Development of a biographical mapping software *(bioMAP)* for the analysis of biopsychosocial health trajectories using the example of young top athletes – a brief report

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1. Introduction

Young competitive athletes move in a social area in which "the efficient body" (Bette & Schimank, 1995, p. 44) is the central prerequisite for success. Physical performance is in turn closely associated with health. Ensuring the performance and health of young athletes necessitates more than just age-appropriate, individualized training and medical care. Adolescent athletes are in a "particularly intensive" (Hurrelmann & Quenzel, 2012, p. 91) and vulnerable phase of their development. They not only have to cope with the demands of elite-level sport, but also with the physical, psychological and social developmental tasks typical of their age (Havighurst, 1953).
The complexity of developmental processes and the individuality of each athlete make highly individualized training management necessary. This poses a great challenge for coaches, not least because there is a lack of appropriate instruments for assessing and controlling the not-directly sport-related aspects of individual development. So far, existing instruments for the individualized control of performance development have primarily been based on medical and technological findings and algorithms.
In team sports, individualized training management represents a particularly difficult challenge. Teams of coaches are in touch with their athletes only temporarily and, due to a variety of tasks in day-to-day business and time restrictions, hardly have the opportunity to keep an eye not only on performance-related aspects but also on their athletes' development in terms of the life circumstances, health, and personality. As the results of the WVL project Individualized Health Management in Young Competitive Sports (GOAL) (Thiel et al., 2011) show, these factors (ranging from psychosocial stability to the adaptation of the individual's life world to everyday training practice) have a considerable influence on the athletic performance development of individual athletes (Thiel et al., 2015).
In order to fill the gap of instruments for individualized training management in the psychosocial field, biographical analyses are useful, as they provide information about developmental experiences of athletes. They can explain how career- and development-relevant life events are perceived and processed individually. Additionally, biographical assessments offer athletes the opportunity to express their subjective feelings.
Methodologically, biographical analyses attempt to capture the influence of critical life events on individual development; they often use the technique of narrative interviews. Despite the undeniable advantages of narrative interviews, this analytical technique is suitable only to a limited extent for elite-level everyday sports practice. This is partly because this data collection method is very time-consuming (both with regard to the assessment itself and the analysis of what has been said), and partly because its success depends largely on the interviewees' ability to retrieve, reflect on, and, above all, verbalize their own experiences.
In view of these disadvantages of narrative interviews, we have developed a new analytical technique, which we called the "biographical mapping" approach. This method enables the reconstruction of biographies and makes them graphically and mathematically comprehensible at the same time. A first, very basic version of this instrument was developed in the BISp-funded project Gesundheit im Spitzensport [Health in elite sports] (Mayer, 2010; Thiel, Mayer & Digel, 2010). In the GOAL project (Schubring & Thiel, 2014a, 2014b; Thiel et al., 2011), this very basic version was developed into a multidimensional biographical mapping instrument. The multidimensional biographical mapping technique has already been successfully used in the GOAL project for the reconstruction of the development of growth and overload problems in adolescent athletes. The mapping method is ideal

for the monitoring of health because its graphic form makes it easier for athletes to communicate sensitive topics such as painful experiences and stigmatizing conditions, which are normally concealed or trivialized in the elite sports culture of risk (Nixon, 1992) (Schubring & Thiel, 2014a). In addition, biographical mappings allow the systematic comparison of self-assessments of one's own development in several development areas (sport, healthy living, health care, etc.). This makes it possible to identify:

- Systematic overloading at an early stage
- Critical moments in athletes' biographies
- Correlations between athletic performance and biopsychosocial health indicators

2. Method

2.1 Starting point

During the development of the software[1] for the analysis of developmental processes, it was necessary to implement the following basic functions, which had previously been carried out manually:

1. The open recording of subjectively significant life events and phases of the athlete's biography (e.g. sporting success, injury periods, nomination for teams, change of club, change of school, etc.) on an individualized time axis (x-axis). The life events and phases entered on the x-axis should remain visible during the entire analysis in order to provide the participants with reference points when they are asked to draw the developmental curves into the mapping. The software must also make it possible to add subjectively relevant life events and phases on the x-axis while drawing the curves.
2. The reconstruction of individual developmental processes in relation to different dimensions, e.g.:
    a. the subjectively experienced state of health,
    b. the athletic performance capability,
    c. the psychological stress of competition,
    d. the physical strain caused by the training etc.
3. The evaluation of the developmental curves. In this regard, the y-axis represents an intensity scale ranging from 0 to 10, with higher values expressing a higher degree of expression of the respective target variable. For example, on a scale of 0 to 10 a higher value represents a very good subjective state of health, a lower value a bad subjective state of health.
4. The independent drawing of the curves in order to avoid a reciprocal influence by already drawn curves. This means that each curve is drawn independently without previous curves being visible.

