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Exploring the Dynamics of Junior-to-Senior Transition: Unveiling Psychological Processes in Athlete Development

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Abstract

This study aimed to explore the dynamic nature of the Junior-to-Senior transition (JST) in athlete development, contributing to theoretical models by employing a dynamic perspective. The dynamic nature of athlete development has gained attention in sport psychology yet only few studies have integrated this dynamic nature in their research methodology. Talent development has evolved to encompass a holistic perspective, incorporating psychological, psychosocial, and academic and financial aspects, alongside athletics. Sport careers are marked by transitions like the JST, requiring the player to cope with transition-related demands. This complex process is believed to be interactive, dynamic and individualistic. By conducting longitudinal assessments during players' transition to senior levels, this study offers one of the first empirical insights into dynamic psychological processes during the JST. Employing an experience sampling method (ESM), challenges arising from non-compliance and attrition prompted the adoption of a single-subject approach, allowing for an exploration of methodological implications associated with intensive sampling methods. The study reveals moment-to-moment changes in psychological processes during the JST, stressing a dynamic outlook. The interplay between self-efficacy and psychological momentum highlights the need for holistic understanding of development processes, to optimize performance and support athlete development. Future research should address sampling design, incorporate qualitative data, and focus on both quantitative and qualitative aspects for a comprehensive understanding of athlete development.

Keywords: junior-to-senior transition, athlete development, dynamic perspective, talent development, sport psychology, experience sampling method, vector autoregressive modeling

Exploring the Dynamics of Junior-to-Senior Transition: Unveiling Psychological Processes in Athlete Development

Jamie Vardy's journey to winning the historical Premier League title with Leicester City F.C in 2016 could not have been more unusual. At the age of 16, Vardy had been released from a professional football club, only to find himself signed by Leicester City F.C at the age of 25 in 2012. Prior to that signing, he had played non-league for 9 years. His remarkable success just 4 years later was historical and defied the common standards of football. When talking about the commitment and motivation to perform well ("Every time I have stepped up a level, I wasn't expecting it to happen, but once it did, I just made sure I worked as hard as I possibly could to stay there."), it becomes clear how Jamie Vardy persistently adapted to new levels of the game. Jamie Vardy's story illustrates how the path of football players rarely follows a linear process.

For many talented football players, their career is made of challenges, failures, and luck. In addition, certain periods in this career are characterized by fluctuating performances that might further increase the perceived challenge of establishing oneself as a senior football player. As Den Hartigh et al. (2016a) suggests, dynamic network structures accurately illustrate these idiosyncratic, non-linear developmental processes given the interactive-dominant nature of the emergence of excellent performance. From this theoretical perspective it becomes clear that the development of excellent performance is highly complex. In practice, a frequently encountered problem is that some football players may never realize the potential they could have fulfilled, showing that making the step into professional football is easier said than done. This study aims to investigate the complex nature of athlete development, specifically focusing on the dynamic processes of psychological states over time during the transition from youth to senior football.

Junior-to-Senior Transition

As football competitions are structured based on age groups, youth players move through various under-age competitions before they start to engage in senior football, typically around the age 18 (Bennie & O'Connor, 2006). However, many promising talents that perform well in under-age categories do not manage to successfully transition to senior teams (Bezuglov et al., 2022; Güllich et al., 2023). This junior-to-senior transition (JST), identified as a crucial point in player development (Stambulova et al., 2017), encompasses normative shifts, expected and predictable events in an athlete's career trajectory (Alfermann & Stambulova, 2007). However, this normative transition is not a one-off moment, but a sequence of phases stretching from being called upon the team to establishing oneself as a player of the first team (Stambulova et al., 2017). They are understood as typical turning phases in the athlete's development. Factors such as age, organizational structure, and sociological processes are influencing these transitions (Wylleman & Lavallee, 2004).

During this transition, demands become disproportionately more challenging (Morris et al., 2016). For instance, the game increases in speed and intensity when compared to junior games. In addition, demands also increase 'off the field' for players when making the move to senior football. As junior players move towards senior football, they leave an environment which is protective and supportive of their development, to enter a climate driven by success and profits (Richardson et al. (2013). A successful transition is enabled by successfully resolving the imbalance created by internal and external demands, using internal and external resources (Stambulova et al., 2017).

Athletic Career Stages

Various athletic career stage models proposed the progression of athletic careers to follow a developmental pattern that can be divided in distinct stages (Bloom, 1985; Coté, 1999). These stages identify the phases the athlete may experience in their athletic career. While these models lacked the emphasis on the transitions between stages of the athletic

career, they provided a framework to understand the dynamic and evolving nature of athletic careers and served as foundation for future models.

