

# Towards Adaptability of Just-in-Time Adaptive Interventions

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**Abstract.** Just-in-time adaptive interventions (JITAI) can promote behavior change in patients. It was the aim of our study to make JITAI adaptable, i.e., to configure JITAI for different purposes and to personalize them for different participants, whilst enabling central maintenance and integrated data analysis across deployments and individuals. We present a concept for adaptable JITAI that was created following a design science approach. It builds on multi-level conceptual modeling and knowledge graphs and will be evaluated in user studies.

**Keywords.** Semantic Web, Artificial Intelligence, Data Analysis, Data Aggregation

## 1. Introduction

Advances in mobile technologies and their pervasive use in daily life enable just-in-time adaptive interventions (JITAI, see [1]) aiming at behavioral change to positively affect mental or physical health, for example, to promote physical activity of patients with cardiovascular disease. The support, e.g., a text message inviting the participant to do some sports, provided by JITAI is *adaptive* to “the dynamics of an individual’s internal state and context” [1], captured by measures such as bio signals, or location, and is triggered automatically *just-in-time*, i.e., when it is deemed necessary or appropriate.

JITAI are typically not designed on an individual basis, instead a JITAI manifests an *intervention design* that is reused for multiple patients, often in the setting of a JITAI study, with the latter having the goal to gain knowledge about the effectiveness of JITAI. In this setting, the question arises, how to adapt, i.e., configure and personalize, JITAI for different studies and multiple participants without losing – despite the heterogeneity introduced with the adaptations – the capability to centrally maintain these intervention designs and to conduct integrated analysis of data from multiple participants and studies.

There has been work on template-based JITAI design [2], however, this is not sufficient for adaptability. For example, such a system may not be able to provide customization of JITAI components as described above. From our point of view, providing hierarchical concretization options for the individual components is necessary.

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## 2. Methods

Following a design science approach [3], we iterated through problem investigation, treatment design and treatment validation. When planning the implementation of a JITAI system, we realized that JITAIs need to be adaptable so that researchers can easily configure and personalize intervention designs for different studies and participants. We designed a specialization concept that facilitates fine-grained concretizations and preserves the capabilities of central maintenance and integrated data analysis. The design has already been preliminary validated using toy examples and will be further validated in user studies.

## 3. Results

The specialization concept is a continuation of our previous work on multi-level modeling of JITAIs [4] and extends deep domain object hierarchies [5] with modeled subclass hierarchies. Specializations of JITAIs and their components are made with regard to different classes of studies and participants, as well as with regard to individual studies and individual participants. These fine-grained specializations lead to a large number of modeled elements arranged in specialization hierarchies. Induced metaclasses can be used to constrain and specify the behavior of a group of classes or to define data aggregation at a particular depth in a specialization hierarchy.

The proof-of-concept prototype builds on semantic web languages, i.e., it takes as input a 2-level composition hierarchy represented using the Resource Description Framework, recursively applies Shape Constraint Language Rules that realize the specialization concept, and produces an extended multi-level composition hierarchy.

## 4. Discussion

The complexity of the specialization concept and the size of an extended multi-level composition hierarchy may be challenging for use. The aim of user studies is to show that our specialization concept facilitates working with such large hierarchies while hiding the underlying complexities. We will, more precisely, investigate the usability (effort to learn, effort to use) and the execution time for materializing adapted JITAIs.

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