Resilience in Youth Soccer: The Relationship Between Static and Temporal Measures

Jean-Luc Marcus Budel

Master Thesis – Talent Development & Creativity

5043573
July 2023
Department of Psychology
University of Groningen
Examiner/Daily supervisor:
Ruud den Hartigh

Abstract

Resilience in psychology has been of wide interest in the past years. On one hand, resilience has been viewed as a personal characteristic that remains stable across time. On the other hand, resilience has been defined as the process of bouncing back to normal functioning after a perturbation. The aim of the current study is to examine whether self-reported (static) resilience correlates with resilience indicators that individuals demonstrate over time. 36 soccer players filled out the static measurement of resilience. In addition, throughout the season they received a message on a daily basis to reflect on their motivation, mood and self-efficacy. Results showed that resilience measured at one point in time does not relate to fluctuations in the resilience indicators (self-efficacy, mood and motivation).. This finding could be valuable for researchers and sport organizations in practice.

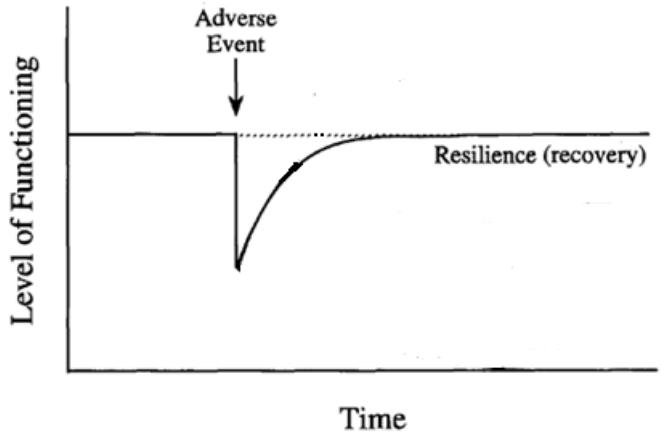
Keywords: resilience, resilience indicators, dynamic measurement, static measurement, correlation analysis, MSSD

Resilience in Youth Soccer: The Relationship Between Static and Temporal Measures

A few years ago, Thomas Marijnissen quit soccer because of mental health issues. His focus switched to psychological recovery, studies and a career outside the elite soccer leagues. This year Marijnissen made his comeback in a high-performance climate at NAC Breda. This procedure of bouncing back following adversity reflects the definition of "resilience". The process of bouncing back to normal functioning after a perturbation is in this study conceptualized as a process (Den Hartigh et al., 2022). Hence, understanding resilience deals with the question: to what extent are individuals able to return to a base rate level after the onset of an adverse event? (see *Figure* 1). Although resilience is often assessed with self-report questionnaires, the aim of the current study is to examine whether self-reported resilience correlates with actual resilience indicators that individuals demonstrate over time.

Figure 1

This figure represents the bouncing back ability from an adverse event to 'normal' functioning measured over time.



Note. Edited from Carver, C. S. (1998). Resilience and Thriving: Issues, Models, and Linkages. In *Journal of Social Issues* 54(*2*). https://doi.org/10.1111/j.1540-4560.1998.tb01217.x

Previous resilience research

Previous research has often held the view that resilience is a personal characteristic or a behavioral trait (e.g., Connor & Davidson, 2003). More specifically, resilience has been viewed as a set of characteristics which facilitates people to adapt to potential future adverse events. Associations have been found between resilience and characteristics like optimism, active coping and social support (Galli & Vealey, 2008). Other research linked resilience to positivity, determination, competitiveness, commitment, maturity, persistence, having a strong social network and a passion for sport (Sarkar & Fletcher, 2014). These characteristics are protective factors which are defined as influences that modify, ameliorate, or alter a person's response to some environmental hazard that predisposes to a maladaptive outcome (Rutter, 1985).

Other protective factors that positively influence resilience are confidence, positive personality, adaptive perfectionism, focus and motivation (Sarkar & Fletcher, 2014). These factors are specifically important because they strengthen the daily recovery process and performance of athletes (Den Hartigh et al., 2022). In this study self-efficacy, mood and motivation are chosen to serve as resilience indicators that strengthen the daily recovery process.

