RRREaT-PT

Editorial, 2026, February

Continuous Short-Term to Long-Term Flexibility: Nature's Balancing Act and Research

I live in the countryside where our garden is surrounded by green grazing lands that are crisscrossed with small ditches and small stripes of woodland. Consequently, there is an abundance of grass that springs into existence everywhere, and every year it leads to the enormous task of removing these weeds from paths and flower borders, by hand because we do not want to use pesticides. In our garden is also a small round pond with a little island of water lilies floating in the middle and a few dandelions and something that looks like cane-grass. The little island is surrounded by water, loud-croaking frogs, and next is a surrounding border with flowers. The surrounding border has a small fence that separates the pond and its flower border from the field of grass, path, and terrace. Every year we have tried to get rid of the grass in this flower border and the little island in the pond, by hand, but this year we could not bring it up again and the flower border became overgrown with grass. Then, on a warm day in June, we were sitting on the terrace and suddenly saw the grass in the flower border shaking. On closer inspection, we noticed a mother duck walking around with five ducklings. Her nest was on the little island in the pond. We were pleasantly surprised and "happy" for not having removed the grass from the flower border this year. This is not the only surprise we have encountered in nature over the years. We like to go for long walks with our dog and in doing so, we noticed that in certain areas you see the same vegetation every year. However, in some years, there suddenly is a lot of a certain kind of flower, such as clovers, whereas another kind of flower can be almost absent. Also, the amount of butterflies and ladybirds, for instance, can vary widely per year. The overall scenery may appear to be the same across the years, but there are also noticeable specific variations in species across the years.

These sudden appearances of flexibility in nature can give the impression that nature performs a balancing act, in that flexibility can arise in a continuum of short- up to long-term changes. On the one hand, there is a favorable preferred structure of biodiversity that appears to be well adapted to its environment, on the other hand, this structure can be flexible at certain times in order to deal with the fluctuations that can arise due to the interconnection of time and organisms in the environment(s), in that it can necessitate changes. It raises the question of whether this balancing act of nature is merely the reacting to a state of the moment, as in an unforeseeable or accidental happening, or the following of patterns, such as there being rules and mechanisms that underlie the flexible actions. Is the sudden abundance of certain plants during one particular summer to be expected or is it an unforeseeable affair? The aim of this article is to explore flexibility as a balancing act of organisms that are in interaction with their environment across time to facilitate our thinking about the consequences of short- up to long-term flexibility for conducting research studies.

Balancing Structured and Flexible Reacting: Components and Patterns

Cell Biology

In a previous article (Van Velzen, 2025a), I compared structured reacting in cell biology that is enabled via DNA as the genetically repeating of cellular components with the mitochondrial bilayer membrane that can react flexibly to circumstantial changes in the cell and the mitochondria's internal environment. Here, structured reacting is the repeating of what is there, and reacting flexibly is the readily changing of what is in order to adapt to deviations to maintain balance. For example, the folding of proteins in the cellular organelle of endoplasmic reticulum (ER) is enabled via DNA in always the same manner, whereas the activities of the mitochondrial bilayer membrane enable flexible reactions to deviations in the environment. The research on both subjects is ongoing, in that the knowledge from these research areas is yet incomplete.

To elaborate on protein folding, proteins are chains of amino acids that have a certain sequence and are folded in a particular 3D-shape to perform a special function (see Åqvist, 2024; Leder et al., 2025; Rajasekaran & Kaiser, 2024). Each specific chain of amino acids is created via DNA which has encoded the arrangements of the amino acids. The organelle of ER can fold each chain of amino acids into their correct shape reliably by, again and again, producing the correct 3D-shape that enables a function. The correctly folded proteins are released from the ER to perform their many functions because they are the workhorses of the cell. When many chains of amino acids remain unfolded and are misfolded, then the cell becomes stressed and cannot function appropriately anymore and may even die. How the protein folding takes place exactly, with the help of ribosomes and chaperones, is currently a major research area. The folding of a chain of amino acids in the ER into a correct 3D-shape is an example of structured reacting to the existence of cells, in that the correct folding supports that the cell is functioning as it should be.

Conversely, the mitochondrial membrane can change quickly to adapt, mainly to the energy demands of the cell, but also to other mitochondrial functions, such as calcium homeostasis and protein and lipid regulation. The asymmetric bilayer membrane that consists of an outer and inner membrane, the in between inter-membrane space, and bulges in the inner membrane that are called cristae, enables mitochondria to react quickly to changes in the cell, such as metabolic requirements and stress (see Giacomello et al., 2020; Landoni et al., 2024; Pabst & Keller, 2024, for overviews). The quick mitochondrial reacting mainly comes forth from the ability of the mitochondrial membrane to lengthen and shorten itself, known as the dynamic process of fusion and division, and the mitochondria to move around and create interconnected networks throughout the cell. As stated by Lovine et al. (2024, p. 1), “They [the mitochondria] are dynamically polymorphic, undergoing morphogenesis events with an extent and frequency that is just now being appreciated.” For example, mitochondria in neuronal axons are small and sparse and active, whereas in dendrites, they are elongated, have a larger volume, and are less active, all in line with the difference in axonal and dendritic neuronal activity (Seager et al., 2020). Especially, the remodeling capacity of the inner mitochondrial membrane and cristae via fusion and division enables mitochondria to respond to the changing metabolic needs in the cell and other stimuli, whereas a lack of remodeling and uncontrolled remodeling leads to a distortion of the inner mitochondrial membrane and cristae and creates less mitochondrial dynamics and the development of diseases (see Figure 1a).

