

Lushness in Game Design: The Role of Non-Interactive Visual Embellishments in Player Experience

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ABSTRACT

The positive effect of visual embellishments such as *juiciness* on player experience (PX) is well-recognized. However, little is known about non-interactive visual embellishments (e.g., decorative background images or game objects players cannot interact with) and their implications for PX. This paper introduces *lushness*, a novel concept referring to non-interactive visual elements in games that are leveraged for decorative purposes. We present results from a study with 31 participants who played four versions of a 2D platformer game with varying levels of lushness: (a) no lushness, (b) low lushness, (c) moderate lushness, and (d) extreme lushness. Results demonstrate positive effects of increased lushness on PX, in particular on audiovisual appeal and overall attractiveness of the game. However, we did not observe differences regarding other aspects of PX, e.g., player competence or cognitive load. Our findings suggest that lushness enhances PX on a surface-level, improving the visual appeal of games without significantly impacting other areas of PX. Designers and researchers can benefit from the informed use of lushness in the development of games to ensure visual appeal, an aspect which we critically appraise for appropriateness in different game genres and contexts of play.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**; • **Applied computing** → **Computer games**.

KEYWORDS

Games, Game Design, Visual Embellishments, Juiciness, Player Experience

ACM Reference Format:

Anna-Lena Meiners, Damian Reich, Kieran Hicks, Dmitry Alexandrovsky, and Kathrin Gerling. 2025. Lushness in Game Design: The Role of Non-Interactive Visual Embellishments in Player Experience. In *International*

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FDG '25, April 15–18, 2025, Graz, Austria

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ACM ISBN /25/04

<https://doi.org/10.1145/3723498.3723720>

Conference on the Foundations of Digital Games (FDG '25), April 15–18, 2025, Graz, Austria. ACM, New York, NY, USA, 11 pages. <https://doi.org/10.1145/3723498.3723720>

1 INTRODUCTION

The digital game market has grown rapidly, with 14,470 new releases on the Steam platform in 2023 alone, a 16% increase over the previous year [1]. As competition intensifies, developers face challenges in differentiating their games, and player experience (PX) quality plays a significant role in helping games stand out. Prior research has focused extensively on how the use of interactive visual elements — commonly referred to as *juiciness* — enhances PX by providing feedback to player actions. Studies show that such embellishments increase immersion, curiosity, perceived competence, and intrinsic player motivation [17, 22], underscoring the role of dynamic feedback in shaping how players engage with games.

However, non-interactive visual elements that exist independently of player actions have received comparatively little attention in games research. These decorations, which we term *lush* elements, and the overall concept *lushness*, may contribute to the visual richness of game worlds, but their effects on PX are not well understood. While *juiciness* enhances the player's interactive experience, *lushness* purely affects a game's atmosphere without direct player involvement, raising the question of whether these passive elements have a meaningful impact on how players perceive and engage with games.

This gap in research is particularly significant because visual aesthetics play a substantial role in shaping first impressions which can be a key factor in deciding to buy a game [28]. In an increasingly saturated market, understanding how visual design choices, such as a game's degree of lushness, influence PX could provide valuable insights for game designers. A better grasp of lushness could inform decisions about where to invest in visual development, especially for games aiming to create immersive environments with little interactive elements.

In this paper, we introduce the concept of lushness, which encapsulates non-functional visual embellishments. To ensure the validity and relevance of this concept, we conducted an expert evaluation with human-computer interaction (HCI) researchers before proceeding with empirical testing to explore its effects on PX. To this end, we conducted an empirical study in which participants

played four versions of a 2D platformer game, each with varying degrees of lushness. We focused on two primary research questions:

RQ1 How can lushness be conceptualized in digital game design?

RQ2 How does lushness influence the player experience?

In light of current findings towards related concepts, we hypothesized the following on how lushness influences the players' experiences (**RQ2**):

H1 Lushness improves the overall player experience. Visual embellishments in games generally influence key factors of PX positively. We therefore expected an improvement of overall PX quality in relation to lushness as a form of visual embellishment. This hypothesis was supported through our findings.

H2 Lushness significantly increases the visual appeal. The aesthetic appeal of games is influenced by world design and amount of visual embellishments [17]. We hypothesized that with added lushness, visual appeal increases accordingly. Our findings supported this.