Researchers have tried to grasp the bouncing back ability of resilient individuals before (Smith et al., 2008; Gijzel., 2020). However, the previous studies investigated this process through self-reflecting methods and static measurements (Smith et al., 2008). Smith and colleagues (2008) tried to test the bouncing back ability of resilience with the Brief Resilience Scale (BRS), but they did not include a dynamic measurement.

Toward measuring the dynamic resilience process

Dynamic variables allow for studying intraindividual variability in longitudinal research to explore results over time (Collins, 1991). Meanwhile, static variables measure characteristics (of behaviors) at one point in time for one or more individuals (Collins, 1991). This implies that static variables do not have the ability to measure the development of such characteristics. For example, measuring someone's resilience at one time, for instance prior to a season, does not explain someone's resilience throughout the whole season.

Moreover, dynamic data have an advantage above static data (Kusev et al., 2018), as static data appeal to someone's long term memory and holistic experiences, while dynamic data appeal to someone's short term memory and more recent events in different sequential time periods. This retrospective (static) view is susceptible for overconfidence according to Kahneman and Tversky (1996), in which people are overly optimistic about their own experiences. Dynamic data are more focused on the sequence of different time frames and therefore less susceptible to such cognitive biases. The Russian psychologist Lev Vygotsky (1978) states that static and dynamic measures together provide better predictive information about how an individual will change and perform in the near future than these measures separately. Thus, when aiming to measure resilience over time the research method should actually be designed to measure resilience over time. In this study three indicators measure resilience and will be explained in the next three paragraphs.

Self-efficacy

One of the important resilience indicators in this study is self-efficacy, which entails someone's belief in their own abilities and competencies (ref). This factor links to the outcome of the previously mentioned study; in terms of having a good self-esteem and confidence in themselves (Sarkar & Fletcher, 2013). Confidence has been identified as a positive influence for dealing with stress and pressure in a competitive sportive environment (Galli & Vealey, 2008; Gucciardi et al., 2011). In an athletic context, it is described as the

degree of certainty someone possesses about his/her ability to be able to succeed in sport (Vealey, 1986). Confidence was found to be a particularly decisive factor mediating the relationship between resilience, stress and performance in Olympic champions (Fletcher & Sarkar, 2012). In other words, from a confidence time series (self-efficacy) it can be distilled if someone is at that point in time more or less resilient than before.

Motivation

The second indicator of resilience in this study is motivation. Actually, optimal levels of motivation are required in high performance contexts and environments where dealing with stress is a requirement for performance (Standage, 2012). This process has been studied in Australian track and field athletes by Mallett & Hanrahan (2004). They found that elite sport athletes tend to internalize and integrate more self-determined forms of extrinsic motivation. In other words, these athletes were able to transform extrinsic motivation into autonomous motivation, where their personal values and beliefs are congruent with external and environmental demands (Ryan & Deci, 2000). These athletes are competent to turn external regulation into self-regulation (Sarkar & Fletcher, 2013). The previous results show that optimal levels of motivation are playing a key role in psychological resilience in elite sport performers. Thus, also daily measures of motivation give information about someone's resilience in a time series.

Mood

The third and last indicator of resilience in this study is mood. Mood is a state of mind which reflects the way athletes are feeling at a particular moment (Den Hartigh et al., 2022). Different kinds of mood are positively related to resilience, of which hope and optimism have the strongest relationship (Sarkar & Fletcher, 2013).

Fluctuations

Dynamic measurements could be studied through several statistical methods. In this study the choice has been made to discover variability in dynamic measurements through fluctuations. As mentioned in the previous paragraph, a dynamic measurement allows for studying someone's development and day-to-day changes (Vygotsky, 1978). Besides, fluctuations give more insight in someone's day-to-day feelings and give a more complete image and thought for call to action (Helmich et al., 2021). Moreover, Helmich and colleagues (2021) argue that fluctuations are currently the best captured type of dynamic measurement and the safest choice in terms of uncertainty.