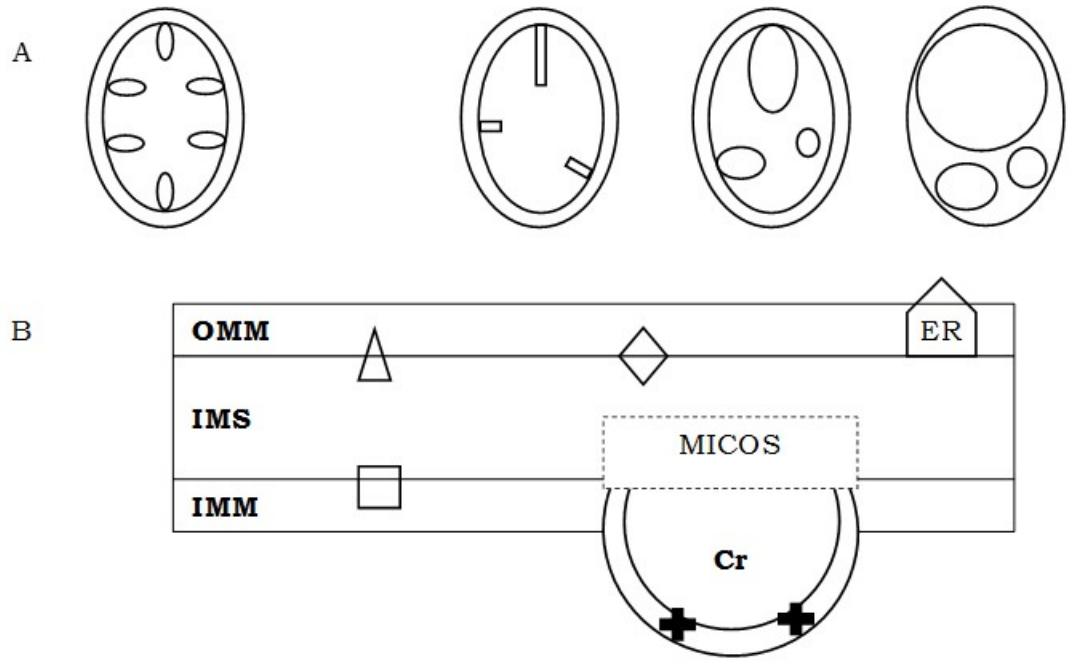


Figure 1. Schematic illustration of the mitochondrial membrane and some complexes involved in the remodeling of the internal mitochondrial membrane and cristae. (A) The left illustration shows the cristae membrane curvature, the next three illustrations show abnormal curvature during loss of cristae membrane remodeling in the MICOS complex, OPA1, MICU1, and F_1F_0 ATP Synthase. (B) OMM = outer mitochondrial membrane. IMS = inter-membrane space. IMM = inner mitochondrial membrane. Cr = Crista. The IMS and Cr are connected via an opening, the so-called MICOS complex that regulates cristae organizing. A major segment of the MICOS is associated with the outer membrane proteins via Δ = TOM or protein translocase and ◊ = SAM, the sorting and assembling complex. ⌂ = the contact side with ER for fusion and division. The inner membrane houses □ = MICU1 or calcium uni-porter that together with OPA1 plays a fundamental role in the formation of cristae junctions (see A). **+** = F_1F_0 ATP Synthase in the crista tip to create energy via oxidative phosphorylation (OXPHOS).

The outer mitochondrial membrane has a flat surface compared to the inner mitochondrial membrane and its cristae, which have a more convoluted and adaptive architecture, in that the inner mitochondrial membrane and cristae house the mitochondrial complexes that are associated with membrane remodeling (see Figure 1b). It is expected that the larger surface areas of the inner mitochondrial membrane and its cristae allow for increased enzymatic activity, and hence, increased flexibility because the dynamic remodeling in the MICOS complex were found to take place in a reversible and balanced manner at a timescale of seconds (Kondadi et al., 2020).

Overall, the comparison between ER's protein folding and the inner mitochondrial and cristae activity suggests that structured reacting is more static and long-term than reacting flexibly, which is more adjusting and quick, but both involve multiple specific components to sense deviations.

