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"Yesterday, all my troubles seemed so far away." Greater Emphasis on Within-Person Variability in Research and Practice within Social and Behavioral Sciences

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Abstract

In research, a shift is noticeable from between-person variability and variable-centered approaches to a combination of between- and within-person variability, thereby integrating a person-centered approach, or even to standalone research on within-person variability. In many domains of social and behavioral sciences within-person (also called intraindividual) variability was largely ignored or even dismissed as simple noise or measurement error variance. This mini-review examines the added value of within-person variability in different domains of human functioning, such as motivation, emotion, executive functioning, memory and sports. Lastly, future developments in research and practice will be discussed.

Keywords: Intraindividual Variability; Interindividual Variability; Within-Person Variability; Between-Person Variability

Introduction

In research within the area of social and behavioral sciences, a well-determined and global shift is noticeable from a static, variable-centered, highly controlled, single-method studies (like surveys, randomized-control trials, or experimental designs) to a more holistic, multi-method approach, tapping the dynamics of human behavior and capturing situated within-person next to between-person variability in the real habitat of the individual [1-3]. In some cases, the focus shifts entirely to standalone research on within-person variability. The mindful and deliberate embarquement in tapping situation- and context-specificity over time, taking into account within-person variability, is epistemologically captivating, though at the same time methodologically and ontologically very challenging [4,5]. The rise of new methods, like experience sampling approaches, person-centered next to variable-centered methods, (latent change) mixture models integrating a person- and variable centered approach, multi-methods and mixed methods, mixed methods intervention studies making use of multi-channel data, and the multifaceted and dynamic approach of interactions, underpins this shift towards more holistic and proliferated (mixed-method) designs. The latter also paves the way to an idiographic approach, being able to compare between-person and within-person variability as well as to embrace the interplay with contextual aspects [3,6]. Modelling and integrating data tapping both between- and within-person variability is noticeable in a domains like motivation, academic emotions, motor/executive functioning, movement and sports, though in many domains of social and behavioral sciences it is largely neglected or even dismissed as mere noise or variation stemming from measurement errors. In this mini review, the (added value of the) aforementioned shift will be illustrated in different domains of human functioning. Finally, future aims and developments in research and practice will be highlighted.

Motivation

Research has amply shown fluctuations in the development of motivation over time and across contexts [7], notifying a general decline in motivation among adolescents to be associated with

a decline in the satisfaction of the basic psychological need for competence, autonomy, and relatedness [8]. Among Australian adolescents, Garn et al. [9] showed that the stability coefficients of autonomous motivation became small and non-significant, suggesting that longitudinal fluctuations in global levels of need satisfaction require far more attention across different time-periods. Moreover, Fernet et al. [10] found that within-person changes in work motivational profile membership occurred for 30 up to 42% of the health care nurses in a 24-month period. Hence, Fernet et al. [10] emphasized the dynamic character of motivation urging for further studies to unfold the predictors of change in motivation not only among employees, but also in upcoming employees to realize a smooth transition from education to work settings.

In the context of a six-months' lasting project-based, cooperative learning setting in secondary vocational education, Minnaert [11] found substantial percentages of students' psychological needs satisfaction of competence, autonomy and relatedness, and in situational interest (i.e., 51 up to 84%) to be attributed to within-student variability. The largest amount of within-students variability was found in the psychological need satisfaction of relatedness. This amount of within-student variability indicates substantial motivational fluctuations within students over time in a project-based learning environment, entreating room and time for targeted person-oriented coaching and – if necessary – tailored intervention. This yields an important take-home message for education- and workplace-based designers who focus on cooperative learning goals within interactive learning and workplace environments.

Academic Emotion

To acquire grade 7 students' daily academic emotions, Ahmed et al. [12] made use of a diary method. Within-person variability in emotional states accounted for 41% (for pride) up to 70% (for anxiety) of total variability in the emotional states. The findings showed that a substantial proportion of variance in students' emotional experiences lies within individuals, however, the between-person variability was substantial enough to suggest that there are definitely interindividual differences in daily emotional experiences too. Of importance is that the within-person variability was smaller for the positive emotions compared to the negative emotions. As positive emotions seemed to be relatively more stable than negative emotions, both between-person and within-person approach to studying emotions is of huge importance in research and in educational practice, especially for monitoring students with higher levels of school-related and/or lesson-specific anger, anxiety, boredom and/or hopelessness.

In their effort to better connect achievement goals and discrete academic emotions in theory and in empirical research, Goetz et al. [13] administered and analyzed interindividual relations (based on trait assessments) and intraindividual relations (based on state assessments) among 10th grade students by assessing students' state goals and emotions using experience sampling. Goetz et al. [13] found that performance-approach and performance-avoidance goals were clearly separated at the intraindividual level ($r = .48$), in contrast to a strong correlation at the interindividual level ($rs = .86$ to $.90$). Achievement emotions were also found more clearly separated at the intraindividual level. It was noted that the intraindividual correlation between state anxiety and state shame was .50, whereas the interindividual correlations were .80 up to .94 (respectively for trait emotions and aggregated state emotions). It was stated by the authors that the strength of relations between variables may highly depend on the situational specificity of the assessment, with state assessments being far more (situationally) specific compared to trait assessments. The latter were based on (mentally) averaged recollections across situations, inflating correlation coefficients at the interindividual level.