A focus on fluctuations shows researchers and practitioners more about when there is a problem with the resilience of a system, or human being, under study and therefore signal when an intervention is needed (Scheffer et al., 2018). These problems with resilience are called *early warning signals* (EWS) in the literature (Helmich et al., 2021). EWS are precisely defined as "a group of statistical time-series signals which could be used to anticipate a critical transition before it is reached" (Southall et al., 2021). In this study EWSs serve as proxies of resilience indicators.

Present research

A recent study argues that resilience may be influenced through a combination of both stationary factors (e.g., resilience at a point in time) and developmental factors (e.g., day-to-day resilience) (Fletcher & Sarkar, 2016). This combination of factors and measures leads to different and more complete considerations of stressful events (Sarkar & Fletcher, 2013; Vygotsky, 1978). That is why we distinguish and compare two different types of resilience in this study. This notion leads to the following central question of this study: to what extent does self-assessed resilience at one moment relate to temporal indicators of resilience?

It is hypothesized that individuals with more fluctuations in motivation, self-efficacy, and mood have a lower score on a static resilience measure.

Methods

Participants

The participants of this study are members of a soccer team (U15/16) in the youth academy of a Dutch football organization. These participants have been recruited through the *Resilient Athletes* program (www.project-ris.nl). In total 53 players were part of the initial dataset. However, participants with many missing observations were not suitable for the planned time series analysis. That is why a twofold criterium has been applied. In the first place, participants should not have more than four days in a row without data. Secondly, participants should have at least 25 datapoints (van der Krieke et al., 2015). This results in a final dataset of 28 players.

Procedure and design

In the beginning of the season all players filled out a psychological questionnaire including the Brief-Resilience Scale (Smith et al., 2008). Regarding the measurements on a daily basis, players receive a message in the morning to answer three questions about their self-efficacy, motivation, and mood (resilience indicators) and two performance related questions after the training session. A time slot of one hour was created to answer these questions every day. Links to the questionnaires through SMS have only been sent during training and matchdays. One person in particular was responsible for monitoring this process. This person stimulated players indirectly to take ownership about their own learning process by checking in with coaches every day. Coaches are then forwarded to activate their players with courageous signals.

Measures

Static measurement.

The Brief-Resilience Scale (BRS) was used as a static resilience measure which measures the ability to ‘bounce back’ in six different items (Smith et al., 2008). One example item is ‘I *tend*

to bounce back quickly after hard times' which is scored from 1 = never, … to 7= always. The internal consistency of the BRS varies between α = .80 to .91 (Smith et al., 2008). The internal consistency of the current dataset on the BRS is α = .839.

Dynamic measurement.

Secondly, participants got twice a day a message on their mobile phones and had to answer three questions before the training session about mood, motivation and self-efficacy and two questions after the training session about the training load and enjoyment (the latter were not included in the analysis). An example of one of the questions is: '*To what extent are you motivated today to perform maximally?*'. Players had to respond from 0 (totally not motivated) to 100 (totally motivated).

Data-analysis These data were transferred into R Studio and IBM SPSS 28 Statistics to analyze. The static measurement of resilience is assessed with an average of the BRS. The dynamic measurement of resilience has been calculated through the Mean Squared Successive Difference (MSSD) (Von Neumann et al., 1941), which has been displayed in the next equation:

$$\delta^2 = \frac{1}{n-1}\sum_{\mu=1}^{n-1}\left(x_{\mu+1} - x_{\mu}\right)^2 \quad (1)$$

where

δ^2 = unity of the mean squared successive difference

$\frac{1}{n-1}$ = degrees of freedom

$\sum_{\mu=1}^{n-1}\left(x_{\mu+1} - x_{\mu}\right)^2$ = summation of the squared differences of each value in the population

This MSSD is a measurement which is able to detect variability in time series analysis. If someone's mood/motivation/self-efficacy differential levels are slowly recovering, these are indicators of low resilience. If someone's mood/motivation/self-efficacy differential levels quickly bounce back, these are indicators of high resilience.

A Pearson's correlation has been calculated between the averages of the BRS and the MSDD of the dynamic measurements to examine whether, as hypothesized, fluctuations in the daily psychological measures are related with a general self-report assessment of resilience.