Plant-Soil Bio-Ecology

In general, the existence and growth of plants is thought to be the interaction between the plant, the environment, and the presence of pathogenic agents, such as pests and insects. As shown in Figure 2, on the one hand, plants require healthy soil and microbial organisms, other plants, and photosynthesis to convert sunlight and water into carbohydrates for energy. These enable the structured reacting of plants in order to exist and grow. On the other hand, the growth and health of plants depends on the environment and pathogens. These can vary across time and place, such as the Eh-pH status (i.e., oxidation-reduction and hydrogen ion concentration: Husson et al., 2021), soil fungi (Camenzind et al., 2021), water for photosynthesis and nutrient uptake (Sumner & Venn, 2021), soil-microbial activity (Wang et al., 2024), and competing plant species (Senthilnathan & D'Andrea, 2024). This requires a flexible reacting from the plant.

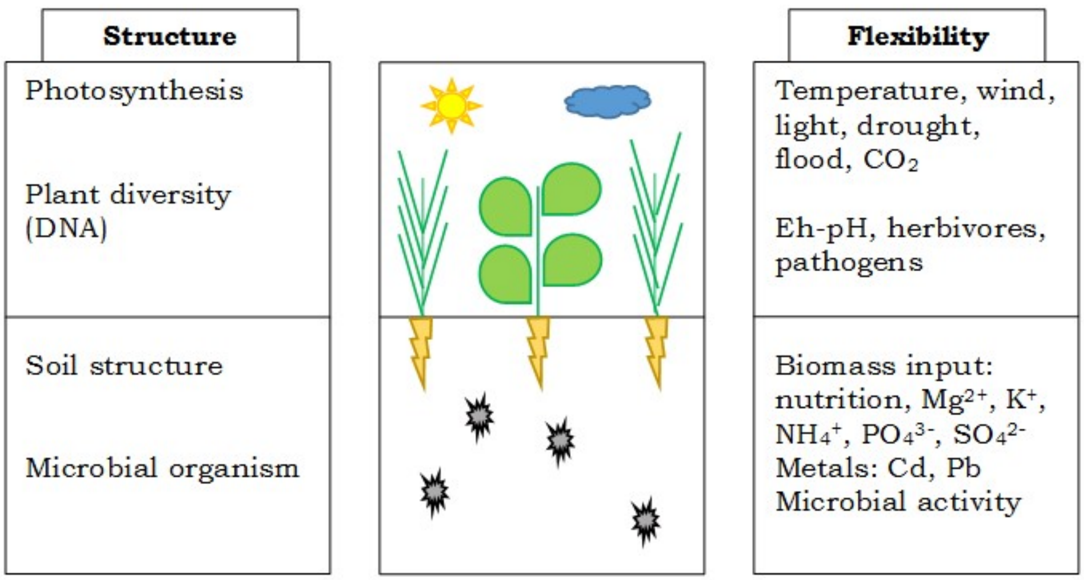


Figure 2. Schematic presentation of the overall plant-soil bio-ecological components.

However, the dynamic interaction between plant species, soil structure, microbial organisms, the various environmental influences, and the diversity of pathogens across time and also place (e.g., the seeds of plants spreading out via the wind and herbivores) provide for a complex puzzle. To solve this complex puzzle, researchers recently have begun to focus on plant-soil feedback or the effects of plant-induced changes in soil properties that impact plant growth (De Long et al., 2023; Heinze et al., 2020). That is, plants condition the soil in which they grow because they not only claim nutrients and chemicals from the soil when they grow, but they also give back nutrients and chemicals when they decay. Plant-soil feedback studies employ a bio-ecological focus that involves the conducting of natural field trials as opposed to the highly controlled greenhouse conditions. However, it is not easy to account for all influences in natural field trials. Take for example Kostenko and Bezemer (2020), who examined how soil legacy effects created by entire plant communities influence plant growth. They placed the plant Jacobaea vulgaris in three kinds of large pots, one filled with field soil, one with live inoculum, and one with sterilized inoculum, in a greenhouse to find a weak positive legacy effect of plant diversity on the root biomass of the Jacobaea vulgaris. Aside from dealing with the various influences of natural environments, field trials also can have variation in space-temporal scales (Frouz, 2024, p. 2), in that the “Immediate interactions and long-term legacy represent endpoints of a gradual continuum rather than discrete categories.” That is, in the initial stages of field forming or development, the present vegetation substantially contributes to changes in the soil until relatively stable soil conditions are reached. A final issue regarding field trials is that the roots from the original vegetation can sprout again and thereby contaminate the research design. To fight sprouting, researchers can dig off the aboveground biomass and weed and use a 5% glyphosate treatment (Forero et al., 2021; Kostenko & Bezemer, 2020), but this interferes with the soil structure.