H3 Lushness significantly increases the player's immersion. Previous studies found a positive influence of added visual embellishments on players' immersion [13, 24]. We expected similar results, but could not support this hypothesis with our study.

H4 Lushness significantly increases the cognitive load of the player. With the addition of design elements on screen, it becomes more complex for users to process the stimuli [30]. Thus, we expected an increase of cognitive load for players with the increase of lushness. Through our study, this assumption was not supported.

This work contributes to a growing body of research on game design by establishing lushness as a novel concept that can enrich the visual appeal of games. We show that akin to juiciness, lushness may enhance player enjoyment, but in a more superficial manner, increasing the visual appeal of games without comprehensively impacting PX, e.g., perceived competence or players' cognitive load.

2 RELATED WORK

Overall in games research, fuzzy definitions and limited studies make it difficult to clearly interpret findings regarding the impact of visual embellishments in user interfaces and thus to develop design recommendations for the application. Generally in HCI, visual embellishments were studied with mixed results as well.

In the following, some related concepts are introduced in more detail.

2.1 Visual Embellishments in HCI

User experience (UX) research has examined the relationship between usability and perceived beauty of user interfaces for decades, with arguments ranging from "what is beautiful is usable" [34], to "what is usable is beautiful" [15], and the notion of what appears beautiful might only seem usable [33]. Visual clarity, i.e. a minimalist, orderly interface design, might cause users to perceive interfaces as both usable and beautiful [26], therefore suggesting that UX quality increases with decreased extraneous visuals. On the other hand, visual embellishments like parallax scrolling are

generally found to increase fun of use and by that enhance users' experiences especially in hedonic contexts, i.e. in cases where non-utilitarian experiences are the goal [11].

At the same time, while there are findings that support the notion that when embellishing data charts visually, overall recall of information is increased [2], it may also lead to increased cognitive load, e.g. when searching for specific information [4]. These mixed findings call for context-sensitive and nuanced evaluation of the use of adventitious visuals.

2.2 Visual Embellishments in Games

The relationship between visual design and PX has been widely studied, with a primary focus on interactive feedback systems. In the following, we focus on two concepts from games research that appear closely related to our proposition of lushness: juiciness and game junk.

2.2.1 Juiciness. One of the most prominent concepts of visual embellishments in games is juiciness, which refers to reinforcing feedback elements triggered by player actions. Initially adopted as a practical design technique in game development, the concept of juiciness was later explored in academic research, highlighting its role in improving player engagement and interaction. Juiciness enhances the sensory richness of gameplay, improving aesthetic appeal and contributing to increased player immersion [17]. Juicy elements serve to reinforce user interaction by providing immediate, often redundant, sensory feedback – such as particle effects, sounds, or animations that are triggered by player input. By definition, juiciness is inherently tied to dynamic feedback and player interaction.

Prior studies show that juiciness not only enhances immersion but also has positive effects on perceived competence and intrinsic motivation by making interactions more satisfying, at least until it reaches a saturation point [22, 23, 31]. Applying juicy design can also have undesirable effects. For example, increased juicy feedback can lead to deteriorating player performance [21, 27] and attention [25], although these relations are poorly understood so far.

Finally, we also want to note that juiciness has been studied beyond visual embellishments, with related work examining juicy haptics [29] and juicy audio design [18]. There are also efforts to develop tools that support quick implementation of popular juicy embellishments like screen shakes, particle effects, or color changes [20].

2.2.2 Game Junk. A second, less interactive concept explored in game design is game junk, which refers to non-functional graphical elements that are not directly tied to gameplay. The term was introduced by Gerling et al., who compared a version of the game *Rockband 2* with and without extraneous visual elements "which are not integrated with the game mechanic" [13].

Their findings suggested that these non-essential elements did not significantly impact PX, although it was noted that the fast-paced nature of the game may have overshadowed the effects of these visual elements. Game junk, therefore, encompasses non-interactive visuals, but the research on its effects remains inconclusive, especially in slower-paced or exploratory game contexts.

E.g., in a study of an open-world role-playing game, *World of Warcraft*, stronger perceived vividness of the game resulted in increased immersion and enjoyment, both central aspects of player experiences [24]. Still, the construct of vividness in game design remains largely self-defined and up to the participants' interpretation in this study, which leaves the research gap regarding non-essential game design elements open.

