Visualising the Effects of Ontology Changes and Studying their Understanding with ChImp *

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Introduction. Since ontologies model a specific domain and its knowledge, they have to evolve, shift, or change over time to accommodate advancements in the respective domains [10]. Ontologies are, however, often used by many other parties besides their direct maintainers. Because of the Semantic Web's decentralised nature, ontologies are shared freely online, inviting other people to use them in their applications [1]. This creates a communication gap between ontology engineers and ontology users, where neither of the groups know about the other's needs or progress. There have been previous investigations on bridging this gap and supporting ontology engineers during the change process, but those focus on the process itself rather than the added benefit of displaying more information about changes [9]. Respective changes do, however, affect not only the ontology itself (e.g., its consistency and quality), but also the services built on top of it, as shown by, e.g., [4, 3, 2, 6, 8, 7]. Inexperienced engineers may lack the expertise to fully grasp all the consequences of their actions. Moreover, experienced engineers are likely to work with ontologies they do not know well and might, therefore, not fully understand the effect of changes. Furthermore, for widely used ontologies the impact of changes may simply be to complex to follow without support. We argue that engineers need a better understanding of the effect of their changes using multiple perspectives, including the change's semantic and structural consequences while editing ontologies.

Methodology. To address the communication gap, we require a tool that can provide engineers summarised information about changes and their effects on the materialisation. Hence, in our work, we introduce ChImp (*Ch*ange *Imp*act), a Protégé [5] plug-in to display information related to the changes. Departing from the assumption that a plugin displaying information would be useful to assess change impacts, we gathered requirements using an online questionnaire.

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The *requirements survey* contained mock-ups of change visualisations for rating, opportunities to provide detailed explanations of preferences, and general questions about demographics, already established practices, and the topic itself. Based on the responses we received, we built ChImp offering three perspectives on changes: a summary of the performed changes, the consistency of the ontology and materialisation impact measures, and changes to ontology measures (such as number of classes or properties).

With ChImp, we investigated the problem of communication and understanding of ontology-change effects by asking the following three research questions with a user study.

RQ1: Do ontology engineers understand the effect of changes on the ontology and on the materialisation better when using ChImp than without?
RQ2: What does severe impact on the ontology and on the materialisation mean to ontology engineers?
RQ3: Are the materialisation impact measures useful and informative for ontology engineers?

The impact understanding study was executed independently and after the requirements survey. We used a within-subject design, where our 36 participants solved two predefined tasks (one with and one without ChImp in random order) using the Pizza Ontology. We then analysed the answers qualitatively.

Findings. Throughout the impact understanding study, participants realised that understanding the effect of changes is important, and ChImp provided valuable information to them to think about the effects of changes constructively. "Severity of impact" means something different to every ontology engineer, but the most common metrics were the consistency of ontology and the number of changes to the materialisation or ontology. Additionally, participants agreed that the impact measures are intuitive, useful, and informative. Having the measures displayed in ChImp helped them get an intuition of how much the materialisation is changing, in turn, also making them understand the consequences of their actions better.

Contributions. Given the above, our contributions are:

- the requirements for a Protégé plugin, which summarises changes and the effect of changes
- the ChImp plugin, which is based on the elicited requirements, and
- using the qualitative evaluation with ChImp, we gained various insights about ChImp and impact understanding such as:
  - Most participants found ChImp to be useful in informing them about the effect of changes, helping them keep an overview of changes and their consequences.
  - Most participating ontology engineers defined severity of impact based on the amount of changes to the materialisation, which directly coincides with the introduced impact measures.

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