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The Impact of Visual UI Elements on Information Comprehension in Websites

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ABSTRACT

Visual user interface (UI) elements can enhance engagement but may also affect how users understand information. Our previous study compared six existing websites and identified two broad user experience (UX) dimensions: cognitive-functional clarity and emotional-aesthetic engagement. Static-oriented websites tended to support clarity and operability, whereas dynamic-oriented websites tended to enhance visual appeal. However, differences in content, brand familiarity, and information architecture prevented the effects of visual elements from being isolated. The present study addressed this limitation using an original fictional tourism website, "Soraka Island." A 2 × 2 between-subjects design manipulated static visual elements and dynamic visual elements at low and high levels, producing four conditions. 44 participants, 11 per condition, browsed the website and created a travel plan. Questionnaire responses were collected using a five-point Likert scale. Medians and interquartile ranges were calculated, and the four conditions were compared using the Kruskal-Wallis test followed by Dunn's test with Holm correction. Four of the 31 questionnaire items had unadjusted omnibus p-values below .05. These item-level analyses were exploratory, while Holm correction was applied to post-hoc pairwise comparisons within each item. The high-static/high-dynamic condition was rated higher than the low-static/low-dynamic condition in visual attractiveness. The high-static/low-dynamic condition was rated higher than two other conditions in perceived liveliness. For the perceived helpfulness of pop-up and hover displays for information comprehension, the low-static/low-dynamic condition was rated higher than the low-static/high-dynamic condition. Perceived movement also differed overall, although no pairwise difference remained significant after correction. These exploratory findings suggest that visual richness may contribute to perceived attractiveness, while greater dynamic presentation was not associated with greater perceived helpfulness for information comprehension within the low-static conditions. Effective website design therefore requires balancing visual engagement with cognitive clarity.

Keywords: User experience, User interface, Information comprehension, Visual elements

INTRODUCTION

User experience (UX) is an important consideration in the design of websites and digital services. Users evaluate interfaces not only according to whether a task can be completed successfully, but also according to the impressions they form, the ease with which they understand information, their emotional responses, and their subsequent behavioral intentions. Website design and user

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engagement are therefore closely related, and visual presentation is one of the interface characteristics that can influence this relationship (Garett et al., 2016).

Visual UI elements can broadly be considered in terms of static and dynamic presentation. Static elements include photographs, icons, tags, card structures, and decorative layouts whose appearance remains relatively stable during interaction. Dynamic elements include animations, transitions, hover effects, slideshows, pop-up information, and other visual changes triggered by time or user action. Previous work has emphasized that UX in web design includes not only functional usability but also visual appeal and enjoyable interaction (Claros, 2022). Research on animated transitions has also shown that motion can affect impressions and interaction experience (Cnattingius, 2021), while interface research has warned that excessive presentation can impair usability when information becomes difficult to process (Ozok et al., 2010).

Our previous study examined the relationship between visual presentation and UX using six existing Japanese websites (Takashima and Takanokura, 2026). Mercari, Cookpad, and Rakuten Travel were treated as websites characterized mainly by static visual elements, whereas Apple, YouTube, and Uniqlo were treated as websites with stronger dynamic presentation. Fifteen participants evaluated all six websites using 12 questionnaire items organized around four conceptual UX phases: attention, comprehension, emotion, and behavior. Exploratory factor analysis consistently identified two broader dimensions. The first represented cognitive-functional clarity, including clarity, ease of use, operability, and comfort. The second represented emotional-aesthetic engagement, including visual appeal, saliency, trust, and strong impressions.

The previous findings suggested that static-oriented websites tended to support clarity, consistency, and operability, whereas dynamic-oriented websites tended to enhance visual appeal and perceived richness. However, the use of existing commercial websites created an important limitation. Their content, information architecture, brand recognition, familiarity, service purpose, and overall visual identity differed substantially. Consequently, the observed differences could not be attributed solely to static or dynamic visual elements. A controlled follow-up experiment was therefore required to examine the effects of visual presentation while keeping the information content as constant as possible.

The present study focused particularly on information comprehension. An original fictional tourism website was used because tourism information search requires users to become interested in a destination while also understanding and comparing sightseeing spots, foods, and activities. This context therefore involves both emotional engagement and cognitive processing. The purpose of the study was to examine how different combinations of static and dynamic visual elements influence users' evaluations of the website, with particular attention to their perceived support for information comprehension.