Overall, the concept of game junk remains loosely defined, with ambiguity regarding whether it includes only non-interactive embellishments, or also extends to interactive or juicy elements. The sparse examples discussed in existing research pertain to non-interactive graphics, but other design elements are not explicitly excluded from the definition. Revisiting the notion of game junk in light of our study on lushness provides an opportunity to clarify this terminology within the broader context of game design vocabulary.

2.3 Lushness as a Means To Fill the Research Gap

Despite the explorations mentioned in section 2.1, and 2.2, non-interactive, purely decorative visual elements remain under-investigated as the ambiguous findings show, particularly when it comes to their influence on the overall PX. These elements, such as background details, environmental decorations, and atmospheric features, are often perceived passively by players but may still play a crucial role in the overall experience of a game.

We introduce the concept of **lushness** to address this gap. Our initial definition of lushness refers specifically to decorative, non-interactive elements that contribute to the visual abundance of games. While lushness shares some characteristics with game junk, it is conceptually distinct because it focuses on enhancing the visual richness of the environment rather than simply adding non-functional objects. Unlike juiciness, lushness does not provide feedback to player actions; instead, it passively enhances the aesthetic atmosphere of the game.

Although the term "lushness" was not explicitly used in industry discourse, game developers have long employed lush design elements to enrich visual experiences, e.g., when remastering games like in the *Super Mario All-Stars* compilation [9], where enhanced background and environmental detail elevated the game's visual appearance (see Figure 1). These design choices, even when used subtly or in a more abstract way, like shadows and background details in *Thomas Was Alone* [3] (see Figure 2), contribute to a richer atmosphere and can affect player perception and enjoyment, much like juiciness, but without directly influencing gameplay interaction.

This study aims to explore how this form of visual embellishment affects PX, particularly in terms of perceived attractiveness, immersion, and cognitive load. This is especially interesting in settings where game prototypes or simplistic games are used. Here, our findings increase explainability of evaluative results and therefore can support future design decision making.

In iterative game development, e.g., when running studies like [14] where different development stages of games are compared regarding rated quality of PX factors, it is particularly useful to



Figure 1: The screenshots of *Super Mario Bros.* in the original NES version [8] (top) and the remastered *Super Mario All-Stars* version [9] (bottom) illustrate the industry practice of adding lushness to games: Environmental details, such as clouds in the sky and grass on the ground, add liveliness to the scene, without direct impact on game mechanics. (Screenshots retrieved from the Super Mario Wiki [7], reproduced as fair use.)

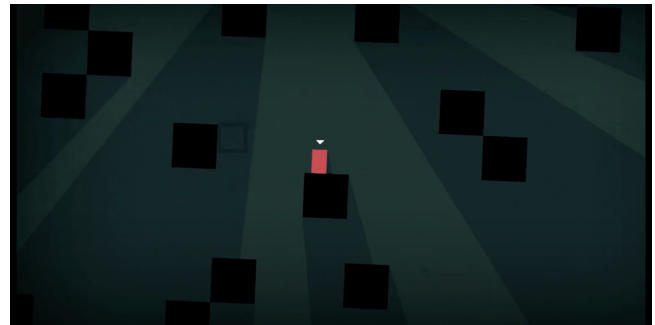


Figure 2: The 2D platformer *Thomas Was Alone* [3] employs more subtle lush design elements by adding shadows and minimal background detail. (Screenshot taken by the authors. © ⓘ)

understand the influence of design decisions on individual PX factors to interpret results meaningfully and be able to focus design efforts on a specific desired PX outcome. Similar PX (re-)testing processes are a standard procedure in the game industry, in the field of games user research, especially in agile game development. A comprehensive understanding of lushness can therefore be valuable in academic studies, where games are developed and/or used as research tools, as well as in industry research.

3 METHODOLOGY

In this study, we followed a two-step process: First, we refined and validated our concept of lushness through an expert evaluation. We used the results from the validation phase to develop the design for the second, main part of the study, an empirical evaluation of the effects of different levels of lushness on PX.