Motor and Executive Functioning

Dealing with motor performance lapses, Jacobsen et al. [14] showed that children with Attention-Deficit/Hyperactivity Disorder (ADHD) demonstrated increased response variability compared to typically developing children. Children with ADHD slowed lower, more variable, and more skewer reaction times on a motor task compared to controls. Although the reaction times skewness for both children with ADHD and control augmented during the second half of the motor task, children with ADHD outperformed the controls at all times. Regretfully, the data in the study of Jacobsen et al. [14] do not explicitly and fully address within-person variability. The increased reaction time skewness on group level call for a more in-depth approach as lower reaction times were associated with reduced reading fluency. Is this valid for every child, for all children with ADHD, and even regardless of the ADHD symptom severity level?

The aforementioned questions can only be answered in case a within- and between-person approach was jointly investigated in the same research. An interesting example stems from Schmiedek et al. [15], who made use of intraindividual means (iMs) and intraindividual standard deviations (iSDs). The authors modelled working-memory related reaction times to disentangle the (non-linear) relationship between iMs and iSDs across age groups. They found that day-to-day variability (by modelling the iSDs) was significantly larger for older than for younger adults. Besides, Schmiedek et al. [15] were able to show that the relations between iMs and iSDs of working-memory related reaction times were non-ergodic, meaning that the structure of between-person differences did not match the structures of within-person variability. As the within-person relations between iMs and iSDs differed reliably and widely across persons, the authors stated that the roughly linear relation of between-person differences in means and standard deviations revealed close to nothing about the functional relations between means and standard deviations within a given person. Noteworthy is the growing interest

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in intraindividual variability in research on cognitive aging, especially to improve our understanding of developing persons as dynamic systems [16].

Movement and Sports

Bartlett et al. [17] reported intra-individual differences in novice, club and elite javelin throwers. Intraindividual differences were greater for the novice and the elite throwers than for the club throwers. Even throwers striving for maximum distance cannot generate identical coordination patterns. Also elite athletes appear unable to produce invariant movement patterns after years of practice [18]. Although it is well-known that processing speed and executive functions decline with advancing age, Fagot et al. [19] found that physical activity had a positive impact on cognitive performances in aging. Their study investigated the influence of physical activity and gender differences on intraindividual differences in inhibitory performance during aging. Based on the physical activity level, healthy adults were divided into active and sedentary groups. An interaction between activity level and gender was revealed, sedentary females being slower and more variable than sedentary men. No gender differences were found in the active groups. These results indicate that the negative impact of sedentariness on cognitive performance in older age is stronger for females. In this study, looking into intraindividual variability brought subgroup differences, namely gender differences, to the fore.

Conclusion and Future Directions

Both in research and in practice, patterns of huge intraindividual variability next to interindividual variability characterize the asynchrony in states and traits within persons, especially those with special (educational) needs. In the literature review of Beckmann and Minnaert [20], the asynchrony between the gift and the challenge(s) and the huge within-person variability in non-cognitive characteristics of twice-exceptional students, i.e., gifted students with specific learning disorders, were clearly depicted. Moreover, the review study of Rizzo et al. [21] stated that cognitive functioning was consistently described as characterized by high within-person variability, confirming that twice-exceptionality rarely manifests as a homogeneous cognitive pattern, but rather as an irregular constellation of abilities, resulting in waxing and waning (achievement) outcomes. By means of State Space Grids analyses on data from autistic students in the Netherlands and in Mexico, within-person variability was addressed upon in the teacher-student interaction dynamics [22]. By means of video-stimulated recall interviews on videotaped lessons, huge within-person variability was encountered in autistic students' thoughts and emotions, highly influenced by the variation in supportive or thwarting factors in the environment [23]. The latter was also drawn from research on persons with congenital or acquired deafblindness interacting with their communication partner [24]: a decrease in the level of support provided by the communication partner leaded often to a substantial immediate and/or long-term decline in students' engagement.

All in all, we can draw the conclusion that a greater emphasis on within-person variability is highly requested in both research and practice within the social, behavioral and movement sciences. To improve our scientific understanding about human functioning and to aim for an epistemological shift forward, we need to jointly embrace between- and within-person variability, in line with Murayama et al. [1] and with Chrzanowski-Smith et al. [25]. We need to test for ergodicity before making conclusions about one individual, as to check whether the structure of between-person variability on the larger population also matches with the structure on the within-person level, as stated by Schmiedek et al. [15].

To understand and support individuals in various contexts, we need to account for situational differences, for assessment-related variations (e.g., state versus trait assessment, speed- or power-related assessments), for fluctuations in the quality of (student-student, student-teacher, child-parent, employee-employer, athlete-coach) interactions, and for the waxing and waning in the (asynchrony in the) mental and physical status of the individual in various domains of human functioning. Beyond and above, we need to grasp the interplay of the aforementioned factors that might give rise to substantial moment-to-moment and day-to-day fluctuations. Rather than being simple noise or measurement error variability, within-person, intraindividual variability is crucial for the adaptation to environmental constraints, for the enhancement of knowledge and skill acquisition, for the improvement of cognitive, social and emotional, attentional and executive functioning over time, and for the optimization of movement, sport performance, and injury risk management. All of the above underpins the compelling (song) title of this contribution: Yesterday, all my troubles seemed so far away.

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