
</table>

East 63% World Class, 37% National Class; West 66% World Class, 34% National Class

Mean values (± standard deviations). DS – domain sport, OS – other sports, d – Cohen’s d, * – p<.05, ** – p<.01, ns – not significant (p>.05)
Figure 1. Frequency of performed training sessions in the athlete’s respective domain sport (above) and in other sports (below) within defined age categories among East and West German senior world class (WC; East: light grey columns; West: white columns) and national class (NC; East: black columns; West: dark grey columns) athletes. East 63% World Class, 37% National Class; West 66% World Class, 34% National Class athletes. Mean values (standard deviations omitted for clarity). Note the different ordinate scales above and below. All significant differences between success groups are marked: * – $p < .05$; ** – $p < .01$. Effect sizes: West in Domain Sport -10 years Cohen’s $d = -0.31$; 11-14 years $d = -0.28$; In Other Sports -10 years $d = 0.24$; 11-14 years $d = 0.45$; 15-18 years $d = 0.43$; 19-21 years $d = 0.45$; 22-25 years $d = 0.45$. Differences between Eastern and Western athletes: In Domain Sport -10 years $p > .05$; all other age categories $p < .01$, 0.62 < $d < 0.90$; In Other Sports all age categories $p < .01$, 0.11 < $d < 0.39$. Interaction region • success: In Domain Sport -10 years $p > .05$; 11-14 years $p < .01$; all other age categories $p > .05$; In Other Sports all age categories $p > .05$.

The athletes from East and West Germany started to practice and to compete in their respective DS and in OS at comparable ages (Table 1). The total number of performed training sessions (DS + OS) was larger among the Eastern squad members during all age categories above 10 years (mean values 39% to 51% higher within the various age categories, all $p < .01$). This difference was down to larger amounts of practice only in their DS (Figure 1). The Eastern athletes increased practice in their
Investment patterns in the careers of elite athletes in East and West Germany

respective DS more rapidly from age eleven years on and performed on average 46% to 63% more training sessions across the age categories compared to their Western peers (0.62<d<0.90). A larger proportion of the West German respondents participated in training (65% vs. 42%, p<.01) and in competitions in OS (50% vs. 33%, p<.01). They practiced OS over more than twice as long periods as their East German counterparts (Table 1; d=0.58) and they performed on average 27% (≤10 years; d=0.11) to 348% (22-25 years; d=0.39) more training sessions outside their DS (Figure 1). Interestingly, as far as East German athletes participated in OS, the transition between the OS and DS implied an overlap of practice in these sports only in 35% of the cases (compared to 67% among the Western athletes; p<.01) and an overlap of competitions in 17% of the cases (compared to 61%; p<.01). In other words, in case of “lacking” exclusive specialisation in one sport, this was “corrected” more rapidly among the East German athletes.

All Eastern (100%) and 97% of the Western competitors used some type of athlete support service. 98% of the East German and 80% of the West German respondents were included in the services of the Olympic Support Centre (p<.01) and 42% vs. 57% (p<.01) used services provided by other organisations (East 2% vs. West 3% alternatively and 40% vs. 54% in addition to services of the Olympic Support Centre). The performers were recruited into the services of the Olympic Support Centre at 17.1 ± 4.9 (East) vs. 19.8 ± 4.7 years (West; p<.01, d = −0.59). Figure 2 displays the proportions of the respondents who used the various service disciplines. As far as significant group differences in the use of the services were revealed, these were utilised by larger proportions of the Eastern than of the Western athletes (general medicine, physiotherapy, career counselling, performance analysis in exercise science and biomechanics). The East German competitors also used the services in medicine and physiotherapy more intensively (p<.01, respectively, not displayed in the Figure). The share of athletes using services in organisations outside the Olympic Support Centres was larger in West Germany, while more Eastern athletes were involved in services in the Olympic Support Centre.

Neither among the East German nor among the West German athletes did their level of early success attained during the juvenile age categories contribute relevantly to explaining individual success differences during senior age (cleared success variance <4%, Table 2). 56% of the East German athletes already attained a top ten placing in junior world and/or European championships at age 18 years, as compared to 39% of their West German peers (p<.01). However, within the senior age boundaries, the proportions of WC performers did not differ significantly between the two regions (East: 63%, West: 66%, p>0.05).
Figure 2: Proportions of East and West German athletes who used athlete services in the Olympic Support Centre (OSC, grey) or in other organisations (white).