In particular, the analytical athletic career model by Stambulova (1994) and the work of Wylleman and Lavallee (2004) filled gaps in the theory by explaining and predicting transitional processes between developmental stages. The work of Wylleman and Lavallee (2004) puts a developmental perspective on the transitions that athletes are facing in their career. In their work, they take a holistic approach that incorporates not only developmental processes an athlete is experiencing in his sporting career but also considers the development as a person outside of the sport. Interconnected development of psychological, psychosocial, academic, and volitional aspects suggests that the individual should not be considered merely as an athlete, but as a holistic person. A holistic perspective is crucial to comprehend the transitional processes that come into play during the athlete's development (Wylleman & Lavallee, 2004).

In this light, the athletic career transition model by Stambulova (Stambulova, 1994; Stambulova et al., 2012) supports a holistic view on the transitional periods, by emphasizing the importance of psychological coping of internal and external demands. Stambulova proposed that the effectiveness of coping with the increase of demands and barriers determines the outcome of the transition (Alfermann & Stambulova, 2007). This model suggests that in each phase of the transition, a specific set of perceived demands, resources, barriers, coping strategies, and outcomes relate to each other differently (Stambulova et al., 2017).

Recently, theoretical models on talent development also stressed the dynamic nature of developmental processes (Den Hartigh et al., 2016a, Den Hartigh et al., 2018). This also holds true for the JST, as Stambulova defines 4 phases within the JST (Stambulova et al., 2017). In the preparation phase, the athlete aims to establish themselves in the senior team,

facing physical and mental stress. The orientation phase involves adjusting to team expectations and the more serious environment, while the adaptation phase focuses on performance and responsibility. In the stabilization phase, consistency is pursued, overcoming challenges through intrinsic motivation.

Toward Longitudinal Research on JST

Based on these theoretical models and conceptualizations, contemporary research has mainly focused on the effect of coping resources and successful transitions (Drew et al., 2019). A recent meta-analysis identified almost 60 factors that impact an athlete's transition to a senior competitive level (Drew et al., 2019). Examples include motivation, self-efficacy, psychological momentum, goal commitment and perceived support. While these factors are suggested to play a role during the transition process most of these findings come from cross-sectional studies. Cross-sectional designs are naturally incapable of capturing how psychological factors change over time given that data collection includes measurements at one point in time. A majority of previous studies have used singular retrospective, semi-structured interviews for data collection (Drew et al., 2019). Therefore, not only being dependent on the memory and recall ability of participants to ensure data quality, this method only provides information of one specific time point and fails to recognize potential changes in factors throughout the various phases during the transitional process (Drew et al., 2019).

A first attempt to mitigate this bias in research of transitional periods stems from the work of Stambulova et al. (2012); this study employed a monitoring instrument, the Transition Monitoring Survey (TMS) with the objective of assessing the transition process and exploring how transition variables contribute to the outcome of the transition. The collected data, therefore, is reflecting the momentary state of the individual over a longer period of time within the transition process. Interestingly, results support the notion of the dynamical transition process. By conducting longitudinal monitoring of psychological states,

the study found transition characteristics to change over time, indicating that the transitional process is dynamic. Based on this, new directions for future research were formulated to intensify the attempts of exploring the dynamic and interactive nature of the JST. Further, findings expand the evidence on transitional variables that contribute to the success of the transition. It was found that variables related to coping strategies, transition demands, environmental support, personal resources, perceived stress and perceived need for additional support are associated with the level of adjustment to senior sport, which provides further incentive to examine psychological processes.

The Current Study

To understand the transitional process that athletes go through, we are taking a process-oriented approach that emphasizes the role of psychological factors *over time* within individual players during the junior-to-senior transition (for fictive network illustration of such a process, see Figure A1, Appendix A). Thereby, we are attending to the necessity to recognize the process in its entirety and account for its dynamic nature. The study focuses on exploring temporal relationships of psychological variables that are crucial for a successful transition, to validate the dynamic and holistic nature of the transitional process.

Psychological factors such as motivation, self-confidence, psychological momentum, goal commitment, and perceived support were assessed using self-reports. Based on theoretical models of athletic career development and investigations of the JST, these variables present relevant transitional factors (Pehrson et al., 2017; Stambulova et al., 2017). Specifically, this study will focus on exploring the temporal dynamics of psychological factors over the course of the JST.