Both greenhouse and field trial plant-soil feedback studies revealed insights about the abilities of plants and soil to react flexibly to environmental conditions that can endanger their ecological homeostasis. For example, Camenzind et al. (2024) found that soil fungal mycelia reacted flexibly by adjusting C:N (i.e., Carbon-Nitrogen) and C:P (i.e., Carbon-Phosphorus) ratios for all growth media types and manipulation. The observed high flexibility of C:P ratios and moderate flexibility of C:N ratios that were found in fungal *individuals* showed that soil fungi can adjust their C:N:P ratios more flexibly than expected, however, “Our data on individual fungal do not directly indicate flexible C:N:P ratios at the community level” (Camenzind et al., 2024, p. 215). Although underlying mechanisms were not accounted for, the indeterminate lifestyle of soil fungi may permit flexibility because soil fungi can dynamically translocate elements within their mycelium if demanded, and they can internally recycle elements and cytoplasm. Another example is the long-term field trial on plant diversity (Fargione et al., 2007; Forero et al., 2021), which showed that a high plant diversity gave higher rates of Nitrogen accumulation and, hence, plant growth. Specifically, some plant species prefer mono-cultures, where others prefer poly-cultures, but in general, plants grow faster in varying plant communities because, when it is just their own kind, they create soils that in the longer term decreases the growth of their own kind.

Additionally, plant-soil studies showed that a higher diversity of plant species and soil-microbial organisms led to an increase in the growth and health of plants (see Saleem et al., 2019, for a review). Healthy plants can fight stressors, such as extreme drought and temperature and attacks from herbivores, insects, and pathogen bacteria. Saleem et al. (2019, p. 146) explain it as follows: “Thanks to its remarkable genetic, ecological, functional, and taxonomic diversity, the soil microbiome is a vital reservoir of microbial traits that are potentially relevant for plant growth and health.” Aside from diversity, there are also insurance plans to restore previous components and states, such as the seeds from plants being capable of surviving in the soil in anticipation of better times. Another example is, in times of extreme drought, plants can die back and some microbial species that can withstand drought can survive. This kind of insurance plan enables the recurrence of a previous well-functioning component and state, as in when better climate conditions arise, pioneering plants can rebuild previously well-functioning states.

Overall, the balance between plant growth and healthy soil involves (a) plant species and microbial diversity, (b) individual micro-species’ ability to react flexibly, and (c) insurance plans to restore original environments. It suggests that flexibility is enabled by multiple soil components in relation to microbial organisms that have the ability to make quick and abrupt adjustments and a plant-feedback system from diverse plant species in relation to soil organisms to enable gradual changes.

Humans and the Environment

So far, the overview from cell biology and plant-soil feedback bio-ecology shows that flexibility in order for organisms to exist in the environment is a complex puzzle that involves multiple components (e.g., cellular organelles and membrane receptors) in a dynamic process (e.g., the quick individual changes of fungal and some bacteria, and the gradual changes via decaying plant species) that takes place across time, which both enable and control variable influences in the environment. It means that fluctuations can arise as deviations from perfect homeostasis as a consequence of environmental influences that meet individual characteristics that require changes, from few to many and from slow to quick, but within certain restrictions to continue the existence of organisms and environment (see Figure 3). With regard to humans, this raises the question of do individual behaviors account for the varying interactions within and between individuals with certain characteristics in the environment and in the short and long term, but within certain restrictions to enable its functionality for all. For example, if we can assume that human flexible behavior to environmental fluctuations in the short and long term are a balancing act that takes place within the restriction of a higher and lower border, then it warrants a scientific search for patterns.

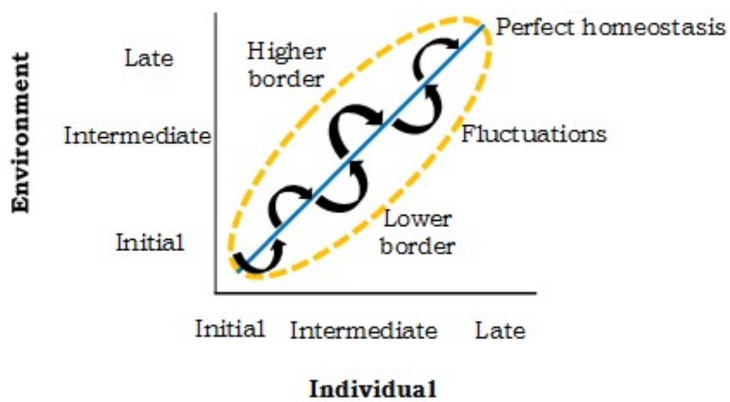


Figure 3. Schematic presentation of the restrictions in the fluctuations of homeostasis based on the individual in the environment across time. Blue linear line = perfect homeostasis. Black arrows = degree of fluctuations in space and time. Orange dotted line shows the upper and lower restriction for homeostatic fluctuations that are acceptable for the proper functioning of the present and near-future overall state.

Human individuals create (partly) and deal with the situation alone and in close harmony with a few or a group of surrounding individuals, often by using a preferred kind of behavior in the situation because this behavior has worked in the past. Having preferred kinds of behavior that are based on past experiences emphasizes the use of personal characteristics as the individually stored information in long-term memory from past experiences about dealing with certain situations. For example, recognizing schemata or scripts (Schank & Abelson, 1977) in situations supports the turning of experiences into knowledge that explains common situations. Figure 3 shows how the human balancing act between preferred and flexible behavior might consist of fluctuations within certain restrictions across time as an ongoing process of person-and-situation interaction based on interpreting the situation.