3.1 Concept Validation

Before conducting the main empirical study, we validated the concept of lushness through an expert evaluation. Four experts from the field of Human-Computer Interaction (HCI) were recruited for semi-structured interviews. These experts had extensive experience in user experience (UX) and game design research, making them well-suited to evaluate the theoretical and practical relevance of lushness in digital games.

During the 45-minute interviews, each expert was introduced to the initial notion of lushness as non-interactive visual embellishments in digital games. To illustrate the concept, we presented video clips of a 2D platformer game that was developed for this study. In these clips, lushness was conceptualized through different amounts of non-functional decorative elements ranging from minimal to extreme, and encompassed, e.g., background imagery or environmental embellishment through objects such as plants. Experts were asked to provide feedback on the clarity, relevance, and boundaries of the lushness concept, as well as its potential overlap with other design concepts such as juiciness or game junk.

Based on the experts' input, we finally defined lushness, ensuring that it remained distinct from other visual embellishment concepts, to represent non-interactive, purely decorative visual embellishments that enhance the visual appeal of a game without interfering with gameplay or providing feedback. We also finalized the amount and type of embellishments added to the final game versions. Specifically, some elements that did not fit the definition of lushness because they may interfere with game mechanics were excluded, e.g., decorative fog that could obscure hit boxes and platforms as it could increase difficulty of the jump'n'run game, and glowing flowers that might suggest direction and provide visual hints to players (i.e., functioning as feedforward cues) as they crossed into the realm of gameplay-relevant information.

3.2 Game Design

The 2D platformer game developed for this study is played on a desktop computer, and takes place in a desolate temple on an alien planet on which the player's character has crash landed. Players explore the game world, avoiding obstacles and enemies, while collecting keys to unlock the temple door, using the WASD and Space keys to navigate the environment. The game includes core mechanics such as movement, jumping, and basic combat. An existing Unity template was adapted to create the game, and can be accessed via [32].

To differentiate the four conditions, we manipulated the amount of background decorations, such as vegetation, rocks, statues, and other decorative assets. In the no lushness condition, these elements were absent, while the extreme lushness condition featured a dense arrangement of embellishments. Figure 3 provides an overview of the four conditions.

3.3 Power Analysis

An a priori power analysis was conducted using G*Power version 3.1.9.7 [10] for sample size estimation based on data from Hicks et al. [17] ($N = 40$), which compared a juicy to non-juicy version of the same game using quantitative evaluation with the PXI. This study was selected for reference, as we expect the effectiveness of lushness to be comparable to juiciness since both share similar visual involvement on-screen. Hicks et al. found a mean effect size of $f = 0.30576742$ (incl. non-significant results), and $f = 0.52140205$ (including significant results only). With a significance criterion of $\alpha = .05$ and $power = .95$, the minimum sample size needed with this effect size is $N = 25$ for an ANOVA. Adding a regularly assumed 15% in case the sample requires non-parametric testing, the minimum is $N = 29$.

3.4 Participants

Thirty-one participants were recruited through social media and word of mouth. Participants required to not have a visual or hearing impairment and to be of age.

The participants' age ranged from 19 to 47, with a mean of 25.8 years. 22 were male, 9 female. 19 participants stated their occupation as university students, and 3 were apprentices in vocational training, 8 were employed, one person chose not to disclose an occupation. The participants' weekly gaming time varied: 12 participants reported to play video games for up to 3 hours every week, 13 played for 3 to 10 hours, and 3 each stated that they either did not play at all, or for more than 10 hours every week. All participants indicated that they had at least some experience with 2D platformer games, with half of the group ($N=16$) stating little and the other half ($N=15$) much or very much experience. 3 self-assessed their video game skills as poor or below average, while the rest rated themselves from average to very good, and one participant rating their skills as excellent.

3.5 Procedure

At the beginning of each session, participants were given information about the study and they were asked to provide informed consent. Each participant played all four versions of the game in varying orders to control for order effects. Each playthrough lasted approximately five minutes per version. After playing each version, participants filled out a paper questionnaire containing closed rating questions, and an open text field for comments on the current version. After the last play session, an exit questionnaire with socio-demographic questions and an overall comment field was filled out. Overall, each session lasted about 45 minutes.