Results

The *Brief Resilience Scale* has a mean of $M = 3.90$ and a standard deviation of $SD = 0.36$. Table 2 displays the descriptives of the three MSSD variables. The MSSD computations can be found in the attachment, where the R script has been added too. A *Pearson's* correlation has been calculated between the *Brief Resilience Scale* and the MSSD per resilience indicator.

Table 2.

Means and standard deviations of the three MSSD values of the resilience indicators.

	MSSD		
	Self-efficacy	Mood	Motivation
M	173.06	100.75	73.04
SD	208.11	165.76	117.42

Table 3.

Pearson's correlations between MSSD values and the Brief Resilience Scale.

		MSSD		
		Self-efficacy	Mood	Motivation
BRS	*r*	-.215	-.193	-.097
	p	.271	.325	.624

The correlations between the BRS and the three resilience indicators are considered as small ($r < .22$). None of the relationships found is significant which is not in line with the hypothesis. Therefore, the null hypothesis will not be rejected.

Discussion

The aim of the current study was to examine whether self-reported resilience correlates with actual resilience indicators that individuals demonstrated over time. It was hypothesized that fluctuations on the indicators of resilience (mood, motivation and self-efficacy) are related with a lower score on the BRS. It can be concluded that this hypothesis could not be supported based upon the low correlations found in this study. Although unexpected, there are different theoretical and practical reasons that may explain the lack of correlation.

First, in the original study of the BRS the 'bouncing back ability' was particularly important for people who are already ill or are dealing with ongoing health-related stressors (Smith et al., 2008). However, in this study resilience is conceptualized in a high-performance context where the study population is enormously specific, such as having a good physical health is a requirement to become a (youth) soccer player. This could be a reason why the BRS does not match with this population.

Second, in this research design the fluctuations in mood, motivation and self-efficacy serve as indicators of resilience (Helmich et al., 2021). Actually, the whole bouncing back process was not included in the study. For example, temporal autocorrelations of the stressors did not play a role in this research design and tend to be essential in resilience (Scheffer et al.,

2018). This mode of measurement is able to grasp the impact of a stressor, whereas the current study only the mean squared successive differences of the resilience indicators tested.

Third, the resilience indicators in this study (mood, motivation and self-efficacy) have been measured from day-to-day. In the review article of den Hartigh and colleagues (2022) it was stated that these resilience indicators strengthen the daily recovery process and performance of athletes. On the other hand, Sarkar and Fletcher (2012) argue that these factors are positive influencers of resilience but are likely to remain stable across time and could be measured at a lower frequency. This notion undermines the measuring frequency of this study.

Lastly, another reason why the two measurements did not correlate could lie in the non-response rate of this study (Berg, 2005). Approximately three-thirds of the initial participants of this study needed to be removed due to non-sufficient responding. Since one of the measurement variables is motivation, it is possible that only the individuals with high in motivation did answer the SMS surveys on a regular basis. The result of this study confirms that motivation is the resilience indicator with the least variation and is likely susceptible for this phenomenon.

Strengths and limitations

The most important and salient asset of this study is the research method, namely by comparing two different types of measuring resilience. This kind of analysis have not been done before in the field of resilience research. In the introduction of this study the advantages of dynamic measurement above a static measurement have been named. This combined research method was aiming at reducing cognitive biases and displaying intraindividual variability over time (Collins, 1991; Kusev et al., 2018; Kahneman & Tversky, 1996). According to Vygotsky (1978) a combined measure of static and dynamical data provides more information about someone’s resilience over time and this study confirms this notion.

Because of two different measurements of resilience allows the monitor for comparing individual results and on his turn input for coaches.

Another strength of this study is the strong ecological validity, especially how closely connected the study population and the 'real world' are. The data have been collected in the natural environment of the participants and were able to register their sincere resilient behaviors without noise. In this study not a single instruction nor manipulation condition have been added to the process, which enables to exclude confounding variables (Frank, 2000). Every participant had the same procedure and opportunities during the whole study. Furthermore, with a comparable data infrastructure every football youth academy should be able to replicate this study and investigate resilience in the same manner.