By collecting longitudinal data on several psychological factors, we aim to understand how these factors interact over time during the JST. Therefore, we revert to the experience sampling method (ESM). By using this method of data collection we gain a deeper

understanding of how psychological processes develop and influence the outcome of the JST. Recently, ESM has gained popularity and is increasingly used by researchers in the fields of emotion dynamics, mood, and psychopathology who have employed the ESM to collect intensive longitudinal data for the investigation of intra-individual processes (De Haan-Reitdijk et al., 2017). The ESM offers the possibility to inform researchers about complex systems and its constantly changing characteristics and dynamic processes. By assessing participants in their natural environment, the retrieval of dense time-series data in ecological contexts is enabled, offering unique insights into the temporal relationships of dynamic and complex processes of psychological phenomena (Trull & Ebner-Priemer, 2009). The concept of temporal dependence refers to the interconnectedness of states over time, where current states are influenced by previous states. As such, temporal dependencies are an integral part towards the comprehension of psychological dynamics (Bringmann et al., 2016).

Understanding the effect of temporal dependence is crucial to comprehend human experience in general (Hamaker et al., 2015). However, specifically in our study understanding temporal dependence will allow us to grasp the complexity of the transitional period and the athlete's development throughout the JST.

This extensive, longitudinal data enables a deeper analysis of fluctuations in the states of these psychological processes over time within the players. To get insight into these intra-individual dynamics, we will conduct time-series analysis and employ a vector autoregressive model (VAR). Autoregressive modeling is a method that investigates the relationship between variables over time using regression equations (Bringmann et al., 2016). This approach allows us to study the dynamics within an individual by examining how current states at a specific time (t) are influenced by their previous states (Hamaker & Dolan, 2009). By employing vector autoregressive (VAR) models, we can extend this analysis to explore the temporal connections between multiple processes simultaneously. This broader scope enables us to

examine whether these processes not only affect themselves but also have potential effects on each other. Cross-lagged effects observed in VAR models can indicate the presence of spillover effects from one variable to another (Ryan et al., 2018). In summary, VAR modeling offers a powerful tool to investigate the interplay and influences of different variables over time.

Method

Participants

In total, 57 Dutch male soccer players agreed to participate in this study (M age = 19.2 years, SD = 1.0 at T0). These players were all part of the Under-21's (U21) team of three professional Dutch soccer clubs, enrolled under full-time scholarships. The sample purposefully consisted of only football players that are at the beginning phase, the preparation phase, of their JST (Stambulova, 2017). The recruitment of the football clubs was managed by one of the supervisors of this research project. Sampling was based on convenience. Academy managers were contacted and information sessions were held with this group of administrators to discuss the study and ask for participation. After that, the research supervisor gave a presentation to teams that agreed to participate, explaining the purpose of the study, the procedure and analysis of the data. At this point, players could also provide consent to participate in the study. To ensure confidentiality for each player, clubs were not involved with the experience sampling procedure. As such, (non)-participation would not affect the players selection status with the club. This study was approved by the University of Groningen's institutional ethics committee.

Experience sampling procedure

Players were surveyed three times a week, for 30 weeks, which corresponds to the period from pre-season through to approximately halfway into the competitive season. On training days, players were sent an automated text message at 07:00 am containing a link to an ESM questionnaire, which they could complete on their own smartphones or handheld device. In previous research, no significant difference in study compliance was found between participants using their own phones or study-provided devices, therefore, in this study we decided to let participants use their own devices (Jones, et al., 2018)

To reduce the burden of the intensive longitudinal data collection, we decided to use only single items from validated instruments or used single-item instruments if available (Ohly et al., 2010). The use of single-item questionnaires is an efficient way to measure momentary states longitudinally, as it keeps the participant's burden as low as possible (Cloos et al., 2022). These items were measured with a 7-point Likert scale ranging from 1 ("not at all") to 7 ("very much"). All items were rephrased to start with: "At this moment during the season, I ... ('',etc.)", ensuring the validity of the momentary assessment of these measures.

In addition, participants were able to indicate the presence or absence of an important event that had impacted their development since the last questionnaire between (2 – 3 days). The events were predefined in seven typical categories, which players could choose from. Players were asked to rate the valence of this event (i.e. negative or positive), on a 7-point Likert scale ranging from –3 as "very (un)pleasant" and 3 as "not so (un)pleasant". These values were subsequently re-coded to be in the right direction.

If a player was approaching the threshold for non-compliance, they received an email notifying their lack of response one assessment prior to the threshold. Non-compliance in this study is defined as a non-response to the survey for a consecutive period of 3 weeks (i.e., 9 or

more assessments), as this would probably indicate that the participant has likely withdrawn from the study.