The study took place in a controlled lab environment, ensuring minimal distractions and an identical game setup for each participant with the same PC, keyboard, display, and headphones, with one exception: One participant decided against using the headphones and used the PC's speakers instead. The study protocol was approved by the ethics board at Karlsruhe Institute of Technology. Participants received a 10 euro compensation for their participation.

3.6 Measures

We used the following validated instruments to measure different aspects of PX and cognitive load in addition to open questions



Figure 3: Levels of lushness presented to study participants: no, low, moderate, and extreme lushness.

that asked participants to elaborate on their experience for each playthrough:

- (1) **Player Experience Inventory (PXI)** [35]: This tool measures several dimensions of PX, including Mastery, Curiosity, Immersion, Autonomy, Meaning, and Audiovisual Appeal. Each dimension is rated on a 7-point Likert scale. Given the nature of lushness, particular attention was given to the Audiovisual Appeal and Immersion subscales.
- (2) **AttrakDiff2** [16]: This questionnaire assesses the general UX quality of an interactive product, through scales for Pragmatic Quality, Hedonic Quality – with subscales Identity and Stimulation – and overall Attractiveness. Responses are given on a 7-point semantic differential scale (e.g., unappealing vs. appealing).
- (3) **NASA Task Load Index (NASA-TLX)** [36]: This tool evaluates cognitive workload using six dimensions: Mental Demand, Physical Demand, Temporal Demand, Performance, Effort, and Frustration. Each scale is rated on a 21-point scale.

3.7 Data Analysis

Given that the data did not meet normality assumptions, non-parametric statistical methods were employed. A Friedman test was conducted to assess the main effect of lushness across the four conditions, with pairwise comparisons using Wilcoxon signed-rank

tests and Bonferroni corrections applied to account for multiple comparisons. Effect sizes were calculated using Hedges' g to quantify the magnitude of the differences. Qualitative feedback from participants was analyzed using thematic analysis to identify common themes related to overall evaluation and experience.

4 RESULTS

Descriptive statistics of the quantitative data as well as Cronbach's alphas for internal consistency of each (sub)scale are presented in Table 1. Data of the pairwise comparisons and main effects, including Hedges' g for effect size, are shown in Table 2.

4.1 Player Experience (PXI)

The overall PX, as measured by the PXI, was rated good across all four levels of lushness. Scale consistency was acceptable ($\alpha > .7$) to excellent ($\alpha > .9$) throughout all conditions, except for Ease of Use in the no, moderate, and extreme lushness conditions, and Progress Feedback in the extreme lushness condition. Overall consistency across all conditions was good ($\alpha > .8$) to excellent ($\alpha > .9$).

Throughout conditions, Meaning and Autonomy were rated lowest of all the scales with slightly negative results, and Mastery, Ease of Use, and Goals & Rules were rated highest and overall good. All other scales received moderately positive ratings throughout

Table 1: Mean, standard deviation and Cronbach's alpha for each level of lushness