Nevertheless, this study contains a few shortcomings as well. In the first place, the initial dataset comprised a lot of missing data which limits on the one hand reliability and on the other hand validity numbers. According to a paper of Schouten et al. (2018) missing data impact the whole dataset and prevent the opportunity to run time series analysis. Over three-thirds of the participants had to be removed from the data which put this study under risk of serious statistical inferences. This limitation has been attempted to counter with the criteria of Van Krieke et al. (2015) by which the reliability of this dataset has been guaranteed.

Furthermore, by diminishing the initial dataset into a final dataset without missing data (based on the two criteria that were set in the method section) a small sample has been left. This small sample size leads to less impactful conclusions about the population and is therefore difficult to generalize the conclusions of this study to a broader group (Hertzog, 2008). With a power of 80% the minimum sample size should have been 30 and could be counted as a threat in this study (Fraenkel & Wallen, 2009).

Practical implications and future directions

This study has reached its point where science meets practice. In the first place, resilience has been defined as a set of characteristics which facilitates people to adapt to potential future adverse events (Galli & Vealey, 2008). Besides, other researchers characterized resilience as an ability to bounce back to normal functioning after a perturbation (Den Hartigh et al., 2022). But more interestingly is: why do these two captures of resilience have barely anything in common with each other? Is there something that is out of sight? Maybe future research could find out if there is a third dimension in this complex mystery of capturing resilience in scientific concepts.

The inferences of this study could be added to the existing knowledge and framework of the *Resilient Athletes* project and in particular the personalized approach (Den Hartigh et al., 2022). Since the different measurements of resilience do not match, it is particularly important that the monitor of the daily data maintains its function. Furthermore, these findings should apply in the one-on-one conversations with coach and player and address inconsistencies and comparisons in the resilience data.

Lastly, in psychological research observational studies are well-known and common to use whereas in this study two self-assessment methods have been used (Rosenbaum, 2005). An augmentation of the current study would be to combine time-series analysis (dynamic measurement) with a standardized way of observing resilient behaviors. This could be executed in a sequential method. Firstly, all the pre-existing quantitative data will be collected. Then, during the season observations will be made according to a predetermined scoresheet on which categories of different resilient behaviors (e.g., ‘a player does immediately go back into defensive position after losing the ball) are represented (Huffcutt et al., 2014). The interpretation of resilience will be based on a decision formula with different weights to guarantee the reliability of this measurement.

(Bergkamp et al., 2022; Meijer et al., 2020).

Conclusion

All in all, self-reported resilience does not correlate with actual resilience indicators that individual soccer players demonstrated over time. This knowledge could be integrated in the existing frameworks of the *Resilient Athletes* project. Improved monitoring and prediction of psychological resilience could help target adequate intervention options which in turn will be beneficial to players and their coaches. Individual trajectories of players will be discussed with coach-player conversations and give them input with situations concerning resilience.

References

Berg, N. (2005). Non-response bias. *Encyclopedia of Social Measure*, *2*, 865–873. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1691967

Bergkamp, T. L. G., Frencken, W. G. P., Niessen, A. S. M., Meijer, R. R., & den Hartigh, R. J. R. (2022). How soccer scouts identify talented players. *European Journal of Sport Science*, *22*(7), 994–1004. https://doi.org/10.1080/17461391.2021.1916081

Carver, C. S. (1998). Resilience and Thriving: Issues, Models, and Linkages. In *Journal of Social Issues* 54(*2*). https://doi.org/10.1111/j.1540-4560.1998.tb01217.x

Collins, L. M. (1991). Measurement in longitudinal research. In L. M. Collins & J. L. Horn (Eds.), *Best methods for the analysis of change: Recent advances, unanswered questions, future directions* (pp. 137–148). American Psychological Association. https://doi.org/10.1037/10099-009

Connor, K. M., & Davidson, J. R. T. (2003). Development of a new Resilience scale: The Connor-Davidson Resilience scale (CD-RISC). *Depression and Anxiety*, *18*(2), 76–82. https://doi.org/10.1002/da.10113

den Hartigh, R. J. R., Meerhoff, L. R. A., van Yperen, N. W., Neumann, N. D., Brauers, J. J., Frencken, W. G. P., Emerencia, A., Hill, Y., Platvoet, S., Atzmueller, M., Lemmink, K. A. P. M., & Brink, M. S. (2022). Resilience in sports: a multidisciplinary, dynamic, and personalized perspective. *International Review of Sport and Exercise Psychology*. https://doi.org/10.1080/1750984X.2022.2039749