The digitalized graphic (Fig. 1) from a biographical mapping of the GOAL project, which was originally carried out by hand, illustrates the entry of relevant life events and periods as well as the visualization of developmental processes in relation to different dimensions.

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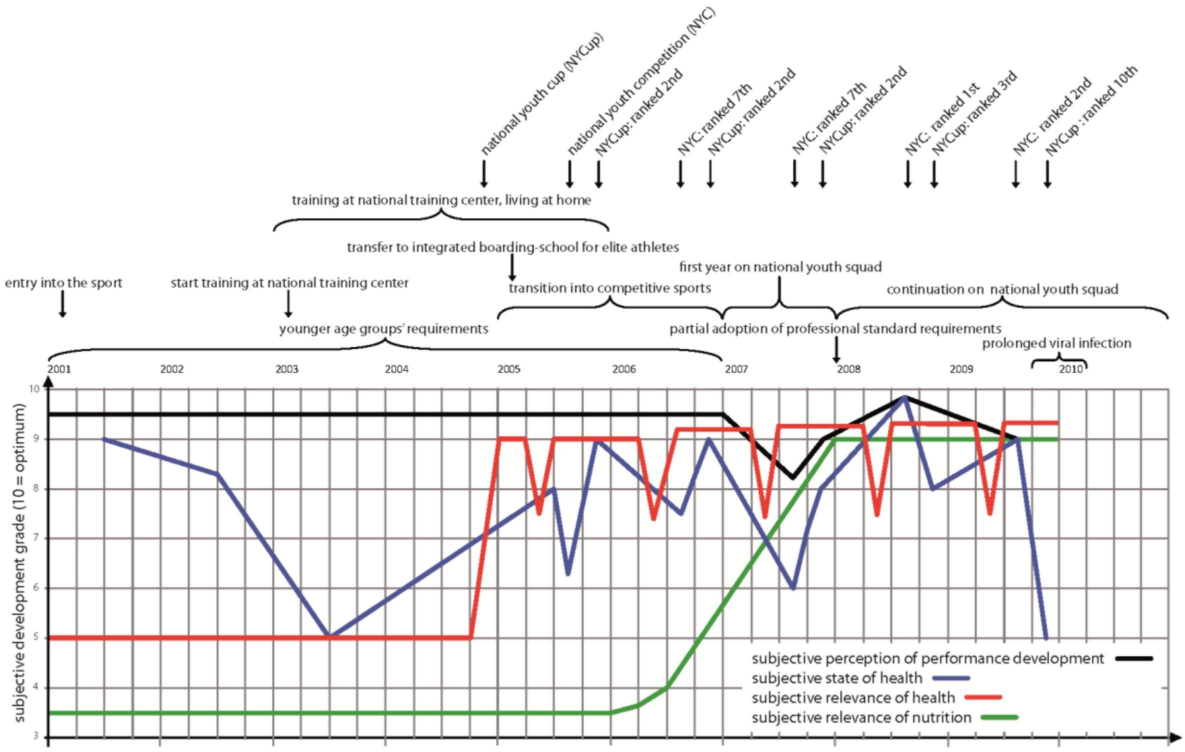

Figure 1: Exemplary biographical mapping (Thiel, Schubring, Schneider, Zipfel & Mayer, 2015)

2.2 Collaboration

The German Volleyball Association served as a cooperation partner for the project. The software development was carried out in close cooperation with the German federal youth training base for Volleyball of the VC Olympia Berlin. As a volleyball club with an affiliated boarding school for the best volleyball and beach volleyball talents in Germany, we were able to find a partner from the world of elite sports who supported us in the development of the software with a focus on the application side of the software. This cooperation also made it possible to carry out an extensive field test of the beta version of the developed software with young Volleyball talents, and thus test its applicability and usefulness in practice.