Measures

Self-efficacy

The model of human adaptation to transition (Schlossberg, 1981) elucidates the process and outcomes of a transition through the interplay of four factors: the situation, individual characteristics (self), available social support, and strategies. According to Schlossberg (1981) the role of the self cannot be underestimated when estimating the resources needed to adapt to change. In line with this, Pummel et al. (2008) suggest that self-efficacy may be predictive of transitional outcomes. Further evidence has shown self-efficacy to potentially being highly predictive in a network of multidisciplinary determinants of sports performance (Neumann et al., 2023). Being confident in one's own capabilities to manage the transition successfully has shown to be an important resource, in the perception of players and staff, when being challenged with demands throughout the JST (Jones et al., 2014).

Perceived self-efficacy was constructed in line with the guide by (Bandura, 2006). To fit the assessment of the momentary state, the question for the item of self-efficacy was phrased: "At this point in the season... how much confidence do you have in yourself to make the step to the first team?"

Psychological momentum

The psychological and behavioral changes that occur when an individual moves closer to or farther away from achieving a goal are manifested as psychological momentum. Athletes who perceive a positive psychological momentum, hence, moving towards their goal often show beneficial psychological states and performance

behaviors, making pursuit of the goal more likely (Den Hartigh et al., 2016b). Den Hartigh et al. (2016b) defined psychological momentum as a dynamic product of multiple interconnected processes, which has influential properties for sports performance. Vallerand et al. (1988) attempted to clarify whether psychological momentum is the cause or outcome of performance, as prior research failed to specify this relationship. The antecedents-consequences model of momentum by Vallerand et al. (1988) predicted that psychological momentum can either enhance performance when positive or impair performance when negative.

The level of psychological momentum represents the perception of someone advancing towards a set goal (Vallerand, 1988). The question was phrased “At this point in the season ... how likely do you think it is to make the step up to the first team?”

Perceived support

The perception of support is another impactful factor that can be explanatory for performance and transition outcomes (Pummel et al., 2008). The level of support from the social environment is proposed to be crucial in meeting the demands of senior level sports (Andronikos et al., 2021).

The measure of perceived social support was phrased to assess the momentary state of perceived social support by the participant. The participant answered to what extent they felt supported by their social environment (e.g. parents, coaches, etc...). This item was phrased: “If you need support ... are there people right now who can make you feel supported?”

Motivation

Morris et al. (2017) found that players who successfully made the step to senior soccer reported high levels of motivation to succeed. The evidence for motivation to be an important factor in performance is rich, additionally it is suggested that when motivation levels are high,

individuals appear more resourceful and overcome transitional obstacles more easily (Chamorro et al., 2016).

Motivation was assessed by asking participants to indicate how motivated they were at this moment to make the transition to the first team. The item's question was phrased: "At this point in the season... how motivated are you to make the move to the first team?"

Goal commitment

The commitment to the transition itself is one of the internal resources that was mentioned by the players themselves in the study of Stambulova et al. (2017). Supporting evidence for the positive impact of being committed suggests that showing high commitment is the crucial difference between the athletes that continue to compete at the highest level in senior sports, compared to the ones that have to withdraw from professional levels (Bennie & O'Connor, 2006).

The goal commitment measure was assessed by asking participants their degree of commitment in this moment to the goal of reaching the first team. The item was phrased: "Making the move to the first team is an important goal for me to go ahead."

Data Analysis

Data was analyzed using the *ctsem* package in R (Driver et al., 2017). This package is specifically designed for continuous time (CT) structural equation modeling of time series data and enables the estimation of relationships over time, using a hierarchical Bayesian approach. Due to the fact that the ESM questionnaire was distributed on training days, we were dealing with unequally spaced data with varying time intervals between successive assessments. To deal with implications that arise from unequally spaced data, we made use of a continuous-time modeling approach that uses stochastic differential equations in the estimation of underlying continuous processes. As such, the analysis considered

psychological processes in a continuous manner, accounting for the unequal intervals (Ryan et al., 2018; Hamaker & Wichers, 2017).

The focus of our CT VAR model was the interplay of processes over time, to understand how psychological states change over time. For the interpretation of the model output, we will study how the drift parameters, the autoregressive and cross-regressive effects of each psychological process change over time. The autoregressive effect reflects the process's temporal stability; in other words, the greater the effect the faster the process regresses back to its equilibrium state. The cross-regressive effects indicate possible interactive relationships over time between the psychological states, similarly here a greater effect size means an effect with more magnitude (Ryan & Hamaker, 2020). The reported values are centered and represent lagged parameters, as they have been taken to the power of the time interval $e^{\Delta t}$ (Ryan & Hamaker, 2020). Data was a priori standardized.

