

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 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

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)



 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.

📕 Very easy (pattern) 📕 Easy (pattern) 📕 Very easy (antipattern) 📕 Easy (antipattern)

IdentifierAnnotation	48	35	16 6	
ConsistentArchetype	50	30	15 6	
ParameterAdherence	50	35	8 7	
VersionedEndpoint	60	28	17 14	
SingularizedNodes	61	31	14 10	
StandardEndpoint	53	36	17 7	
PertinentDoc	49		7 6	
HierarchicalNodes	60	31	10 14	
DescriptiveEndpoint	53	34	12 12	
ConsistentDoc	61	29	10 18	
VerblessEndpoint	48	43	12 14	
ContextualResource	59	36	13 17	
TidyEndpoint	46		14 7	
StructuredEndpoint	44		12 7	
	80 60 40 # of	20 readability rating	gs per difficult	0 40 50 t y level

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

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*).

#8: Standard #9: Singularized #10: Versioned #11: Adherence #12: ConsistentArchetype 14: Structured 増加 100 報告に . : * **P** 0.50 Patterns and Antipatter

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.



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.



Conclusion and Future Works:

Parameters	
Name	Description
player_id * required	Unique identifier of a player.
string	player_id
(path)	

lame Des	cription
book_id * required Unio	ue identifier of a book.
string bo	ok_id

Please select one answer

Delete a player information for a specfic id
 Returns a player information for a specfic id
 Partially update a player information for a specfic id
 Update a player information for a specfic id

Q16) What is the purpose of the above endpoint?

Please select one answer
 Delete a book information for a specific id
 Partially update a book information for a specific id
 Returns a book information for a specific id
 Update a book information for a specific id

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

SingularizedNodes	35		14 8	
StandardEndpoint	29	63	16 6	
PertinentDoc	29	55	8 5	
HierarchicalNodes	45	45	9 13	
DescriptiveEndpoint	34	53	12 10	
ConsistentDoc	34	58	10 17	
VerblessEndpoint	41		11 12	
ContextualResource	39		11 18	
TidyEndpoint	30	52	12 5	
StructuredEndpoint	28	55	14 4	
	80 60 # (40 20 of understandability	0 20 30 40 50 y ratings per difficulty level	

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

- 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.

References:

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