Fletcher, D., & Sarkar, M. (2012). A grounded theory of psychological resilience in Olympic champions. *Psychology of Sport and Exercise*, *13*(5), 669–678. https://doi.org/10.1016/J.PSYCHSPORT.2012.04.007

Fletcher, D., & Sarkar, M. (2016). Mental fortitude training: An evidence-based approach to developing psychological resilience for sustained success. *Journal of Sport Psychology in Action*, *7*(3), 135–157. https://doi.org/10.1080/21520704.2016.1255496

Fraenkel, J. R., & Wallen, N. E. (2009). The nature of qualitative research. *How to design and evaluate research in education*, 420.

Galli, N., & Vealey, R. S. (2008). "Bouncing Back" From Adversity: Athletes' Experiences of Resilience. In *The Sport Psychologist* (22). https://doi.org/10.1123/tsp.22.3.316

Gijzel, S. (2020). *Bouncing Back Using a Complex Dynamical Systems Approach to Measure Physical Resilience in Older Adults*. [Doctoral dissertation, Radboud University Nijmegen]. Retrieved on 5th of May 2023, from repository.ubn.ru.nl

Gucciardi, D. F. (2011). The Relationship Between Developmental Experiences and Mental Toughness in Adolescent Cricketers. *Journal of Sport and Exercise Psychology*, *33*(3), 370–393. https://doi.org/10.1123/JSEP.33.3.370

Helmich, M. A., Olthof, M., Oldehinkel, A. J., Wichers, M., Bringmann, L. F., & Smit, A. C. (2021). Early warning signals and critical transitions in psychopathology: challenges and recommendations. *Current Opinion in Psychology*, *41*, 51–58. https://doi.org/10.1016/j.copsyc.2021.02.008

Hertzog, M. A. (2008). Considerations in determining sample size for pilot studies. *Research in Nursing and Health*, *31*(2), 180–191. https://doi.org/10.1002/nur.20247

Huffcutt, A. I., Culbertson, S. S., & Weyhrauch, W. S. (2014). Moving Forward Indirectly: Reanalyzing the validity of employment interviews with indirect range restriction methodology. *International Journal of Selection and Assessment*, *22*(3), 297–309. https://doi.org/10.1111/IJSA.12078

Kahneman, D., & Tversky, A. (1996). On the Reality of Cognitive Illusions. In *Psychological Review*, 103(3), 582-591. https://doi.org/10.1037/0033-295X.103.3.582

Krieke, L. van der, Jeronimus, B. F., Blaauw, F. J., Wanders, R. B. K., Emerencia, A. C., Schenk, H. M., Vos, S. de, Snippe, E., Wichers, M., Wigman, J. T. W., Bos, E. H., Wardenaar, K. J., & de Jonge, P. (2016). How Nuts Are The Dutch: A crowdsourcing study of mental symptoms and strengths. *International Journal of Methods in Psychiatric Research*, *25*(2), 123–144. https://doi.org/10.1002/mpr.1495

Kusev, P., van Schaik, P., Tsaneva-Atanasova, K., Juliusson, A., & Chater, N. (2018). Adaptive Anchoring Model: How Static and Dynamic Presentations of Time Series Influence Judgments and Predictions. *Cognitive Science*, *42*(1), 77–102. https://doi.org/10.1111/cogs.12476

Mallett, C. J., & Hanrahan, S. J. (2004). Elite athletes: why does the 'fire' burn so brightly? *Psychology of Sport and Exercise*, *5*(2), 183–200. https://doi.org/10.1016/S1469-0292(02)00043-2

Meijer, R. R., Neumann, M., Hemker, B. T., & Niessen, A. S. M. (2020). A Tutorial on Mechanical Decision-Making for Personnel and Educational Selection. *Frontiers in Psychology*, *10*, 1-8. https://doi.org/10.3389/fpsyg.2019.03002

Rosenbaum, P. R. (2005). *Encyclopedia of statistics in behavioral science*.