Due to the high attrition rate of participants, we decided to take on a single-subject approach that allowed us to explore dynamic processes of psychological states over time within one individual. This individual's case has been selected for reasons of data quality and completeness. For this specific individual the items of self-efficacy and psychological momentum provided sufficient data points for interpretable results, therefore the following analysis will specifically focus on the dynamics of these two processes. In consideration of the empirical evidence, namely the dynamic nature of these two processes and the relationship with transitional and performance outcomes, the analysis promises to deliver theoretically and practically meaningful results.

Results

Continuous-Time Vector Autoregressive Model (CT VAR Model)

The results of the autoregressive effects (See Table A4, Appendix A) for the psychological processes of self-efficacy ($\bar{x} = 0.6390$, $SD = 1.2765$, $CI = [0.3550, 0.9169]$) and psychological momentum ($\bar{x} = 0.1887$, $SD = 2.2694$, $CI = [0.0302, 0.5936]$) indicate that there is a high temporal stability within both processes, however changes in psychological momentum seem more persistent due to a lower autoregressive effect (See Graph A2, Appendix A).

In examining the cross-regressive effects (See Table A4, Appendix A), we found that the effect of self-efficacy on psychological momentum ($\bar{x} = 1.6547$, $SD = 1.3685$, $CI = [1.0372, 3.5177]$) suggests that self-efficacy significantly affects psychological momentum. Similarly, the effect of psychological momentum on self-efficacy ($\bar{x} = 3.4439$, $SD = 1.7942$, $CI = [1.4429, 11.3759]$) indicates that psychological momentum affects self-efficacy over time, the effect being even greater than the effect of self-efficacy on psychological momentum. Both effects are suggested to be significant, as the confidence intervals do not encompass a value of zero.

Discussion

The aim of the current research was to investigate the dynamic nature of the JST. This work takes on a dynamic perspective and adds an empirical account to the theoretical model of athlete development, in particular the junior-to-senior transition. More broadly, this study relates to dynamic network approaches that propose the interactive-dominant and idiosyncratic development of excellent performance (Den Hartigh et al., 2016a). Through conducting a longitudinal momentary assessment of player's data throughout their transition to senior level, this study is among the first to provide a first empirical account of the dynamic relationships of psychological processes during the JST. Our results back the emerging holistic perspective of athlete development, and more specifically, the JST. In addition, this

research will identify advantages associated with these types of data collection and demonstrate the valuable perspective on individual development dynamics within sports and performance psychology.

In line with previous research, the results of this study support the notion that the development of athletes follows an idiosyncratic, dynamic and interactive-dominant pattern. Non-compliance and attrition, likely caused by high participant burden, led to methodological issues. Such issues are common in intensive sampling methods (Dejonckheere, et al., 2022). By adopting a single-subject approach, we provide room to discuss the analytical procedure and methodological challenges that arise from the applied methodology. Psychological processes have been shown to be dynamic and interactive throughout the JST, reflected by changes from one measurement to the other. These changes over time do not only occur within processes, but significant cross-effects suggest that these dynamic processes interact with each other throughout the transition period.

Theoretical and Practical Implications

Our results illustrate the temporal associations between the two psychological processes of self-efficacy and psychological momentum (See Appendix A). The autoregressive effects show that both processes remain relatively stable over time, indicating changes to be not persistent over time and the state of equilibrium being reached sooner rather than later. In other words, following a perturbation, this subject returns to its baseline level quite quickly. This perturbation could be caused by various events, Swainston et al. (2020) for instance, has suggested the involvement in first team training or information on future development to be possible events that impact an individual's trajectory. The process of self-efficacy shows less temporal stability, displaying longer periods of states away from the state

of equilibrium (See Graph A3, Appendix A). The moment-to-moment changes observed in the psychological processes support a dynamic perspective of the JST.

Increasing the scope of our analysis, we looked at potential effects of self-efficacy and psychological momentum on each other. The cross-regressive effects displayed in the drift matrix (graphic) indicate that both processes significantly affect each other. Positive effects of self-efficacy on psychological momentum, and vice versa, suggest an interactive relationship between these two variables over time. An increase in self-efficacy seems to be related to an increase in psychological momentum, and vice versa, while the psychological momentum has on self-efficacy is bigger. Den Hartigh et al. (2016a) proposed the emergence of excellent performance to be a function of dynamic networks, originating from interactive and multiplicative relationships. Our results are in line with this assumption, as the interconnected, dynamic relationship between the two psychological processes could be observed in moment-to-moment changes.