Therefore, the similarities between the aforementioned cellular, plant-soil, and human structured and flexible reacting to the environment are that it involves quick, in terms of fast and short-term, up to and including gradual, in terms of slow and long-term, adjustments to the environment. For cells and plants, the components that are involved in the adjustments can be coordinated among themselves. For all, it makes signaling an important part of the balancing act because this is the basis for selecting flexible reactions to changes in the environment.

Signaling and Situation Interpretation

Mitochondrial Signaling

As aforementioned, mitochondria are the main energy producing organelle in the cell and they regulate various biochemical materials and in doing so, mitochondria direct metabolism, stress responses, immunity, and cellular fate (i.e., differentiation, survival, and death) in direct physical connection to the other cellular organelles of ER, lysosomes, and vacuole, and lipid droplets (see Picard & Shirihai, 2022; Shen et al., 2022, for an overview). Examples of the input information that mitochondria use for signaling are metabolites, nutrients, hormones, ions, gases (e.g., O_2 and NO), ATP, ADP, NADP, and RNA and DNA transcriptions. The mitochondrial membranes house a variety of signaling components that are grouped into four main classes: (a) nuclear receptors; (b) protein receptors; (c) metabolite and ion transporters; and (d) mitochondrial DNA sensing.

For example, the signaling of mitochondrial stress can consist of detecting unfolded and misfolded proteins, loss of mitochondrial DNA, defects in the electron-transport chain, knockdown of mitochondrial protein translation, and problems with mitochondrial fusion and division. Similarly, mitochondrial immune signaling reacts to damages and the presence of various pathogens.

Overall, mitochondrial signaling consists of a variety of receptors, transporters, and molecular features that can detect differences in dealing with information inputs, but that also can "communicate" with other cellular organelles. Hence, the signaling is complex due to the variations that are possible to detect, but it is also restricted by there being kinds of components that create kinds of signaling pathways, such as the MICOS complex. Noticeably, the research on mitochondrial signaling still adds to the list of involved molecular components and cellular organelles and tissue that play a direct role in the mitochondrial signaling pathways.

Plant-Cell Signaling

Plants use a diversity of pathways to signal environmental and developmental features that require a reaction. The scientifically discovered signaling pathways of plants are routes of intra- and extra-cellular communication regarding (a) transport to the inside of plant cells, (b) functional analysis of the plant itself (e.g., plant growth and development, flowering, and gene expression), and (c) abiotic and biotic stresses (see Chen & Heidari, 2020; Khalil et al., 2024; McAinsh & Taylor, 2017, for overviews). The major signaling pathways of plants are the routes for responding to unfolded and misfolded proteins, cellular tissue (i.e., secreted signals) and organelles (e.g., ER and lysosomes), nutrients and metabolites (i.e., energy messengers), and immunity (e.g., damages and viruses). Similar to mitochondria research, plant-cell signaling is a research area in development. For example, little is known about the electrical signaling pathways (i.e., the action and slow-wave potentials) of plants, and whether or not these pathways differ from animals (Barbosa-Caro & Wudick, 2024). It is expected that the quick responses of a plant, such as the mimosa plant's reacting to mechanical stimulation of the leaflets, are electric signaling events that involve action potentials.

What can be the reason for plants to have different kinds of pathways to signal environmental and developmental features? First of all, the complexity of signaling may be simplified, in that specificity of pathways can narrow down a complex process into sub-parts. Although all plant-signaling pathways are diverse and have signal specificity, the main site for signaling is the plasma membrane. Second, each kind of signaling pathway can amplify in this way particular signals that will stand out among the other signals and ensure the eliciting of certain reactions. Third, having different kinds of signaling pathways may enable cross talk between certain kinds of pathways and, thereby, integrate certain information. Finally, having different kinds of signal pathways may resort to eliciting different kinds of coordinated activity to ensure that homeostasis occurs in a controlled manner. Hence, plant-cell signaling seems to exist of different kinds of pathways to emphasize different kinds of information in order to fine tune and coordinate responses. As such, the pathways enable to produce direct contact between adjacent cells, overcome short distances of nearby cells, and travel long distances via the bloodstream to distant target cells.

Overall, plant-cell signaling is a complicated process because many environmental and developmental features can produce a variety of different influences and the process may involve the participation of other cells and organelles. Although plant-cell signaling is a complex process, it also becomes somewhat less complicated when there are signaling pathways that coordinate the environmental and developmental information to enable that plant cells can react suitably to influential changes.

Human Situation Interpretation

Humans sense their environment via their senses, then they interpret via their brain what is happening in relation to themselves at that moment to decide on appropriate reactions. In interpreting the situation, the person and the situation interact. Research on person-and-situation interaction faces the difficulty of having to conceptualize both person and situation separately and in a meaningful conjunction to one another. This is a difficult endeavor because of the many variables involved, having to set the boundary lines in order to demarcate situations (i.e., where does it begin and end), and the issue of how to align person and situation in either the same person in one and multiple situations or persons in situation(s) for the purpose of finding patterns (Furr & Funder, 2021; Rauthmann & Sherman, 2020; Van Velzen, 2023). Currently, theoretical psychology studies (i.e., personal, social, work, and organization related) are focusing on person-and-situation interaction as a dynamic process.