* – \( p < .05 \), ** – \( p < .01 \). Use of medical services in total (orthopaedics, internal medicine and/or general medicine): East 94%, West 80% \( (p < .01) \); use of performance assessment in total (medical, biomechanical, and/or exercise science): East 94%, West 88% \( (p < .05) \). Proportion of the users of the particular services in the OSC larger among Eastern athletes and use in other organisations outside the OSC larger in Western athletes: General medicine, physiotherapy, career counselling \( (p < .01 \), respectively) and sport psychology \( (p < .05) \).

No significant difference between the East German senior WC and NC competitors was revealed in any variable of their practice history (Table 1, Figure 1) or of their
involvement in athlete support services (all $p>.05$). The success groups only differed in so far as the WC performers were recruited into the Olympic Support Centre at an older age ($18.0 \pm 4.9$ vs. $16.2 \pm 4.2$ years, $p<.05$, $d=0.40$). Among the West German athletes, the WC and the NC athletes did not differ in any variable of the use of athlete support services either (all $p>.05$), and the WC athletes were also recruited into the Olympic Support Centre at a later age ($20.6 \pm 4.5$ vs. $18.5 \pm 4.7$ years; $p<.01$, $d=0.46$). However, these success groups differed significantly in their developmental practice structure (Table 1, Figure 1). The WC athletes were typified by a later commencement of training and of competitions in their respective DS and a smaller practice amount in this sport during childhood. A higher proportion of the WC competitors trained (73% vs. 50%, $p<.01$) and competed in various sports (58% vs. 38%, $p<.01$). They participated in other sports beyond their respective domain sport over longer periods (mean values in training over twice as long, $d=0.62$, and in competitions over three times as long as NC athletes, $d=0.74$), performed higher amounts of practice in OS during all age categories (69% to 480% more sessions across the various age categories; $0.24<d<0.45$), and they specialised exclusively in their respective DS at a later age ($d=0.63$; Table 1, Figure 1).

Table 2: Correlations between the attained success level within juvenile age categories and the greatest success attained at senior age among East and West German athletes.

<table>
<thead>
<tr>
<th>Juvenile Success</th>
<th>Senior Success</th>
<th>East Germany</th>
<th>West Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r_s$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤10 yr</td>
<td>0.05 $^m$</td>
<td>-0.07 $^m$</td>
<td></td>
</tr>
<tr>
<td>11-14 yr</td>
<td>-0.12 $^m$</td>
<td>-0.11 $^m$</td>
<td></td>
</tr>
<tr>
<td>15-18 yr</td>
<td>0.19*</td>
<td>0.16**</td>
<td></td>
</tr>
</tbody>
</table>

* $p<.05$, ** $p<.01$, $^m$ not significant ($p>.05$)

The interactions between region and success were significant with regard to the age of commencement of training and competitions and of complete specialisation in the DS, age of the international championship debut, the duration of involvement in training as well as in competitions in OS (Table 1), and the early intensity of training in the DS until age 14 years (Figure 1).

**Discussion**

This study addressed the comparison between senior squad members in Olympic sports from Eastern and Western Germany with regard to their developmental practice and competition history, the use of athlete support services, and the attained success. East German athletes were characterised by greater total amounts of specialised practice in their respective domain sport through youth and adulthood, earlier specialisation, earlier recruitment into an Olympic Support Centre, more use of athlete support services and greater early success during adolescence. However, neither regional group differed in the success level attained during senior age.
Table 3: Review of the comparison between East and West German athletes with regard to characteristics of their sport-related biography and to the attainment of world-class senior success. $o =$ no significant effect.