Thinking about how dynamic systems complexity affects outcomes like successful transitions or performance behavior, it's clear that even small changes anywhere in the system can have a big impact on the whole picture. In this light, low temporal stability in both processes are exacerbating the complexity of the transition process. With this in mind, developmental processes, like the JST, become less predictable and need to be carefully studied to learn how to support and guide athletes through these transitions. Coaches for instance should become more aware of these numerous, ever-changing processes that inevitably impact an athlete's development and provide room for reflection on performance and an ongoing transition. Self-reflection has been suggested to be an important predictor of JST success (Jonker et al., 2012). Being aware of the ongoing process, gives rise to the opportunity of adaptation to challenges and needs of the transition. As we know, coping with

transitional barriers and obstacles is crucial when progressing to higher levels, adapting and adjusting is a dynamic answer to dynamic variables that hinder progression.

The multitude of factors and processes influencing transitional processes have been established, from athletic attributes, to environmental factors, and psychological characteristics (Drew et al., 2019). The interconnectedness of these developmental determinants should be accounted for by viewing the development holistically. Following the theoretical outlines of Wylleman and Lavallee (2004), a perception of the developing individual needs to include not only physical and technical factors, but take the entire person and everything that affects and is affected by that person into the equation. With findings from earlier research (Stambulova, 2012) that articulate the importance of psychological factors, our findings amplify the call for a holistic approach to athlete development.

In essence, the dynamic interrelationship between self-efficacy and psychological momentum underscores the need for a holistic understanding of how individuals' psychological states potentially undergo change at different rates and are affected by interconnected states that accumulate in a dynamic complex system, ultimately causing performance and transition outcomes. This deeper comprehension could inform strategies for optimizing performance, fostering psychological well-being, and finally, emphasize a holistic approach in developmental contexts.

Clubs are recommended to apply this ESM approach in their daily workflow, ensuring daily monitoring of transition variables. To ensure, as many facets in the development process are supported, an interdisciplinary approach should include a wide range of professionals to guide and support athletes (Bailey et al., 2010). In practice, this means that a collaborative approach is needed, in which physical and mental aspects are integrated in the development of players. Resilience research by Den Hartigh et al. (2022) has recently proposed a

collaborative approach to the study and improvement of dynamic, psychological constructs. Utilizing the expertise of psychologists, data scientists and sports scientists, a constant flow of data generated by daily monitoring can help to create individualized feedback (Den Hartigh et al., 2022). This daily monitoring offers the chance to detect patterns in dynamic processes, which allows coaches and staff members to apply tailored interventions (Den Hartigh et al., 2022). Acknowledging that growth occurs over time highlights the need for an athlete's continuous adaptation to overcome challenges and meet demands. It becomes a necessity for all stakeholders to direct attention to the long-term development of athletes. A holistic approach should take a pivotal role in this long-term development. Equipping players with a comprehensive skill set, including mental skills, life skills and a growth mindset, that present transferable competencies, enhance their resourcefulness in successfully attaining optimal performance (Stambulova et al., 2009).

Limitations and Future Directions

The results of this study point towards the dynamic interaction of psychological suggested attributes that make up the JST. However, our results have to be judged with careful consideration. Even though trends indicate more emphasis on intra-individual processes in contemporary research and the increased use of accompanying methods, the methodological and statistical challenges for this approach cannot be underestimated (e.g., Bolger & Laurenceau, 2013; Hamaker & Wichers, 2017; Trull & Ebner-Priemer, 2020). Following the concerns expressed by Trull and Ebner (2017) for the use of intensive longitudinal assessment, we now address specific issues that deserve careful consideration in the planning of future research.

First, participants typically experience a high burden through this type of assessment. This may result in difficulties with compliance and risks of drop-outs, or potential exclusion

of participants as they do not meet minimum response requirements (Trull & Ebner, 2017). To anticipate this burden, we decided to keep the time extent as low as possible, by assessing variables with single-item measures. Additionally, a presentation was held with the participants to explain the purpose of the study, the procedure and analysis of the data. This approach was taken with the intention to create a spirit of respect and collaboration, as research has suggested this to be compliance enhancing (Green et al., 2006). It is critical to define and report compliance, to indicate generalizability as only extensive reporting on the methodology allows for robust and generalizable results.

A logical consequence of increased burden and non-compliance is reduced sample size. When having a small sample size, power and generalization of the study's results is problematic. As suggested by Hecht and Zitzmann (2020), a lack of time points or participants in the sample can result in biases and low performance in the model estimation, but compensating with increasing participant size or more time points should resolve this issue. Based on the challenges we faced, we highly recommend that future researchers prioritize the planning of sampling design and sample sizes to ensure an adequate sample size for longitudinal studies. Especially, testing the assumption of idiosyncratic developmental pathways should be central to future projects to amplify the importance of individualistic programs and strategies that can be adapted to the needs and unique challenges an athlete faces. Furthermore, future research should aim to cover a broader time range, culturally diverse samples, and wider age groups to increase generalizability of results.