First, research on situation taxonomies and psychological characteristics and personality coherence (Rauthmann & Sherman, 2019, 2020; Kandler & Rauthmann, 2021) focuses on situational features, in the plural, in terms of the different kinds of information they can offer: (a) objective, quantifiable cues (e.g., temperature, objects, and persons); (b) psychological characteristics (i.e., personal interpretation); and (c) classes (i.e., kinds of situations, such as travel situations). The psychological characteristics of situations that were obtained as a six-factor solution of taxonomies of situation classes from multiple unrelated studies are threat, stress, tasks, processing, fun, and mundaneness situations, that all refer to what the situation yields. Personality coherence consists of personal traits (i.e., that are consistent across contexts and situations, but developing), the person's adaptations regarding the context (i.e., characteristic for a person in a context), and states or dispositions in the situation (i.e., that fluctuate with the situation). Aside from having developed clear definitions regarding the person, the situation, and their interaction, these studies have also provided for information about the implications of using multiple measurements and obtaining person-environmental fits via self-reported measures (i.e., mostly rating scales).

Second, research on the Situation Five (Ziegler et al., 2019) and understanding personal experiences (Fliedner & Horstmann, 2025; Horstmann et al., 2020) refers to studies that connect personality to situation perception (i.e., the evaluation of external stimuli based on previous knowledge, personality, and current states, such as mood) via the Big Five of personality traits (i.e., emotional stability, extraversion, openness, agreeableness, and conscientiousness). The development of the Situation Five led to the importance of the concepts of outcome-expectancy, briskness, cognitive load, psychological and physical load, and lack of stimuli. The difficulty of understanding personal experiences is that the focus has to be on the subjective experience of life events rather than assuming that the effect of a life event is similar to all participants (Fliedner & Horstmann, 2025), and that positive and negative affect are explained via participants' self-reported behavior as measured via rating scales (Horstmann et al., 2020).

Third, other current theories on personal traits and the impact of the situation or situational perceptions by also including the Big Five personality states (Columbus & Strandsbjerg, 2025) are: (a) Whole Trait Theory that refers to stable personality traits, in that it describes how much of a trait someone enacts in behavior and that it incorporate states or explanatory social-cognitive mechanisms (i.e., the underlying interpretive, motivational, temporal, and random causes) for behaving differently or inconsistently in situations (Fleeson & Jayawickreme, 2021); (b) Revised Latent State-Trait Theory that refers to traits being dynamic because they relate to the situation and include the person's past, which is established by employing probability theory and latent variable modeling (Geiser et al., 2017); (c) Cognitive-Affective System Theory that refers to each person's network of affects, goals, beliefs, expectancies, competencies, and self-regulatory strategies that mediate the effect of situation on behavior, and which are established via if-then profiles (Zayas et al., 2021); and (d) Trait Activation Theory that refers to personality dynamics in the workplace as the expression of traits that are dependent on the situation, in that the situation offers the opportunity for a trait to be expressed or not (Tett & Fisher, 2021).

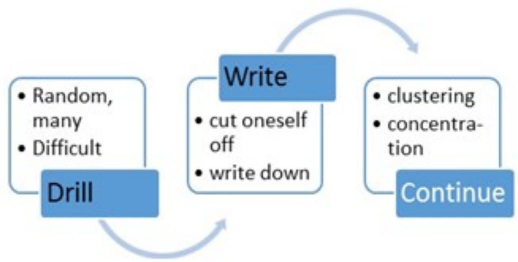
Overall, this overview of currently major personality trait-state theories all focus on the dynamic process in which the person and the situation, but especially the person-and-situation interaction agree with personality traits and states (Baumert et al., 2017; Columbus & Strandsbjerg, 2025; Kritzler et al., 2024; Kuper et al., 2024). Additionally, the studies are focusing on the individual person via within-subject data analysis because the empirical consistency of between-subject data on traits, states, and situations is inconclusive (i.e., some persons' personality state does not change across the years, whereas other persons' state does so significantly), traditional trait measures may not capture the nuances of personality fluctuations across situations, and it is difficult to separate person and situation variables. Empirical evidence for the major personality trait-state theories is obtained by collecting substantial quantitative data sets to employ statistical data analyses, mainly via selected-choice closed-ended questions and experience sampling. Experience sampling is the data-collection method of capturing the individual's thoughts, feelings, and behavior within daily routines by having individuals respond to questions several times per day via their mobile phone. Because it can be demanding for individuals to comply to experience sampling, the questions are as few and as brief as possible.