EXPERIMENTAL WEBSITE AND DESIGN

An original fictional tourism website named "Soraka Island" was developed as the experimental stimulus. A fictional destination was chosen to reduce the influence of prior knowledge, previous travel experiences, and established impressions of actual destinations. The website provided information about

sightseeing spots, local foods, and activities, allowing participants to browse multiple alternatives before creating a travel plan. The informational content was kept equivalent across experimental conditions, while visual presentation was systematically manipulated. Figure 1 shows representative screenshots illustrating the difference between the low- and high-static conditions. Dynamic visual elements are not illustrated in the figure because their manipulation involved temporal and interactive effects, such as animations, hover effects, slideshows, and pop-up information.

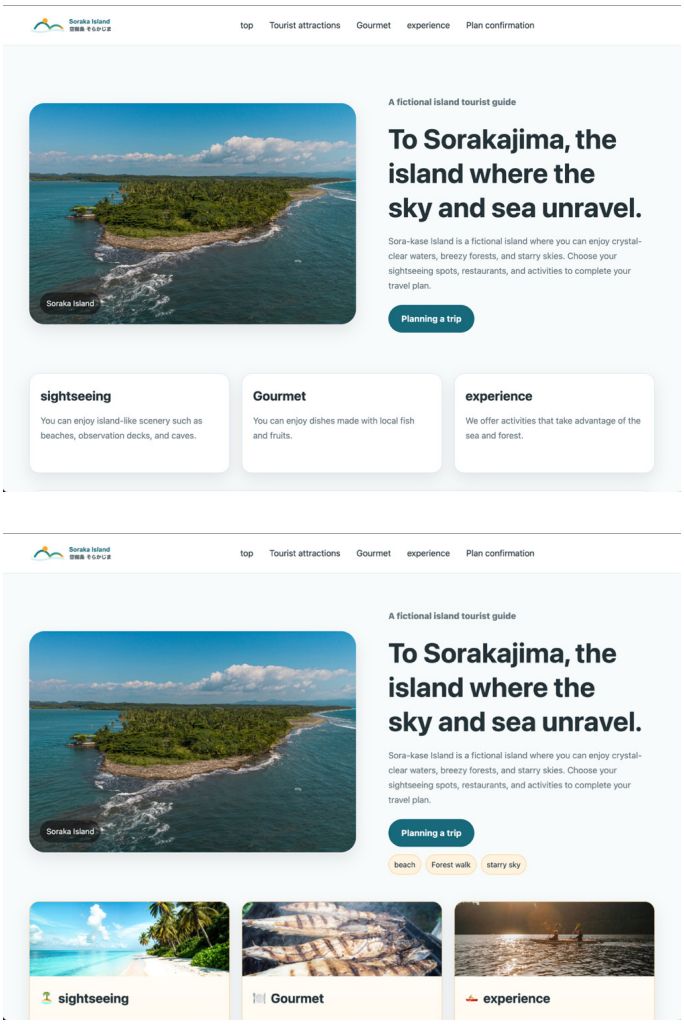


Figure 1: Representative screenshots illustrating the low (top) and high (bottom) levels of static visual elements on the Soraka Island website.

Static visual elements were defined as visual components that did not require motion or temporal change during presentation. They included photographs, icons, decorative layouts, tags, and card-based designs. In the high-static condition, these components were used more extensively to create a visually rich and structured interface. In the low-static condition, their quantity and visual prominence were reduced. Static elements were expected to contribute to information organization, visibility, and the presentation of destination characteristics.

Dynamic visual elements were defined as components whose visual state changed through time or user interaction. They included hover-based text expansion, image enlargement, card animations, slideshows, and pop-up information. These effects were incorporated more extensively in the high-dynamic condition and minimized in the low-dynamic condition. Dynamic presentation was expected to attract attention and strengthen perceived interactivity, but it could also require additional visual processing or compete with information relevant to the user's task.

The experiment employed a 2 × 2 between-subjects design. Static visual elements and dynamic visual elements were each manipulated at two levels, low and high. This produced four conditions, summarized in Table 1. Condition A contained low levels of both element types; condition B contained high static and low dynamic elements; condition C contained low static and high dynamic elements; and condition D contained high levels of both.

Table 1: Experimental conditions.

Condition	Static Visual Elements	Dynamic Visual Elements
A	Low	Low
B	High	Low
C	Low	High
D	High	High

PARTICIPANTS, PROCEDURE, AND MEASURES

44 participants took part in the experiment, with 11 participants assigned to each condition. Each participant interacted with only one version of the Soraka Island website. Participants were instructed to imagine that they were visiting the island for the first time and were gathering information to create a travel plan. They browsed the website and selected one sightseeing spot, one food item, and one activity. This task was designed to reproduce a realistic information-search and decision-making situation rather than passive viewing of an interface.