Future research investigating the temporal relationships of athlete development is needed, assessing intensive longitudinal data to account for the dynamic nature of the development of athletes. Psychological processes unfold over time, therefore, assessing external and internal factors longitudinally will allow us to understand how psychological processes are influencing athletes' development. Using intensive longitudinal assessment

offers great advantages to answer questions about where and when processes take place (Hamacher & Wicher, 2017). The assessment of ecological data has to amend the various circumstances of participants' lives, which can result in unequal time intervals in data assessment. The consequences of this can be accounted for by continuous-time models (De Haan-Reitdijk et al., 2017), researchers are urged to consider this method for unequally spaced data to increase the statistical validity of future studies. This recommendation urges the field to actively pursue additional research to advance the understanding of longitudinal processes in sports and athlete development. While there has been progress in recent trends, it is crucial to continuously shift the perspective of athlete and sports development towards a more comprehensive and dynamic approach. This entails adopting a holistic approach that considers these developments as interconnected and evolving entities, viewing them in their entirety.

While the emphasis on quantitative, longitudinal studies is important and should be prioritized further, we would like to emphasize the importance of qualitative data too. For example, we have assessed personally meaningful events in our participants and let them reflect on them in more detail, which is something that would offer potential insights for more advanced studies in the future. By understanding how player's experiences relate to the dense time points in time-series data, we can significantly advance our comprehension of individual development processes, like the JST.

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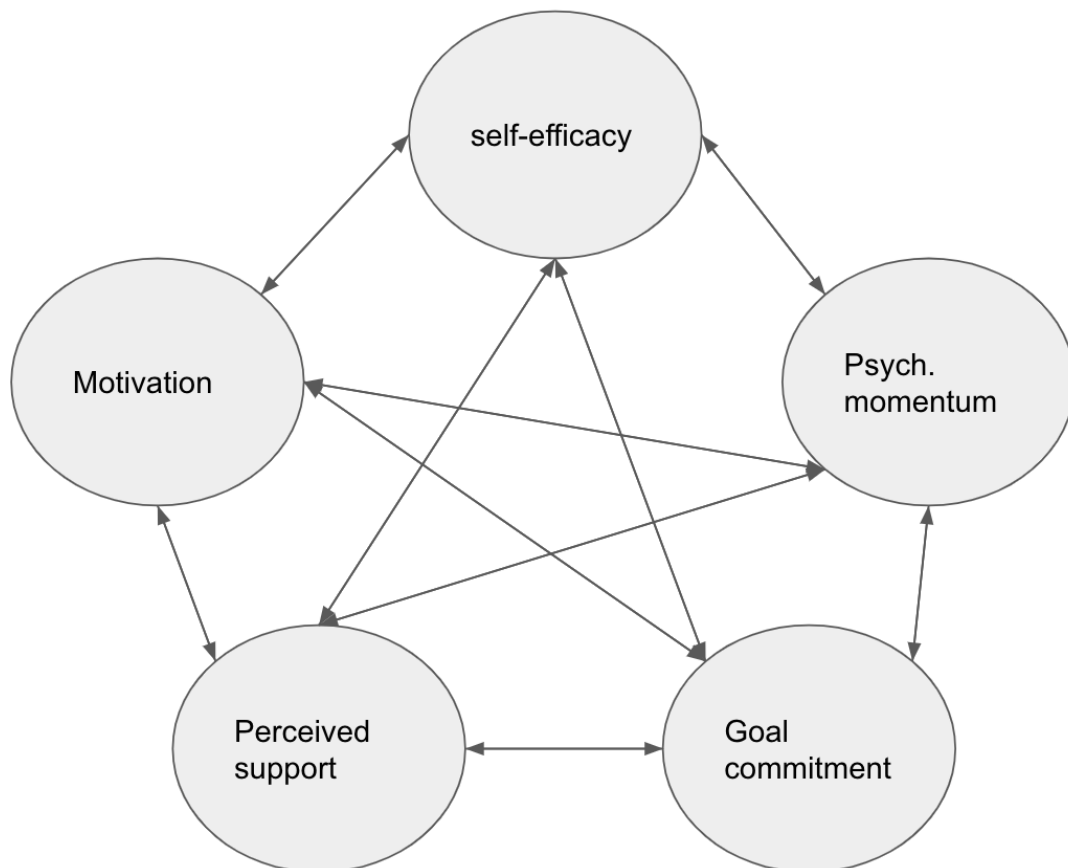
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Appendix A

