Impact of Linguistic Patterns and Antipatterns on the Understandability and Readability of APIs

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Abstract:
Context: Web APIs have become fundamental to modern software systems, enabling seamless interaction and communication between applications and services. Understandability and readability of APIs are important for effectively comprehending and using Web APIs. Despite the presence of established API design rules and guidelines, poor design practices are still prevalent in Web APIs.
Objective: Therefore, we aim to evaluate the impact of API design practices (linguistic design patterns and antipatterns) on the understandability and readability of Web APIs. We also aim to examine the effect of demographic information on the understandability and readability of Web APIs.
Method: We conducted an experiment and presented participants with API snippets. Participants were asked to answer the purpose of the API snippets (comprehension task) and rate the difficulty in understandability and readability of the API snippets.
Results: The finding of our experiment revealed adherence to linguistic design patterns significantly enhances the understandability and readability of Web APIs. In contrast, linguistic design antipatterns have negative effects understandability and readability of Web APIs. Additionally, demographic information has very little impact on the understandability and readability of APIs.
Conclusion: Finally, our findings provide empirical evidence highlighting the importance of adhering to good API design practices to enhance the understandability and readability of Web APIs.

Research Objectives:
- The primary objective is to evaluate how API design practices (patterns and antipatterns) impact the understandability and readability of APIs.
- Determine whether API design practice violations make it harder to understand and read APIs.
- Explore whether different levels of API design experience influence comprehension.

Research Question:
- **RQ1:** Which linguistic design patterns and antipatterns have an impact on the understandability of Web APIs?
- **RQ2:** Do linguistic design patterns and antipatterns significantly influence software professionals' perceived difficulty in the understandability of Web APIs?
- **RQ3:** Do linguistic design patterns and antipatterns significantly influence software professionals' perceived difficulty in the readability of Web APIs?
- **RQ4:** How do participant demographics influence the understandability and readability of Web APIs?

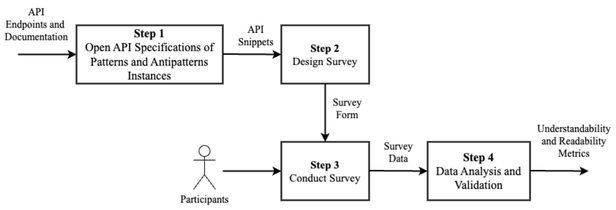


Figure 1: Overview of the impact study.

Methodology:
- **Step 1:** We created Web API snippets from the API linguistic design patterns and antipatterns endpoint pairs utilizing the OpenAPI specification format.
- **Step 2:** We conducted our survey via a LimeSurvey tool and asked participants to determine the purposes of 28 API snippets. Questions were presented randomly to avoid familiarization effect and took a maximum of 25-30 minutes to complete.
- **Step 3:** The survey was open for about three months (October 23, 2024 – January 31, 2025) and was widely advertised in our network at the start.
- **Step 4:** We first export all responses as a CSV file for analysis. Then, we clean and transform the data by:
  - Removing incomplete responses.
  - Standardizing free-text responses.
  - Converting text to numerical values (1 = correct, 0 = incorrect).
  - Adding binary columns for demographics (e.g., *is Student*, *is Academia*).

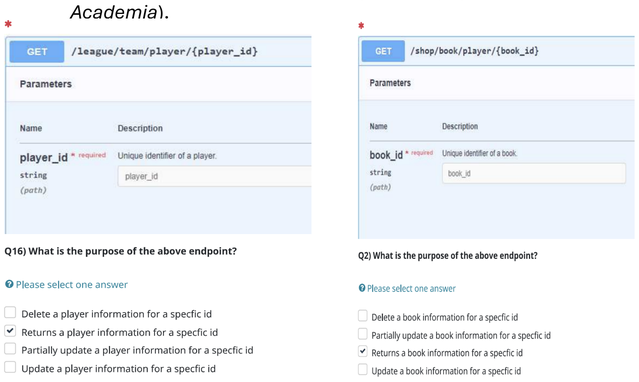


Figure 2: Example of a comprehension question based on ✓Contextualized Resource Names (left) and ✗Contextless Resource Names (right), with the correct answer marked..

Results and Discussion:
- **RQ1:** All 14 tasks following linguistic design patterns had better comprehension performance than those following linguistic design antipatterns. Violating linguistic design patterns had a strong negative impact on the understandability of APIs.

$$TAU_{p,t} = correctness_{p,t} \times \left(1 - \frac{duration_{p,t}}{max(duration_s)}\right)$$
participant (p)
task (t)

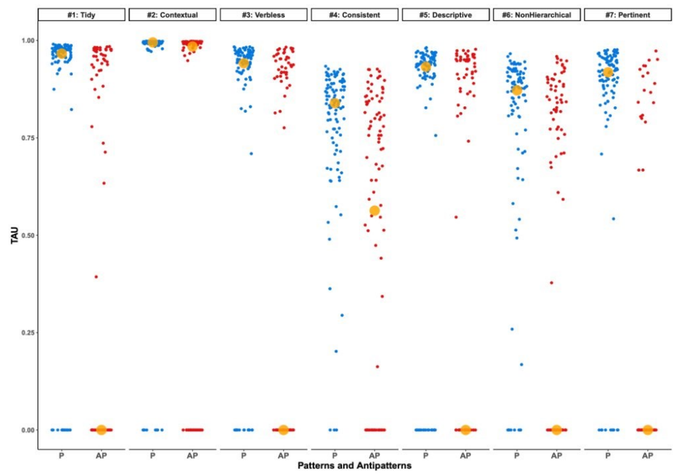


Figure 3: TAU distributions.