Scale	None	Low	Moderate	Extreme	Total
PXI – Meaning	-.74 (1.17), $\alpha = .907$	-.46 (1.2), $\alpha = .885$	-.32 (1.12), $\alpha = .849$	-.19 (1.25), $\alpha = .900$	$\alpha = .933$
PXI – Curiosity	.72 (1.46), $\alpha = .911$	1.01 (1.28), $\alpha = .900$	1.31 (1.36), $\alpha = .927$	1.33 (1.69), $\alpha = .940$	$\alpha = .899$
PXI – Mastery	1.77 (.9), $\alpha = .808$	1.61 (1.15), $\alpha = .879$	1.62 (1.05), $\alpha = .864$	1.6 (1.27), $\alpha = .929$	$\alpha = .897$
PXI – Autonomy	-.72 (1.39), $\alpha = .956$	-.52 (1.37), $\alpha = .915$	-.56 (1.43), $\alpha = .932$	-.38 (1.64), $\alpha = .970$	$\alpha = .966$
PXI – Immersion	1.12 (1.12), $\alpha = .787$	1.31 (.98), $\alpha = .835$	1.3 (.99), $\alpha = .845$	1.48 (1.0), $\alpha = .733$	$\alpha = .841$
PXI – Progress Feedback	1.24 (1.43), $\alpha = .849$	1.26 (1.39), $\alpha = .870$	1.2 (1.32), $\alpha = .793$	1.11 (1.22), $\alpha = .680$	$\alpha = .941$
PXI – Audiovisual Appeal	.6 (1.8), $\alpha = .958$	1.34 (1.48), $\alpha = .966$	2.11 (.98), $\alpha = .911$	2.23 (.78), $\alpha = .884$	$\alpha = .876$
PXI – Challenge	.44 (1.49), $\alpha = .841$.39 (1.35), $\alpha = .768$.29 (1.43), $\alpha = .882$.4 (1.76), $\alpha = .917$	$\alpha = .918$
PXI – Ease of Control	2.11 (.72), $\alpha = .676$	1.92 (.96), $\alpha = .703$	2.08 (.84), $\alpha = .680$	2.05 (.83), $\alpha = .676$	$\alpha = .872$
PXI – Goals & Rules	2.12 (.99), $\alpha = .777$	1.82 (1.18), $\alpha = .836$	1.96 (1.01), $\alpha = .845$	1.91 (1.2), $\alpha = .889$	$\alpha = .947$
AttrakDiff2 – Pragmatic Quality	1.28 (.72), $\alpha = .782$	1.16 (.73), $\alpha = .765$	1.08 (.74), $\alpha = .742$	1.12 (.7), $\alpha = .682$	$\alpha = .904$
AttrakDiff2 – HQ-Identity	-.34 (.78), $\alpha = .764$.18 (.58), $\alpha = .669$.55 (.5), $\alpha = .495$.56 (.57), $\alpha = .637$	$\alpha = .856$
AttrakDiff2 – HQ-Stimulation	-.96 (.92), $\alpha = .851$	-.63 (.87), $\alpha = .872$	-.4 (.66), $\alpha = .629$	-.22 (.82), $\alpha = .798$	$\alpha = .914$
AttrakDiff2 – Attractiveness	.66 (1.11), $\alpha = .934$	1.24 (.66), $\alpha = .832$	1.44 (.66), $\alpha = .782$	1.52 (.56), $\alpha = .759$	$\alpha = .869$
TLX – Mental Demand	-4.55 (5.06)	-4.16 (4.05)	-4.35 (4.96)	-3.03 (4.85)	N/A
TLX – Physical Demand	-7.58 (3.09)	-7.65 (3.16)	-8.03 (3.18)	-7.9 (2.74)	N/A
TLX – Temporal Demand	-5.71 (5.08)	-5.45 (4.38)	-6.29 (4.05)	-6.29 (4.56)	N/A
TLX – Performance	-5.45 (4.02)	-3.9 (4.56)	-4.42 (4.9)	-4.65 (4.88)	N/A
TLX – Effort	-5.71 (4.16)	-5.77 (3.86)	-5.97 (4.01)	-5.65 (3.51)	N/A
TLX – Frustration	-5.32 (4.92)	-4.97 (4.7)	-5.77 (4.33)	-4.68 (5.66)	N/A
TLX – Workload	-5.72 (3.4), $\alpha = .859$	-5.32 (3.02), $\alpha = .822$	-5.81 (3.25), $\alpha = .854$	-5.37 (3.37), $\alpha = .847$	$\alpha = .935$

conditions, except for the Audiovisual Appeal scale which improves from average to very good ratings as lushness is increased.

Additionally, Meaning and Curiosity ratings increased continuously as lushness was added. For the Progress Feedback, Immersion, and Autonomy scales, addition of lushness initially increased ratings, but further increase of lushness resulted in mixed differences of ratings, while mean ratings stayed on a similar level throughout all lushness conditions. The Goals & Rules, Ease of Use, Mastery, and Challenge scales were rated slightly worse when adding a low level of lushness compared to no lushness. Ratings for these scales stayed about the same for each level of applied lushness, though.

Notably, the Audiovisual Appeal dimension was the only one that showed statistically significant effects of lushness. A Friedman test indicated a significant main effect of lushness on Audiovisual Appeal ($\chi(3) = 25.565, p < .001$). Pairwise comparisons using Wilcoxon signed-rank tests revealed significant differences between all conditions except between the moderate and extreme lushness conditions (see Table 2 for details). This suggests that increasing the amount of lushness progressively enhances the perceived visual appeal, but the effect plateaus between the moderate and extreme levels.