After completing the browsing and planning task, participants responded to a questionnaire consisting of 31 items. All responses were measured using a five-point Likert scale. The questionnaire included items concerning the visual attractiveness of the website, perceived liveliness, perceived amount of movement, information comprehension, and the usefulness of visual information. Interaction logs and screen recordings were also collected during the experiment. The present paper focuses on the questionnaire results; behavioral data will be integrated in subsequent analyses.

STATISTICAL ANALYSIS

Because the questionnaire used a five-point Likert scale, medians and interquartile ranges (IQRs) were used as descriptive statistics. Differences among conditions A, B, C, and D were examined separately for each questionnaire item using the Kruskal-Wallis test. When an omnibus p-value below .05 was observed, Dunn's

multiple-comparison test was conducted as a post-hoc analysis, and Holm correction was applied to the pairwise comparisons within that item. Because 31 questionnaire items were examined separately, the item-level omnibus tests were treated as exploratory analyses. No additional multiplicity correction was applied across the 31 omnibus tests. Therefore, the item-level findings should be interpreted as hypothesis-generating rather than confirmatory.

Although the experimental design was factorial, the present analysis treated the four combinations as independent groups. The results below therefore describe differences among the four conditions rather than formal estimates of the main effects of static elements, the main effects of dynamic elements, or their interaction. These distinctions are important when interpreting the findings.

RESULTS

Among the 31 questionnaire items, four items (Q14, Q26, Q27, and Q30) had unadjusted omnibus p-values below .05 in the Kruskal-Wallis tests. As described above, these item-level omnibus tests were exploratory and were not adjusted for multiplicity across the 31 questionnaire items.

Table 2: Questionnaire items with unadjusted omnibus p-values below .05.

Item	Questionnaire Item
Q14	The visual appearance of this website was attractive.
Q26	I felt that the page as a whole was lively.
Q27	I felt that there was a lot of movement within the website.
Q30	Pop-up and hover displays helped me understand the information.

Table 3 summarizes the medians, interquartile ranges (IQRs), unadjusted Kruskal-Wallis test statistics, and Holm-adjusted post-hoc comparisons for these four items. Pairwise differences after Dunn's test with Holm correction were identified for Q14, Q26, and Q30. Although Q27 showed a significant overall difference, no individual pairwise comparison remained significant after correction.

Table 3: Significant questionnaire results.

Item	A Median [IQR]	B Median [IQR]	C Median [IQR]	D Median [IQR]	H (p)	Dunn-Holm
Q14	4.0 [1.0]	4.0 [0.0]	3.0 [3.0]	5.0 [0.25]	9.0181 (.0291)	D > A, p = .0358
Q26	3.0 [1.0]	5.0 [1.0]	2.0 [2.0]	3.5 [1.5]	11.0014 (.0117)	B > A, p = .0253; B > C, p = .0253
Q27	2.0 [1.5]	2.0 [1.0]	3.0 [2.0]	3.0 [2.5]	9.8185 (.0202)	No significant pair
Q30	4.0 [0.5]	4.0 [1.0]	3.5 [2.0]	4.0 [1.25]	8.8965 (.0307)	A > C, p = .0492

Note. Omnibus p-values were not adjusted for multiple testing across the 31 questionnaire items. Holm correction was applied to post-hoc pairwise comparisons within each item.

Visual Attractiveness (Q14)

A significant overall difference was observed among the four conditions ($H = 9.0181$, $p = .0291$). The median [IQR] values were 4.0 [1.0] for condition A, 4.0 [0.0] for condition B, 3.0 [3.0] for condition C, and 5.0 [0.25] for condition D. Dunn's test with Holm correction showed that condition D was rated significantly higher than condition A (adjusted $p = .0358$).

Thus, the high-static/high-dynamic configuration received higher visual-attractiveness ratings than the low-static/low-dynamic configuration. Because conditions A and D differed in both static and dynamic presentation, this result indicates an advantage of the visually richer combined configuration but does not isolate the contribution of either factor individually.

Perceived Liveliness (Q26)

A significant overall difference was also observed for perceived liveliness ($H = 11.0014$, $p = .0117$). The median [IQR] values were 3.0 [1.0] for condition A, 5.0 [1.0] for condition B, 2.0 [2.0] for condition C, and 3.5 [1.5] for condition D. Condition B was rated significantly higher than condition A (adjusted $p = .0253$) and condition C (adjusted $p = .0253$). No other pairwise comparison remained significant after correction.