As already indicated, person and situation trait-state research faces challenges, along with all other person-and-situation interaction research. First, the issue of test effect or testing, which occurs when a person's score on the second administration of a test is influenced by the administration of the first test. Taking a test will familiarize a person with the content of the test and this can influence the way the person responds to another test. Taking a test also can lead to considering oneself in a situation rather than reacting to an actual situation. This is called selective bias in responding (Bolger et al., 2003), in that the situational cues that are presented in the questions can lead to an incorrect reconstruction of memories and the selecting of some instances of person-and-situation interaction and the overlooking of others. Bias in responding can also appear when the variety in inquiry on a phenomenon is too narrow.

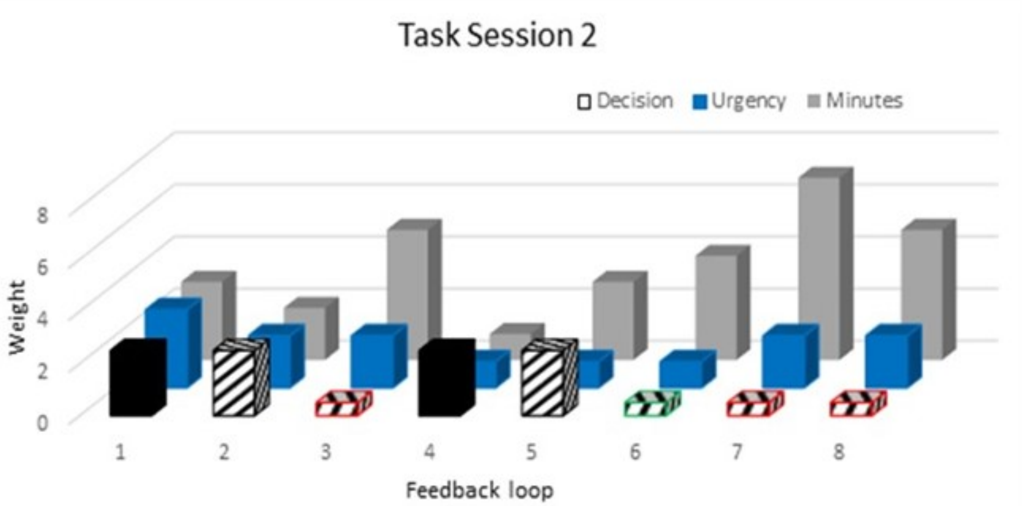
Second, the issue of context. Different definitions of context exist (see Meier & Dopson, 2019, for an overview), such as, "Any feature of the circumstances in which an intervention is conceived, developed, implemented and evaluated" (Craig et al., 2018, pp. 7-8) and "Context as observable features and as relational and dynamic features" (Greenhalgh & Manzano, 2022, p. 583). Also, context is a complex construct. For example, Squires et al. (2019) initially identified 201 unique contextual features in healthcare, which they further summarized into 21 broader categories. Pfadenhauer et al. (2017) tackled the complexity of context by distinguishing three dimensions (i.e., context with seven domains, implementation with five domains, and setting referring to the specific physical location). Van Velzen (2023a) defined context as the objectively agreed upon overall act of what is taking place as inferred from multiple individuals, but each individual also constructs a subjective "context" based on one's perspective or physical-spatial place, focus of observation, and interpretation by valuing or giving meaning to what is happening in agreement with one's knowledge (i.e., experiences and actual-world information stored in long-term memory) and self-identity or one's typical thoughts, feelings, and behavior (see also Van Velzen, 2023). To prevent a lack of clarity, Van Velzen's (2025b) concept of context refers to the overall agreement on situation among individuals *and* the individually constructed context or personal storyline, in that the situation is perceived (i.e., sensed) and interpreted (i.e., aware) over time as a continuing process via feedback loops. Nevertheless, the measurement of person-and-situation interaction while accounting for the issues of testing and context provides for difficulties (Van Velzen, 2025c) as is shown in the next section.

Revisiting the Study on Complex Learning and Problem Solving

To study person-and-situation interaction, Van Velzen (2025c) conducted a preliminary and small case study (i.e., one participant executing an unfamiliar complex task, responding to questions, and responding to an interview afterwards). The aim of the study was to explore the measurement of person-and-situation interaction via behavioral decision-making during temporal window frames. Participant selection included having a high ability in learning and problem solving. There were two learning and two problem-solving tasks, each accompanied by open-ended questions about each considered behavioral decision-making moment by: (a) stating the point of time in minutes, to understand the length of temporal window frames; (b) rating on a three-point scale the intensity or urgency of thoughts and feelings (i.e., from "I might should try something else" to "I urgently need to do something else"); (c) ticking off the constructs of concentration, method of task execution, knowledge, wandering thoughts, uncertainty, and other; and (d) giving written descriptions, as comprehensively as possible, in one's own words. The results (see Figure 4) informed about (a) reasoning and the decision-making process, (b) major activities, (c) the duration of temporal window frames in minutes, and (d) the level and experience of urgency in considering the task in relation to the study or working method(s) employed.



1. The task to memorize many random numbers is difficult: Decide to drill the numbers (I find drilling annoying). 2. Trying to write things down as well, difficult to cut oneself off from background noise: writing down helps. 3. Trying to look for clusters (I always try to connect information), the concentration improves: I will continue this method. Later, wandering thoughts remain to be an issue.