4.2 Pragmatic and Hedonic Quality (AttrakDiff2)

All versions of the game were rated generally high on Pragmatic Quality and Attractiveness, while HQ-Identity received average to slightly positive ratings and HQ-Stimulation negative to average results with added lushness. Scale consistency was overall good ($\alpha > .8$) to excellent ($\alpha > .9$), with questionable ($\alpha > .6$) scale consistency for Pragmatic Quality in the extreme lushness level,

HQ-Identity in the low, moderate, and extreme lushness level, and HQ-Stimulation in the extreme lushness level. Adding lushness increased ratings for every scale in every condition, except for Pragmatic Quality which is initially rated lower with added lushness, but stays about the same between moderate and extreme lushness. Pragmatic Quality ratings showed no significant differences across conditions, suggesting that lushness did not significantly affect the functional perception of the game.

Lushness did significantly influence both Hedonic Quality scales and overall Attractiveness. The Friedman test revealed a main effect of lushness on the HQ-Identity subscale ($\chi(3) = 44.233, p < .001$), HQ-Stimulation subscale ($\chi(3) = 21.130, p < .001$), and overall Attractiveness ($\chi(3) = 19.713, p = .001$). Significant pairwise differences were observed between most conditions, except between moderate and extreme lushness, indicating that increasing lushness enhances Hedonic Quality and Attractiveness but reaches a ceiling effect.

4.3 Cognitive Load (NASA-TLX)

Total workload remained low across all conditions, indicating that increasing lushness did not impose additional cognitive demands on players, with physical demand rated lowest and mental demand highest, but still very low. Initial addition of lushness generally slightly increased ratings across scales. Between low and moderate levels of lushness, ratings decreased slightly, and between moderate and extreme lushness increased again. Scale consistency of the overall workload scale was good ($\alpha > .8$) to excellent ($\alpha > .9$). The analysis of the NASA-TLX scores indicated no significant effects of lushness on any of the workload dimensions.

Table 2: Results of significance testing for pairwise comparisons using Wilcoxon-signed rank tests and for main effects using Friedman tests, values corrected using Bonferroni correction, * indicates significance