<table>
<thead>
<tr>
<th>Practice and Competitions in the Domain Sport</th>
<th>Comparison between Regions</th>
<th>Pattern mostly leading to World Class Success</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>East</td>
<td>West</td>
</tr>
<tr>
<td><strong>Young age of</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>start training</td>
<td>$o$</td>
<td>$o$</td>
</tr>
<tr>
<td>start competing</td>
<td>$o$</td>
<td>$o$</td>
</tr>
<tr>
<td>international debut</td>
<td>Earlier</td>
<td>Later</td>
</tr>
<tr>
<td>specialisation</td>
<td>Earlier</td>
<td>Later</td>
</tr>
<tr>
<td><strong>Practice intensity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in childhood</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>in adolescence</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>in adulthood</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td><strong>Success</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in childhood</td>
<td>$o$</td>
<td>$o$</td>
</tr>
<tr>
<td>in junior age</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>in senior age</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Practice and Competitions in Other Sports</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of training involvement</td>
<td>Shorter</td>
<td>Longer</td>
</tr>
<tr>
<td>competition involvement</td>
<td>Shorter</td>
<td>Longer</td>
</tr>
<tr>
<td><strong>Practice intensity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>in childhood</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td>in adolescence</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td>in adulthood</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td><strong>Athlete Support Services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age of recruitment</td>
<td>Earlier</td>
<td>Later</td>
</tr>
<tr>
<td>Intensity of services</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>Institution (OSC vs. others)</td>
<td>More OSC</td>
<td>More others</td>
</tr>
</tbody>
</table>

The use of the athlete support services did not contribute to explaining success differences within either East or West Germany.\(^9\) None of the characteristics of the developmental training structure differentiated between senior WC and NC success within East Germany.\(^10\) The athletic careers of Western athletes in their respective DS were mostly relatively decelerated compared to Eastern careers. Within West Germany, the WC careers were even more decelerated compared to those with NC success. The WC performers were characterised by a later start of training and of competitions and a lower practice amount in their respective DS through childhood, a later specialisation, and more practice and competitions in other sports performed over longer periods. As reviewed in Table 3, the developmental practice patterns leading

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\(^10\) To what extent the amount or type of training contributed to the success attainments in the former GDR sport system remains unstudied to date. However, it is conspicuous that a concept that was equally applied to male and female athletes led to much more success among the females and less success among the males.
to international senior success were inconsistent and partly contrary between the two regions. The pattern that mostly led to world-class success among Western performers generally did not among Eastern athletes, and the career pattern that led to WC success among Eastern athletes mostly did not in West Germany.

We are not aware of other published studies comparing investment patterns at the individual athlete level between different sport systems. However, the present results correspond closely to findings at the organisational level, indicating that East German sport clubs, Elite Sport Schools and Olympic Support Centres were consistently characterised by extended costs, but not larger output (Emrich, Fröhlich, Klein et al., 2009; Emrich & Pierdzioch, 2011; Emrich & Wadsack, 2005; Flatau & Emrich, 2011; Güllich et al., 2005). The results signify that the *individual* investment patterns one decade after the breakdown of the GDR obviously reflected persistent differences between the economic orientations in Eastern and Western Germany. More specifically, the East German data demonstrate manifestations of aftermaths of the predominant orientation towards effectiveness (and less efficiency) settled in the centrally planned economy of the GDR, which diffused into the training structure in sports. Western athletes achieved equal success with less investment. I.e., the Eastern sport system and its training methodology and athlete support system have turned out as less efficient and were characterised by greater wastage of resources during the 1990s.

**Individual and collective economic orientations in West and East Germany**

In an open society (including its subsidiary sport system), the larger scope for (largely) self-determined decisions about the allocation of one’s time implies greater individual responsibility (athlete, parents) for the decision about the allocation of one’s time (with respect to open societies, cf. generally Popper, 1957). The career in high-performance sports is a widely private enterprise and a profoundly individual project. The risks of extensive investments (time, also the athlete’s body, health, money) are largely carried by the individual and one pursues to consider and balance the individual costs, risks and benefits carefully. Correspondingly, the successful investment pattern of most West German world-class athletes was characterised by:

1. Reduced total costs (less practice time, less use of athlete support services)
2. A larger individual contribution in the total investment and longer periods of development according to (predominantly) individual orientations (later recruitment into support programmes)
3. Larger investment in the matching process between the athlete and the sport as well as wider distribution of the investment risk based on the exploration of diverse domains (sampling various sports)
4. A larger proportion of initial investment (later first success; see Table 3)
These manifest a rather resource-preserving pattern leading to a longer delay of reward, but also to buffered costs and risks of investment and eventually to higher benefits in terms of international senior success (cf. Güllich & Emrich, 2012a).