The highest rating was therefore observed in the high-static/low-dynamic condition. In particular, the difference between conditions A and B, which shared the same low level of dynamic presentation, suggests that increasing static visual richness may contribute to perceived liveliness when dynamic presentation is limited.

Perceived Amount of Movement (Q27)

Q27 asked whether participants felt that there was a large amount of movement within the website. A significant overall difference was observed among the four conditions ($H = 9.8185$, $p = .0202$). The median [IQR] values were 2.0 [1.5] for condition A, 2.0 [1.0] for condition B, 3.0 [2.0] for condition C, and 3.0 [2.5] for condition D.

The two low-dynamic conditions showed lower median ratings than the two high-dynamic conditions, which was directionally consistent with the intended manipulation of dynamic visual elements. However, no individual pairwise comparison remained significant after Holm correction. Therefore, the result provides supporting, but not definitive, evidence that the difference in dynamic presentation was perceived by participants.

Perceived Helpfulness of Pop-Up and Hover Displays for Information Comprehension (Q30)

Q30 evaluated whether participants perceived pop-up and hover displays as helpful for understanding information. A significant overall difference was observed among the four conditions ($H = 8.8965$, $p = .0307$). The median [IQR] values were 4.0 [0.5] for condition A, 4.0 [1.0] for condition B, 3.5 [2.0] for condition C, and 4.0 [1.25] for condition D.

Dunn's test with Holm correction showed that condition A was rated significantly higher than condition C (adjusted $p = .0492$). Conditions A and C both contained low levels of static visual elements but differed in the amount of dynamic presentation, with condition C containing a higher level of dynamic elements. Within these low-static conditions, the lower-dynamic configuration therefore received a higher evaluation regarding the helpfulness of pop-up and hover displays for information comprehension.

This result suggests that increasing the amount of dynamic presentation does not necessarily increase users' perceived benefit of such elements for understanding information. However, Q30 reflects participants' subjective evaluation of support for comprehension rather than an objective measure of comprehension performance.

DISCUSSION

The present experiment extends our previous study by examining visual UI elements under more controlled conditions. While the earlier study suggested that UX evaluations can be broadly organized into cognitive-functional clarity and emotional-aesthetic engagement, the use of existing websites made it difficult to separate visual presentation from differences in content and brand familiarity (Takashima and Takanokura, 2026). The Soraka Island experiment reduced these differences by presenting common tourism content while systematically varying static and dynamic visual elements.

The Q14 result suggests that a visually rich combination of static and dynamic elements may be associated with higher perceived visual attractiveness. Condition D, which contained high levels of both static and dynamic elements, was rated significantly higher than condition A, in which both were low. This finding is broadly consistent with our previous observation that visually dynamic websites tended to receive relatively high evaluations of visual appeal. However, because conditions A and D differed in both factors, the present result does not identify the independent contribution of either static or dynamic elements.

The Q26 result indicates that perceived liveliness does not necessarily depend on movement alone. Condition B, which contained high static but low dynamic presentation, was rated significantly higher than conditions A and C. In particular, conditions A and B shared the same low level of dynamic presentation but differed in static presentation. This suggests that, under low-dynamic conditions, visually rich static elements may contribute to a stronger impression of liveliness. Photographs, icons, tags, cards, and decorative layouts may create visual variety and richness even when the interface itself remains relatively stable.

Q27 provides complementary information about the perceived amount of movement. Median ratings were lower in the two low-dynamic conditions than in the two high-dynamic conditions, which was directionally consistent with the intended manipulation. Although the overall Kruskal-Wallis test was significant, no pairwise comparison remained significant after Holm correction. Therefore, this result should be regarded as supporting evidence

that participants perceived differences in movement rather than as a definitive manipulation check.

The result most directly related to information comprehension was Q30. Participants in condition A rated pop-up and hover displays as significantly more helpful for understanding information than those in condition C. Both conditions contained low levels of static elements, whereas condition C contained a higher level of dynamic presentation. Thus, increasing dynamic presentation did not lead to a higher perceived contribution of pop-up and hover displays to information comprehension.

One possible explanation is that the effectiveness of dynamic elements depends on how frequently and in what context they are used. Pop-up and hover displays can support users by revealing supplementary information when needed. However, when dynamic effects are used extensively, they may require additional interaction or draw attention to changes in the interface itself. As a result, increasing the amount of dynamic presentation may not automatically increase its perceived usefulness for understanding information.