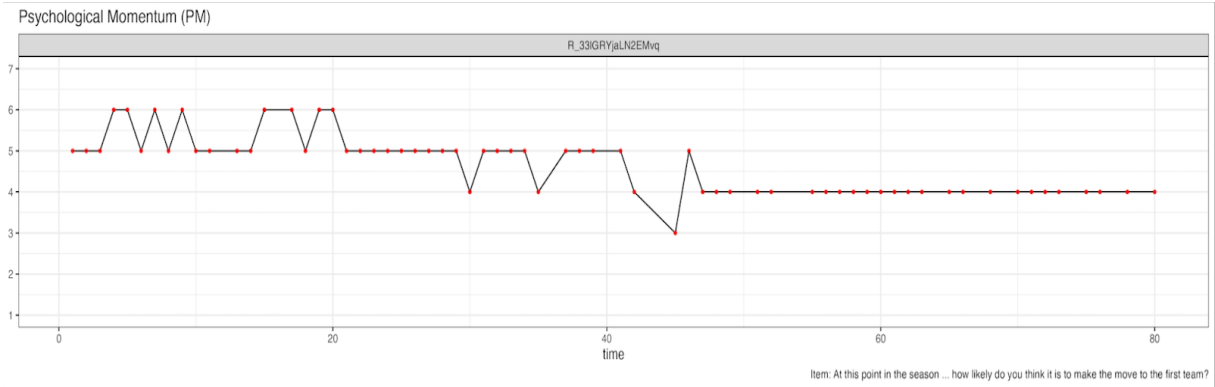
Figure A1

Fictive Network Model

Note. Fictive illustration of a JST process network. In this case, these 5 factors potentially influence the JST process of an individual over time. Bidirectional arrows between all factors indicate the proposed multidirectional, temporal relationships of these factors, impacting an individuals' JST process. Note that this network is only speculative, and serves the purpose to illustrate a hypothetical future model of an idiosyncratic, dynamic network model explaining JST processes.

Graph A2

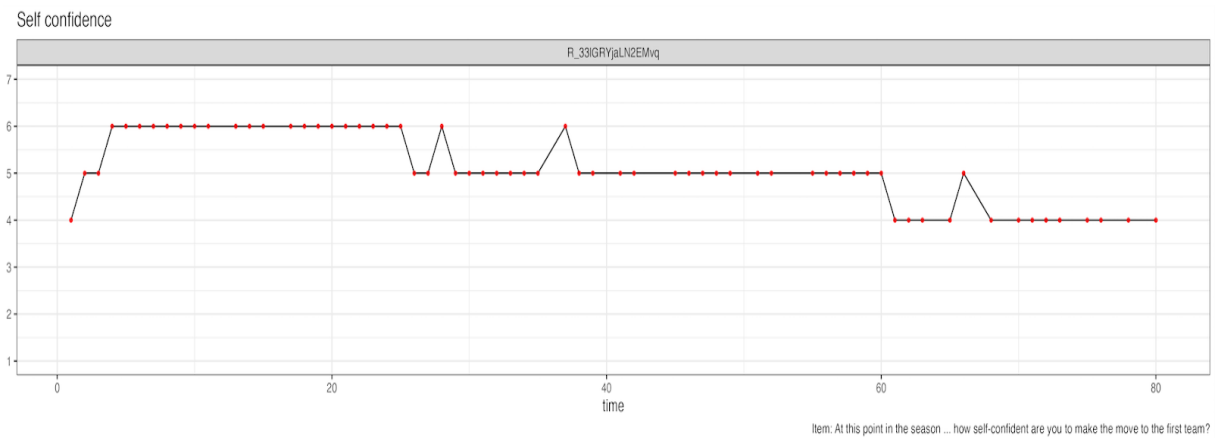
Time-Series: Psychological Momentum



Note. Time-series graph depicts data points (red dots) over the course of the JST.

Graph A3

Time-Series: Self-Efficacy



Note. Time-series graph depicts data points (red dots) over the course of the JST.

Table A4*Descriptives CT-VAR model*

Matrix Parameter	Mean	SD	CI (2,5%)	CI (97.5%)
AR effect of Self-Efficacy	0.6390	1.2765	0.3550	0.9169
AR effect of Psychological Momentum	0.1887	2.2694	0.0302	0.5936
CR effect Self-Efficacy on Psychological Momentum	1.6547	1.3685	1.0372	3.5177
CR effect Psychological Momentum on Self- Efficacy	3.4439	1.7942	1.4429	11.3759