In contrast, the career in high-performance sport in the GDR system was part of a public enterprise and the centralised and tightly controlled GDR sport system implied large delegation of individual decision autonomy to the state. Some societal characteristics were particularly “favourable” for the motivational system and for the individual disposition to accept very high individual costs. The general societal scarcity of travel possibilities, educational and professional opportunities and leisure opportunities was contrasted by substantial privileges for athletes, coaches and officials regarding educational and occupational prospects, nutrition, travelling to Western countries, and a factual status of a “public servant in sport” including ample material safeguarding mechanisms. However, most of these extrinsic incentives decreased in the 1990s – the restriction of travel possibilities ceased, the inclusion in the sport system no longer implied nutritional or educational privileges, and the scarcity of educational and leisure opportunities gradually declined – and the question is raised why the corporative actors continued attempting to perpetuate the organisational structures and economic orientations irrespective of the changed societal and economic conditions. We contend that this behaviour can – partly – be understood as a kind of path dependence (Arthur, 1990; David, 1985, 1994): The set of decisions we face is limited by decisions we took in the past; having received positive feedback (increased utility) to a chosen path (a way of using and allocating resources) in the past, we sometimes tend to maintain this path “locked in”, even when conditions have changed and the perpetuation of the chosen path is no longer the best solution. So we see constant behaviour under changing conditions and therefore oftentimes inappropriate means for realising objectives.

Most coaches and officials working in East Germany in the 1990s had been socialised and educated in the GDR. They may simply not have got to know alternative ways of developing success. In addition, the eminent number of full-time coaches and other job positions in the athlete support programmes of Elite Sport Schools and Olympic Support Centres as well as facilities in these centralised organisations were existent and required justification by occupying them through extensive training and support programmes and their administration (Emrich, 1996; Emrich & Wadsack, 2005; Güllich, 2005). Giving them up would have signified extensive sunk costs (education and further education of coaches, know-how, building of facilities; cf. Arkes & Blumer, 1985) and people often tend to avoid sunk costs even if this leads to increased follow-up costs (seeking for the glory of the past; Kelly, 2004). Also, during a period of destabilisation after the breakdown of the societal and economic system of the GDR, the belief in the rationality of the GDR sport system – having been the only realm in which the GDR had been able to compete internationally – and
in its methods as well as cementing the “community of faith” based on the common ideology among the actors in East German sport may have helped alleviate the collective perception of unsteadiness and uncertainty.

The observations in East German sports correspond to the second and third “degree” of path dependence as described by Liebowitz & Margolis (1995, 206ff.). The decision to conserve the “Institute for the Research and Development of Sport Equipment” and the “Research Institute for Physical Culture and Sports” was determined already in the unification treaty, and information exchange about conditions and development of successful athletic careers in East and West Germany may have needed some years after unification (second degree). However, the persistence of some of the organisational structures and of the economic orientations of the GDR system was even politically rewarded and reinforced during the 1990s and beyond (third degree; see examples below). This becomes comprehensible if we regard the functionality of the organisations’ behaviour not only narrowed to the function of “producing” success, but more differentiated, namely considering that extending costs may have been functional for Eastern sport organisations. Constituting extensive costs and risks on the part of the individual athlete (expanding the time for training and associated costs for equipment, passages, coordination with education, as well as educational and health-related risks) was conducive for the organisations in legitimising the requirement of numerous full-time coaches and further supporting and administering positions in relatively large organisations together with respective massive finances.

Interestingly, this was eagerly facilitated by political convergence in various ways:

- The economic efficiency of the athlete services delivered by the Olympic Support Centres correlated with their governmental funding in the following way (Emrich & Pierdzioch, 2011; Emrich & Wadsack, 2005): Among the Eastern Olympic Support Centres, the funding was the higher the more inefficient their delivery of services. In contrast, this correlation was vice versa in West Germany.

- The relaunching of the Elite Sport Schools as the follow-up organisation of the “Child and Youth Sport Schools” (KJS) was justified by the contention that expanded training volumes were required during childhood and youth (DSB, 1997).

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11 First degree: A decision is path dependent, but other paths are taken into account and the chosen path is not considered less efficient than changing to another path. Second degree: Decisions are based on limited information. Having access to relevant information later, one recognises that alternative paths would have been more efficient. These decisions are, however, not considered “inefficient” because relevant information was unknowable at the time of decision. Third degree: Path dependence leads to inefficiency while relevant information about changed circumstances and efficient solutions is available – i.e. inefficiency is remediable – but these are not obtained.