Feedback loop	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Minutes	3	2	5	1	3	4	7	5
Urgency	3	2	2	1	1	1	2	2
Decision	2.5	2.5	0.5	2.5	2.5	0.5	0.5	0.5

Figure 4. Results of one learning task decision-making process (Van Velzen, 2025c). The black box = decision, the black-white shaded box = pre-decision, the height of the box = the kind of study method, the green outline of the box = positive thoughts and feelings, and the red outline of the box = negative thoughts and feelings.

The study showed that the description in one's own words of the process of task execution by expressing thoughts and feelings on the questions at the self-selected consideration moments (i.e., aware temporal window frames) in time was essential to understand what happened during the decision-making process. The graph clarified the meaning of the consideration moments as the feedback process of behavioral decision-making, the feelings of urgency in finding a proper way to execute the task, and the selected kinds of effective and efficient study methods to tackle the task. However, a problem was the unsatisfactory measurement of the person-and-situation interaction via the construct of urgency in relation to the constructs of the theoretical framework, in that it did not inform about why the context was interpreted in a certain manner in terms of how common it was and if behavioral decision-making focused on structured or flexible reacting. It raises the question of how the literature overview that is presented in this article can inform about the measurement of person-and-situation interaction as an ongoing interpreting balancing act between structured and flexible behavioral decision-making via reasoning as signaling pathways rather than urgency.

First, the overview showed that flexible reacting is the deviating from structured reacting in terms of making quick behavioral changes that are intended to last shortly (i.e., adapt to the near-present moment), in that it will be possible to return to the original structured reacting with its preferred reactions as a kind of backup plan that has shown its function in previous situations. The example study revealed a diversity of considerations that were analyzed from the participant's responses: (a) cognitive component (i.e., "The task is difficult" and "My concentration improves") and cognitive preference (i.e., "I always try to connect information"); (b) physical component (i.e., "Back-ground noise"); and (c) emotional preference (i.e., "Drilling is annoying"). These considerations were enabled by the prompts in the questions that consisted of the constructs of concentration, study or working method, knowledge, wandering thoughts, and uncertainty. However, the responses did not provide information about person-and-situation interaction in terms of mentioning the reasons beyond the considerations. For example, the response of "Wandering thoughts remain an issue," does not make clear why there were wandering thoughts and how common they are when doing complex tasks. Hence, the decision-making behavior could be inferred from the flow of the written responses of the participant, but it remained unclear *when and why* flexibility was replacing preferred behavioral decision-making in order to maintain behavioral balance and, hence, whether or not it was within the personal upper and lower borders (see Figure 3).

Second, the issue of observable temporal window frames and context. The study revealed that the observable temporal window frames could be measured in minutes, which showed initially short periods of time for trying out various study methods, and longer periods of time after having selected a suitable study method. The signaling of stress was found, for instance, in the response of "It is difficult to cut oneself off from background noise," which implies the signaling of one's concentration in relation to the context. The valuing of events in agreement with one's self-identity for the purpose of understanding contextual interpretation was found, for instance, in the responses: "Difficult task" – "I decided to drill" [as the best thing to do] – "I find drilling annoying." However, these kind of responses do not inform about why the background noise and difficult task were interpreted in terms of when and why the behavioral decision is a customary one regarding which contexts (i.e., valuing events by including knowledge and self-identity) and circumstances (i.e., distracting influences from near-present personal and situational occurrences).

To conclude, when contemplating person-and-situation interaction as an on-going interpretive process that develops across time, it raises the question of if its consequences (i.e., the kinds of behavioral decision-making) are merely the actions to a state of the moment, as in unforeseeable or spur-of-the-moment happenings, or if there are patterns regarding flexible behavioral decision-making, as in reasoning providing for signaling pathways that accordingly can function as personal observation focus points. The brief literature overview presented in this article shows that from a biological (i.e., cells and plants) rather than a human perspective, researchers have found that flexibility can consist of multiple possible alternatives, but they are enabled via a restricted amount of specific processing patterns, such as those that take place in the MICOS system for mitochondria, and the signaling pathways for plants. The specific processing patterns have large supporting components (i.e., the inner mito-chondrial membrane and cristae for mitochondria, and the cellular receptors and organelles for plants) that enable a thorough sensing, but to signal influences, it is brought back to a lesser amount of processing patterns, in that flexibility can be employed while ensuring that it can be restored to a previous and well-adapted structured kind of reacting. For research purposes, it all appears to come back to two things. First, data collection should establish a thorough overview of person-and-situation interaction that encompasses a large variety of different kinds of information (i.e., interpretive thoughts and feelings in relation to prior behavior and contextual and circumstantial features) and then, second, bring it together to a few flexibility creating signaling pathways or reasoning patterns that enable not only short-term up to longer-term flexible change, but also the restoring to previous preferred or habitual states because these have proven to be functional in the long run.

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