Rutter, M. (1985). Resilience in the Face of Adversity. *British Journal of Psychiatry*, *147*(6), 598–611. https://doi.org/10.1192/bjp.147.6.598

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68–78. https://doi.org/10.1037/0003-066X.55.1.68

Sarkar, M., & Fletcher, D. (2014). Psychological resilience in sport performers: a review of stressors and protective factors. *Journal of Sports Sciences*, *32*(15), 1419–1434. https://doi.org/10.1080/02640414.2014.901551

Sarkar, M., & Fletcher, D. (2013). How Should We Measure Psychological Resilience in

Sport Performers?, *17*(4), 264–280. https://doi.org/10.1080/1091367X.2013.805141

Scheffer, M., Bolhuis, E. J., Borsboom, D., Buchman, T. G., Gijzel, S. M. W., Goulson, D., Kammenga, J. E., Kemp, B., van de Leemput, I. A., Levin, S., Martin, C. M., Melis, R. J. F., van Nes, E. H., Romero, L. M., & Olde Rikkert, M. G. M. (2018). Quantifying resilience of humans and other animals. *Proceedings of the National Academy of Sciences*, *115*(47), 11883-11890. https://doi.org/10.1073/pnas.1810630115

Schouten, R. M., Lugtig, P., & Vink, G. (2018). Generating missing values for simulation purposes: a multivariate amputation procedure. *Journal of Statistical Computation and Simulation*, *88*(15), 2909–2930. https://doi.org/10.1080/00949655.2018.1491577

Smith, B. W., Dalen, J., Wiggins, K., Tooley, E., Christopher, P., & Bernard, J. (2008). The brief resilience scale: Assessing the ability to bounce back. *International Journal of Behavioral Medicine*, *15*(3), 194–200. https://doi.org/10.1080/10705500802222972

Southall, E., Brett, T. S., Tildesley, M. J., & Dyson, L. (2021). Early warning signals of infectious disease transitions: A review. *Journal of the Royal Society Interface*, *18* (182). https://doi.org/10.1098/rsif.2021.0555

Vealey, R. S. (1986). Conceptualization of Sport-Confidence and Competitive Orientation: Preliminary Investigation and Instrument Development. *Journal of Sport and Exercise Psychology*, *8*(3), 221–246. https://doi.org/10.1123/JSP.8.3.221

von Neumann, J. (1941). *Distribution of the ratio of the mean square successive difference to the variance*. Institute for Advanced Study.

Attachment 1

```r
# Lees data
data <- read_excel("Dagelijkse_meting_clean.xlsx")
selected.IDs <- read_excel("selected_ids.xlsx")

# Selecteer spelers
data.subset <- data[data$playerId %in% selected.IDs$ID,]
n <- length(unique(data.subset$playerId))

# Statistieken
summary(data.subset)

# Verwijder rijen met missing data in selfEfficacy
data.subset <- data.subset[complete.cases(data.subset$selfEfficacy), ]

# Aantal datapunten per speler
sort(table(data.subset$playerId))

# Check statistieken
summary(data.subset)

# Analyse
#x.df <- data.frame(trial,gr,t,c,ts,cs)
mssd.values <- data.frame(mssd(data.subset[,c("selfEfficacy", "mood", "motivation")], group = data.subset$playerId))
write_xlsx(mssd.values,"mssd_values.xlsx")
```

27:1 (Top Level) R Script

Attachment 2

Correlations

		Gemiddelde van brief resilience scale	selfEfficacy	mood	motivation
Gemiddelde van brief resilience scale	Pearson Correlation	1	-,215	-,193	-,097
	Sig. (2-tailed)		,271	,325	,624
	N	28	28	28	28
selfEfficacy	Pearson Correlation	-,215	1	,309	,543**
	Sig. (2-tailed)	,271		,110	,003
	N	28	28	28	28
mood	Pearson Correlation	-,193	,309	1	,344
	Sig. (2-tailed)	,325	,110		,073
	N	28	28	28	28
motivation	Pearson Correlation	-,097	,543**	,344	1
	Sig. (2-tailed)	,624	,003	,073	
	N	28	28	28	28

**. Correlation is significant at the 0.01 level (2-tailed).