12 Hence, it is uncertain to which extent the perpetuation of economic inefficiency constitutes path dependence with regard to the target of “producing” success or rather a replacement of the goal variable of success by the goal variable of facilitating external resource supply.
Some Eastern regional federations started to relaunch the former “Framework Training Concepts” (RTK) of the GDR as early as in 1994. These central collective prescriptions of age specific training volumes and their demonstrative public communication correlated positively with more positive evaluation of the federations and higher public funding (DSB, 1997). The quantitative prescriptions were also rapidly incorporated into the National Concept for Youth High-Performance Sport of the umbrella organisation (DSB, 1997).

The communicative neutralisation of the deficient economic efficiency of many East German sport organisations together with the effective maintenance of the belief in the rationality myth (cf. Meyer & Rowan, 1977) of their “production” of success obviously fell on the right ground in their umbrella organisation and in the political sport administration. The survival of the old patterns was apparently possible as long as no change was enforced through budget restrictions (cf. Emrich & Pierdzioch, 2011).

Practical implications
The present findings suggest that organisational structures and training patterns from a centrally planned economy do not exhibit the expected benefits in terms of success, but only increased individual and social costs, when embedded in the societal and economic conditions of an open society. The increased resources supplied to the athlete from the athlete support system lead, in turn, to greater individual resource expenditure on the athlete’s part. This signifies that parts of the expended resources at both, the individual and collective level could be used for other individual and collective utilities while achieving equal individual and collective success; i.e. a reallocation of resources would lead to greater total utility. We deem these observations to be practically relevant in the light of numerous attempts at “blueprinting” components from former centralised Eastern sport systems in many current national sport systems (e.g. centralisation in high-performance centres, elite sport schools, youth high-performance sport academies etc.; cf. for example the description of Diggel, Burk, & Fahnner, 2006; Güllich, 2005; Radtke & Coalter, 2007; Röger, Rütten, & Ziemainz, 2006).

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13 Teichler (1999b, 300-305) documented how the perpetual expansion of the training volumes was governmentally ordered in as many as 19 decrees of the GDR politbureau and general secretariat in 1958 to 1989. This commission was succeeded in the 1990s by the follow-up organisation of the “Research Institute for Physical Culture and Sport”, the Institute of Applied Training Science (e.g. Martin, Rost, Krug, & Reiss, 1998; Pechtl, Ostrowski, & Klose, 1993; Rost & Martin, 1997; Stark, 1997; for an empirical testing and critical discussion of the validity of these prescriptions, cf. Güllich & Emrich, 2006; Güllich, Pitsch, Papanasissou, & Emrich, 2000; the federations’ prescription for childhood and youth age turned out to be on average 20 to over 60% above empirical data from world class athletes, and a closer individual correspondence with the prescriptions did not lead to higher success).
Methodological considerations and implications for future research

This study does have limitations. We have explored *aggregated* time investments over defined age periods with regard to the dependent variable of the *highest* individual senior success achieved. The group comparisons reflect “only” majorities and minorities within groups. There were considerable intra-group variations in training volume and specialisation, and each combination of high or low training volume, high or low degree of specialisation, extensive or little or no use of athlete services, and high or low success was existent within each group, which highlights the limitations of group comparisons (cf. Güllich & Emrich, 2012a). In addition, time investment in sport presumably varies intra-individually in the course of the career and of the singular season based on periodisation concepts of the training process, but also because of varying demands external to sport, e.g. exams at school or university etc. Likewise, success and associated utilities presumably vary in the course of the career.

While we believe that these limitations do not question the meaningfulness of the present results, further scrutiny of the problem should address the ensuing questions:

1. Which total investment volume expended over which total time period is distributed to which intensities and frequencies during which age periods and with which variation during these periods? Which total utilities over which total time period are distributed to which intensities and frequencies during which age periods and with which variation during these periods? Which total opportunity costs over which total time period are distributed to which intensities and frequencies during which age periods and with which variation during these periods? These can be approached appropriately using life cycle models (Ghez & Becker, 1975; Mincer, 1975). Thereby, utilities from sporting involvement other than success (e.g. immediate rewards inherent to the sporting activity, such as joy and having a good time with friends etc.), potential effects of a successful sport involvement on utilities outside of sport (e.g. effects of publicity or positive image on job opportunities), as well as the existence and amount of opportunities alternative to sport and the value of their utilities need to be considered.

2. How does the individual athlete take decisions about investment, based on which available information and individual preferences during which age periods? To which extent are the decisions influenced by the sport organisation, the family and peers?

References


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