2.3 Implementation

The methodical approach of the service project was based on the central phases and milestones of software development (cf. Grechening, Bernhart, Breiteneder & Kappel, 2010). In addition to development workshops based on group discussions with selected experts from elite sports, extensive alpha and beta tests were conducted with coaches and athletes. This ensured that the content of the software fits to the requirements of elite sports practice, but also that aspects of user-friendliness were incorporated into the development of the software right from the start. Against this background, the project was implemented in three phases:

1. Analysis and definition of requirements
2. Conception and development of the alpha and beta version
3. Testing, documentation, and implementation of the Release Candidate

3. Data collection with the *bioMAP software*

The bioMAP software we developed is designed for Windows and can be operated on tablet computers, laptops, and desktop PCs.

Prior to data collection, central study parameters must first be defined using the XML file on which the software is based. Depending on the research problem, the period to be investigated must be scaled to the desired length (week, month, year, several years, whole life span). Before the assessment, it is also necessary to determine which curves are to be drawn. Optionally, a-priori categories can be defined for an ad-hoc classification of subjectively relevant life events and phases (e.g. sport, health, school/occupational, or private events/phases) (cf. Fig. 2).

The digital assessment procedure is equivalent to the manual procedure described above. First, subjectively relevant life events and phases of the interviewee are recorded on the x-axis that represents an individualized time scale. The curves for each predefined dimension are then drawn independently of each other. The dimensional curves can either be entered via a multi-touch screen with simple finger movements or the stylus, or alternatively using a keyboard, mouse and/or trackpad.

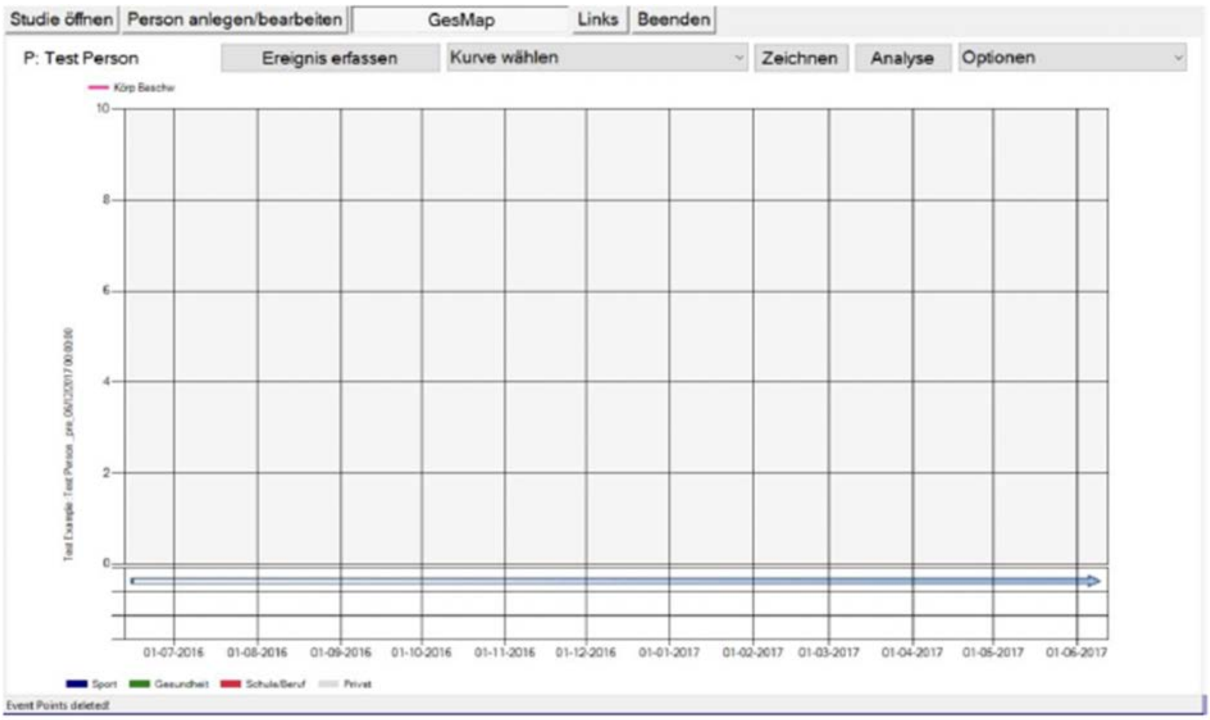

Figure 2: Coordinate system for the collection of the curve courses and life events