This interpretation should be treated cautiously because Q30 measured subjective helpfulness rather than objective comprehension performance. The present results therefore do not demonstrate that dynamic elements reduce information comprehension. Instead, they indicate that, within the low-static conditions, participants exposed to the higher level of dynamic presentation did not perceive pop-up and hover displays as more helpful for comprehension. Future analysis using behavioral data and objective comprehension measures will be necessary to clarify this relationship.

Only four of the 31 questionnaire items had unadjusted omnibus p-values below .05. Because the item-level omnibus tests were not corrected for multiplicity across all 31 items, these findings should be regarded as exploratory and hypothesis-generating. Taken together, the observed patterns suggest that visual elements may contribute differently to attractiveness, liveliness, perceived movement, and perceived support for information comprehension.

From a practical perspective, effective tourism website design should therefore balance visual engagement with cognitive clarity. Static elements may help organize and present information in a stable form, while dynamic elements may be useful when they serve a clear informational purpose. Rather than maximizing visual effects, designers should select static and dynamic elements according to the role they play in supporting users' information-search and decision-making processes.

LIMITATIONS AND FUTURE WORK

This study has several limitations. First, the sample consisted of 44 participants, with 11 participants in each condition. The statistical power was therefore limited, and the present findings should be interpreted as exploratory.

Second, 31 questionnaire items were tested separately, and no multiplicity correction was applied across these omnibus Kruskal-Wallis tests. Although Holm correction was applied to post-hoc pairwise comparisons within each item, the across-item Type I error rate was not controlled. Consequently, the

four items with unadjusted omnibus p-values below .05 should be interpreted as exploratory, hypothesis-generating findings rather than confirmatory evidence. Future confirmatory studies should prespecify primary outcomes or apply an appropriate across-item multiplicity-control strategy.

Third, the present paper focuses primarily on subjective questionnaire evaluations. Although interaction logs and screen recordings were also collected, these behavioral data have not yet been integrated into the current analysis. Future work should examine navigation sequences, interaction frequency, task duration, repeated actions, and the composition of participants' travel plans. Such analyses may clarify the behavioral processes underlying the questionnaire results and determine whether the visual conditions influenced information-search strategies or decision-making.

Fourth, Q30 measured participants' perceived helpfulness of pop-up and hover displays for information comprehension rather than objective comprehension performance. Future studies should therefore include objective measures such as comprehension accuracy, information recall, comparison accuracy, or task completion performance to determine whether differences in perceived helpfulness correspond to measurable differences in information processing.

Finally, although the experiment employed a 2×2 factorial design, the current Kruskal-Wallis analysis treated the four combinations as independent groups. It therefore did not directly estimate the main effect of static visual elements, the main effect of dynamic visual elements, or their interaction. Statements concerning the effects of individual factors should consequently be treated as provisional interpretations of condition differences rather than definitive factorial effects. Future research should employ analytical methods appropriate to the factorial structure and larger samples to examine these effects more directly.

CONCLUSION

This study examined how different combinations of static and dynamic visual UI elements influence user evaluations in a controlled tourism website. An original fictional website, Soraka Island, was developed so that the informational content could be held relatively constant while the amount of static and dynamic presentation was systematically manipulated. 44 participants used one of four website conditions and created a travel plan.

The high-static/high-dynamic condition was rated significantly higher than the low-static/low-dynamic condition in visual attractiveness. The high-static/low-dynamic condition received higher evaluations of perceived liveliness than conditions A and C, suggesting that a lively impression can be created not only through movement but also through visually rich static presentation.

The perceived amount of movement also differed significantly among the four conditions at the omnibus level, and the median ratings were directionally consistent with the intended dynamic manipulation, although no significant pairwise differences remained after Holm correction.

In the exploratory analysis, participants in the low-static/low-dynamic condition rated pop-up and hover displays as significantly more helpful for understanding information than participants in the low-static/high-dynamic condition. Within the low-static conditions, higher dynamic presentation was not associated with greater perceived helpfulness of pop-up and hover displays for information comprehension. However, because the evaluation was subjective, the result should not be interpreted as direct evidence that dynamic elements objectively reduce comprehension performance.

Together with our previous findings, the present exploratory results suggest that static and dynamic visual UI elements may contribute differently to emotional-aesthetic engagement and cognitive-functional clarity. Effective website design should therefore use visual elements according to their informational role rather than simply increasing visual richness. In particular, dynamic elements should be introduced selectively so that they support, rather than compete with, users' information-search and comprehension processes. Balancing visual attractiveness with cognitive clarity is likely to be important for designing tourism websites that are both engaging and easy to understand.

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