

Proposal

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Adaptation of Cognitive Reactions to Experienced Situational Features

A Formal Extension within the PersChange Framework

Over the past decades, the view of personality has changed substantially. Personality was originally assumed to be rigid and largely unchangeable. However, recent longitudinal research shows that personality systematically adapts to environmental demands and that observed changes do not appear to reflect random fluctuations across time (Bleidorn, 2024; Haehner, Wright, et al., 2024). Contemporary personality theories increasingly conceptualise personality as a dynamic process shaped by momentary reactions to situations and their accumulation over time (Fleeson, 2001; Fleeson & Jayawickreme, 2015, 2025). In line with this perspective, the TESSERA framework describes how situational triggers gradually contribute to personality change (Wrzus & Roberts, 2017). Taken together, these approaches converge on the idea that personality change can be understood as an adaptive process through which individuals adjust their cognitive, affective, and behavioural reactions to the situations that prevail in their environment. The aim of this thesis is to formalise this adaptive process for cognitive reactions within an extension of the PersChange framework.

Background

Personality development across the lifespan is increasingly understood as a process of systematic adaptation. Longitudinal research shows that not only mean trait levels change over time, but also individual developmental trajectories and the variability of reactions (Bleidorn et al., 2022; Haehner et al., 2026; Specht et al., 2011). Personality is therefore characterised both by gradual shifts in mean levels and by changes in the consistency with which individuals respond to environmental conditions.

At the same time, personality is still regarded as relatively stable. Single experiences are generally not considered sufficient to produce lasting personality change. Instead, more enduring

influences, such as life events that unfold over extended periods, are associated with small but reliable shifts in personality traits (Haehner, Krämer, et al., 2024). Examples include entering long-term employment, starting or ending a romantic partnership, becoming a parent, or experiencing prolonged health-related challenges. Such events often involve sustained changes in daily demands, roles, and social contexts. Personality change therefore appears to result from cumulative and sustained experiences rather than from single events.

A central mechanism that may underlie this gradual adaptation is the cognitive interpretation of situations. Individuals do not respond directly to objective situational characteristics but to their subjective interpretations of them. The same situation can therefore lead to different cognitive reactions depending on the thoughts it evokes. Cognitive reactions thus capture the subjective meaning assigned to situational input and form a key interface between environmental experiences and long-term personality development.

To better understand how cognitive reactions arise from situational input, it is useful to consider formal models from related domains. Although developed in decision-making research, Prospect Theory provides a relevant conceptual analogy. Its value function describes how objective outcomes are transformed into subjective evaluations. Two aspects are particularly informative. First, evaluation is reference dependent, meaning that information is interpreted relative to an internal reference point rather than on an absolute scale. Second, the relationship between objective input and subjective response is often non-linear. The notion of diminishing marginal utility implies that proportional changes in objective input do not necessarily result in proportional changes in subjective evaluation. Applied to the present context, a doubling of an objective situational feature would therefore not be expected to produce a doubling of the corresponding cognitive reaction. Although Prospect Theory addresses different psychological processes, its formal treatment of subjective transformation offers useful guidance for modelling related processes (Pachur et al., 2017), in this case cognitive reactions.

Finally, the PersChange framework provides a simulation environment for representing personality-related processes from an agent perspective and allows for explicit formalisation of psychological mechanisms. Within this framework, two central concepts are distinguished that are directly relevant to the present work. Feature expressions refer to objective characteristics of a situation, such as the friendliness or harshness of communication within a context. Cognitive reactions refer to the cognitive interpretation of such features, for example the extent to which a communication style is perceived as fair or unfair. Both concepts are represented on a numerical scale between 0 and 1, which defines the parameter and outcome space of the mechanism to be developed. Furthermore, in the simulation, feature expressions and cognitive reactions are stored pairwise as elements of an individual's experience history and can therefore be used to model the adaptation of the interpretation mechanisms.

Aim and Research Questions

Building on this theoretical perspective, the present thesis adopts a formal modelling approach to investigate how cognitive reactions to situations can be represented and how they change over time. The interpretation mechanism developed in this work will be implemented within the PersChange framework.

In the current state of the PersChange framework, cognitive reactions are represented in a simplified manner as linear functions of situational features. The aim of the present work is to model this transformation in a more psychologically plausible way. In particular, learning mechanisms are introduced through which repeated experiences gradually modify how specific situational features evoke cognitive interpretations. Cognitive reactions thus become dynamic outcomes of prior experience rather than fixed mappings of situational input.

The central aim of this thesis is to develop a formal model describing how cognitive reactions to situational features arise and how they adapt through experience. Under the assumption that personality change reflects gradual adaptation to recurring environmental conditions, the focus lies on identifying general principles that determine how subjective interpretations of situations evolve over time.

The research therefore centres on the conditions under which cognitive reactions stabilise or continue to change. Closely related is the question of when cognitive reactions change more quickly or more slowly. In addition to the interpretation mechanism itself, prior experiences are assumed to play a crucial role. Some learning histories may lead to cognitive reactions that remain adaptable, whereas others may result in consolidated and stable response patterns. The aim is thus to identify both the mechanisms and the preconditions that determine whether cognitive reactions adapt or remain rigid over time.

Research Approach

Building on existing theories of personality development and on mathematical formulations derived from established models, formal mechanisms are developed to describe how cognitive reactions arise from situational features and how they adapt through experience. These mechanisms are translated into explicit computational rules and implemented within the PersChange framework.

The implemented model is examined using computer simulation. Therfore two complementary strategies are applied. First, the parameter space is explored systematically in order to understand how different combinations of situational characteristics and prior experiences influence the behaviour of the system. Second, scenario-based simulation studies are conducted. These scenarios represent simplified sequences of situations, for example derived from life events as discussed above. The main goal is not to replicate specific empirical datasets, but to investigate possible developmental dynamics under theoretically plausible conditions.

Based on these analyses, general principles are derived that help explain when cognitive reaction patterns remain flexible and adaptive and when they become rigid or even maladaptive. This provides a basis for formulating hypotheses that can be empirically tested within the CHILL project and may, in the longer term, also inform the development of interventions aimed at personality change.

Planned Schedule

Milestones	Task	Doc/Link
31.01.2026	Submitting the proposal	Proposal
30.04.2026	Complete the conceptual outline for the “Cognitive Interpretation” (<i>R</i>)	
?? .05.2026	Master’s thesis presentation (<i>date to be arranged with W. Bleidorn</i>)	
?? .06.2026	Master’s examination (<i>date to be arranged with W. Bleidorn</i>)	
30.06.2026	Finalising the integration in PersChange (<i>Python</i>)	
30.08.2026	Conduct the planned investigations and derive hypotheses relevant to the CHILL project from the findings	
30.09.2026	Submitting draft version of the thesis	
?? .10.2026	Master’s thesis presentation (<i>date to be arranged with W. Bleidorn</i>)	
01.12.2026	Submitting final version of the thesis	

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