The individualized x-axis with the significant life events and phases is used to support a biographical perspective and gives the participants orientation when drawing the curves. In order to be able to reflect on the intensity of the respective experiences when drawing the curves, the participants use the y-axis, which represents an intensity scale ranging from 0 to 10 (cf. Fig. 3).

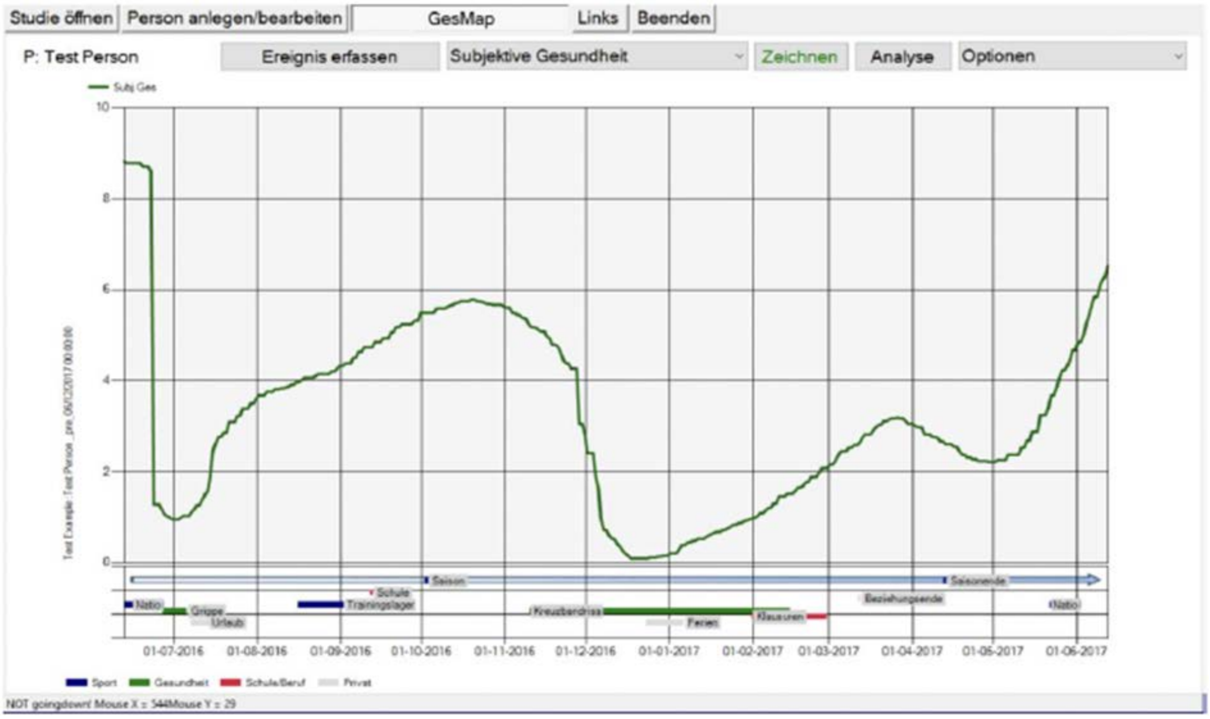

Figure 3: Exemplary curve course of the dimension "subjective health"

For the application test of the developed software in elite sports practice, based on discussions and expert ratings, we decided to record the following (health-related) curves:

- Subjective health
- Physical complaints
- Athletic performance capability
- Well-being in the team
- Motivation for training
- Motivation for school
- Sport load
- School load
- Difficulty of organizing daily life
- Quality of sport specific diet
- Perceived support from family
- Perceived support from coach