- **RQ2:** For all 14 tasks, adherence to linguistic design patterns led to significantly lower perceived difficulty ratings for understandability than linguistic antipatterns.

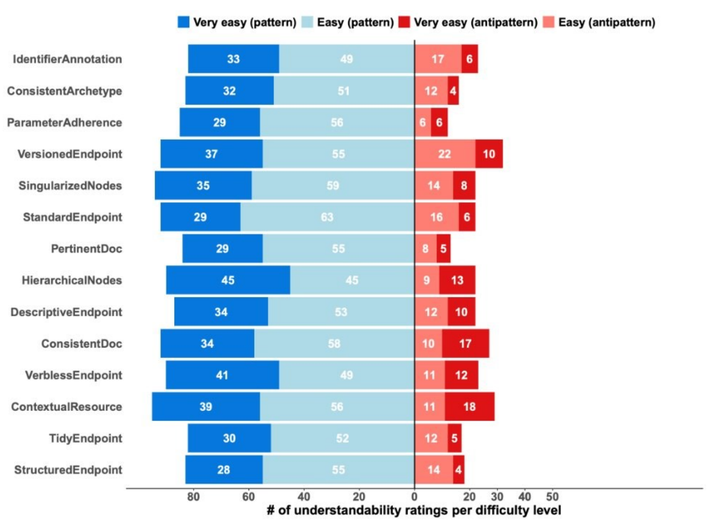


Figure 4: Bar plots of the perceived difficulty in understandability.

- **RQ3:** For all 14 tasks, the following linguistic design patterns have significantly lower perceived difficulty ratings for readability compared to tasks that follow linguistic antipatterns.

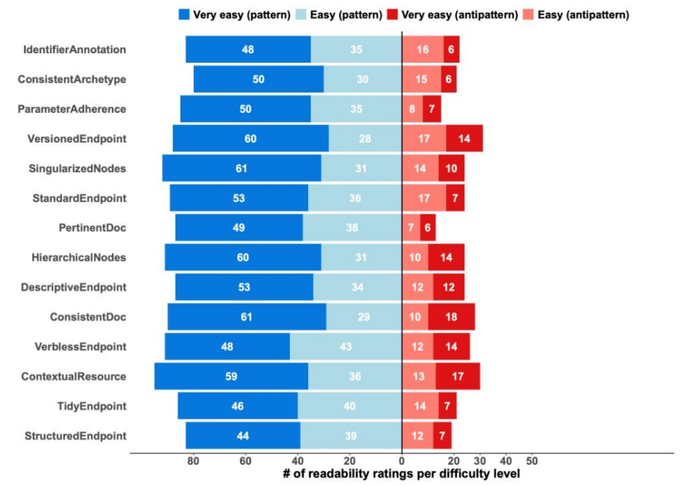
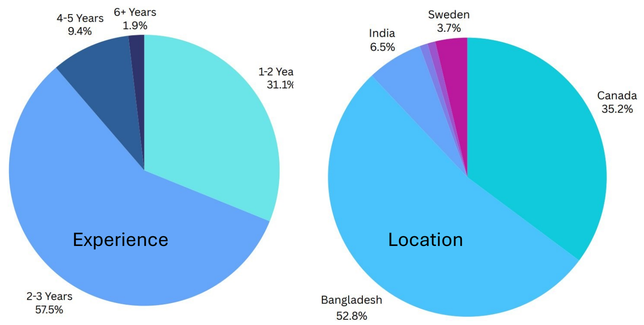


Figure 5: Bar plots of the perceived difficulty in Readability.

- **RQ4:** Among all the demographic attributes, only years of experience and knowledge of Richardson maturity model in API design have some degree of correlation with perceived difficulty in understandability and readability of Web APIs. However, experience in API design and knowledge of Richardson maturity model do not influence the tasks following linguistic design antipatterns, as participants find these tasks difficult to understand and read regardless of their experience with API design.



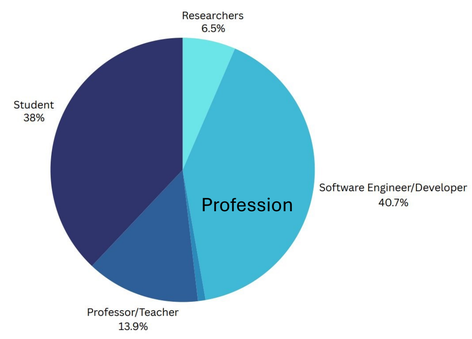


Figure 6: Demographic information of participants.

Conclusion and Future Works:
- We identified a significant negative impact on understandability and readability for all 14 patterns and antipatterns.
- Our results indicate that API snippets following antipatterns negatively affect understandability and readability.
- Expand the participant pool to include a broader and more diverse set of developers for deeper insights.

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