In the extensive field test of the final bioMap software, an assessment was conducted with 24 young athletes (12 females, 12 males) aged 16 to 20 years. At the time of data collection, all athletes were training at the Federal Volleyball Base in Berlin (C, D and C/D squads). This field test did not show any problems and confirmed the practical suitability of the instrument. The athletes pointed out the user-friendliness of the bioMAP software and confirmed the stimulative nature of the graphic reconstruction of individual biographies. Almost all of the athletes mentioned - without being asked explicitly - that they really enjoyed the assessment with the bioMap software. The bioMAP software is therefore an easy-to-use instrument that is also very popular with athletes.
The field test also showed that the participants draw the curves almost intuitively and experience the drawing activity as cognitively stimulating. Drawing the curves and thinking about particularly relevant events stimulates high degrees of (self-)reflection processes and promotes an active evaluation of

one's own career. The assessment also made it clear that it was much easier for participants to draw a curve than to describe these processes verbally, especially when dealing with sensitive topics. In addition, the curves are an excellent starting point for further narrative interviews or detailed one-on-one interviews between coaches and athletes. Figure 4 shows an exemplary result of a bioMAP assessment.

Figure 4: Exemplary result of a bioMAP assessment

4. Conclusion

The bioMAP approach is an innovative, software-supported approach for the biographical reconstruction of developmental processes. Due to its easy use, it is ideal for elite-level sports. The bioMAP approach can not only be used for the monitoring of health, but also for the reconstruction of training and performance development or team integration, etc.

According to the experience gained in our service project, we propose the following areas of application in elite-level sport:

1. Practical tool for coaches for the initial assessment of new team members in order to create a general understanding for the individualized training management by identifying individual opportunities for further development and already existing health problems
2. Practical tool for coaches for the systematic evaluation of a season, e.g. at the end of the season
3. Practical tool for coaches for the analysis of acute problems at any time if required
4. Scientific instrument for identifying typical high-stress phases and health-sensitive phases in athletes' biographies

As an anamnestic tool, which allows intra- and inter-individual comparisons through the quantification of data, the bioMAP software can make a significant contribution to the optimization of health and training management in elite sports. The graphically supported reflection over a period of time (career, season, training camp) enables the identification of complex health problems, barriers to performance development, or systematic incorrect stress. The software thus offers added value both for coaches (knowledge gain) and for the interviewed athletes (critical self-reflection).

Our experience shows that an assessment with the software takes less time than a differentiated anamnestic conversation. However, depending on the number of curve dimensions to be recorded, it can be expected that the assessment takes between 30 and 60 minutes. Therefore, sufficient time should be allowed outside the regular training schedule. In the expert discussions, this was also mentioned as a possible barrier for use.

Over the course of the project, it became clear that bioMAP yields very large potential for the effective implementation of coach-athlete conversations. On the one hand, this is due to the reflection-stimulating nature of the assessment, which can shed light on deep-rooted and unconscious aspects. For example, in the initial conversation with new athletes, a lot of information can be obtained in condensed form, which would only appear gradually over time without this technique or possibly not at all. On the other hand, the systematization associated with bioMAP also makes it easier for less experienced coaches to easily generate the information necessary for individualized training and health management for young athletes.

In order to validate the bioMAP, it will be necessary to evaluate the data collected in the field test in more detail and to examine how the individual health-related trajectories interact with each other. The integrated Excel export function and the possible data transfer to common statistical programs also allows a statistical evaluation of the data, which is particularly relevant for studies with larger samples. For example, inter-individual comparisons (e.g. calculation of curve mean values for typical life events, inter-correlations of curves) as well as statistical analysis of intra-individual developments (e.g. Time Series Analysis or Latent Growth Curve Modelling) should be considered.

In order to guarantee a standardized, reliable, and efficient application in the practice of elite sport, concrete guidelines for analysis will have to be developed in the future. These could be given to coaches for evaluation purposes. For the development of such guidelines, however, comprehensive representative biographical analyses are still necessary. Further studies with the bioMAP software will therefore be required to identify typical trajectories with regard to health risks. On this basis, an alert function could also be integrated into the bioMAP software, which would point out the necessity of countermeasures if the athlete experiences or is at risk of experiencing psychological, physical, or social distress, but also in cases when performance appears to stagnate.

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