Scale	None / Low	None / Moderate	Low / Moderate	None / Extreme	Low / Extreme	Moderate / Extreme	Main
Meaning	W = 90.0, p = .888, g = .233	W = 75.0, p = .066, g = .361	W = 130.0, p = 1.0, g = .119	W = 51.5, p = .093, g = .447	W = 104.5, p = 1.0, g = .217	W = 167.5, p = 1.0, g = .108	p = .188, $\chi^2 = 9.977$
Curiosity	W = 128.5, p = 1.0, g = .209	W = 130.5, p = .366, g = .414	W = 150.0, p = 1.0, g = .225	W = 133.0, p = .413, g = .383	W = 151.0, p = .917, g = .212	W = 180.0, p = 1.0, g = .014	p = 1.0, $\chi^2 = 6.114$
Mastery	W = 95.5, p = 1.0, g = -.154	W = 141.0, p = 1.0, g = -.151	W = 156.5, p = 1.0, g = .01	W = 130.0, p = 1.0, g = -.154	W = 98.0, p = 1.0, g = -.009	W = 175.0, p = 1.0, g = -.018	p = 1.0, $\chi^2 = 1.388$
Autonomy	W = 99.0, p = 1.0, g = .147	W = 123.5, p = 1.0, g = .113	W = 147.0, p = 1.0, g = -.03	W = 89.0, p = 1.0, g = .224	W = 99.5, p = 1.0, g = .092	W = 101.0, p = 1.0, g = .117	p = 1.0, $\chi^2 = 1.954$
Immersion	W = 142.0, p = 1.0, g = -.181	W = 85.5, p = 1.0, g = .17	W = 184.5, p = 1.0, g = -.011	W = 135.5, p = .76, g = .339	W = 117.0, p = 1.0, g = -.171	W = 157.5, p = 1.0, g = .181	p = 1.0, $\chi^2 = 3.758$
Progress Feedback	W = 103.5, p = 1.0, g = -.031	W = 108.0, p = 1.0, g = -.071	W = 148.0, p = 1.0, g = -.039	W = 84.5, p = 1.0, g = -.148	W = 134.0, p = 1.0, g = -.114	W = 115.5, p = 1.0, g = -.075	p = 1.0, $\chi^2 = 3.036$
Audiovis. Appeal	W = 39.5, p = .017, g = .444*	W = 42.0, p = .004, g = 1.027*	W = 55.0, p = .041, g = .6*	W = 27.0, p = .002, g = 1.157*	W = 45.0, p = .029, g = .734*	W = 125.0, p = 1.0, g = .132	p = .0, $\chi^2 = 25.565^*$
Challenge	W = 159.5, p = 1.0, g = -.037	W = 188.5, p = 1.0, g = -.102	W = 165.5, p = 1.0, g = -.069	W = 131.0, p = 1.0, g = -.026	W = 163.5, p = 1.0, g = .007	W = 175.5, p = 1.0, g = .066	p = 1.0, $\chi^2 = .484$
Ease of Control	W = 85.5, p = 1.0, g = -.213	W = 92.0, p = 1.0, g = -.041	W = 107.5, p = 1.0, g = .165	W = 77.5, p = 1.0, g = -.068	W = 123.5, p = 1.0, g = .142	W = 101.0, p = 1.0, g = -.025	p = 1.0, $\chi^2 = 2.752$
Goals & Rules	W = 30.5, p = .058, g = -.272	W = 118.5, p = 1.0, g = -.159	W = 85.0, p = 1.0, g = .126	W = 17.0, p = .093, g = -.183	W = 100.0, p = 1.0, g = .08	W = 87.5, p = 1.0, g = -.038	p = .370, $\chi^2 = 8.484$
Pragmatic Quality	W = 141.5, p = .988, g = -.158	W = 153.5, p = .638, g = -.269	W = 215.0, p = 1.0, g = -.112	W = 190.5, p = 1.0, g = -.093	W = 193.0, p = 1.0, g = .068	W = 151.5, p = 1.0, g = .181	p = 1.0, $\chi^2 = 2.434$
HQ- Identity	W = 44.0, p = .0, g = .748*	W = 25.0, p = .0, g = 1.338*	W = 76.0, p = .008, g = .669*	W = 22.0, p = .0, g = 1.308*	W = 65.0, p = .004, g = .657*	W = 216.0, p = 1.0, g = .024	p = .0, $\chi^2 = 44.233^*$
HQ-Sti- mulation	W = 103.5, p = .049, g = .363*	W = 95.0, p = .012, g = .689*	W = 158.5, p = .783, g = .29	W = 72.0, p = .002, g = .834*	W = 100.5, p = .07, g = .472	W = 112.5, p = 1.0, g = .236	p = .0, $\chi^2 = 21.130^*$
Attrac- tiveness	W = 98.0, p = .015, g = .616*	W = 79.5, p = .01, g = .841*	W = 123.0, p = .419, g = .308	W = 67.0, p = .007, g = .966*	W = 123.5, p = .154, g = .465	W = 160.5, p = 1.0, g = .134	p = .001, $\chi^2 = 19.713^*$
Mental Demand	W = 124.5, p = 1.0, g = .054	W = 154.5, p = 1.0, g = .038	W = 145.0, p = 1.0, g = -.012	W = 96.0, p = .448, g = .302	W = 119.0, p = .912, g = .282	W = 132.0, p = .644, g = .266	p = .989, $\chi^2 = 5.097$
Physical Demand	W = 56.0, p = 1.0, g = -.107	W = 51.0, p = 1.0, g = -.142	W = 34.5, p = .787, g = -.043	W = 52.0, p = 1.0, g = -.109	W = 42.5, p = 1.0, g = -.001	W = 40.0, p = 1.0, g = .043	p = 1.0, $\chi^2 = 1.698$
Temporal Demand	W = 95.0, p = 1.0, g = .016	W = 94.5, p = 1.0, g = -.125	W = 69.5, p = 1.0, g = -.156	W = 92.0, p = 1.0, g = -.119	W = 82.0, p = 1.0, g = -.147	W = 91.5, p = 1.0, g = .0	p = 1.0, $\chi^2 = 3.488$
Perfor- mance Effort	W = 55.5, p = .228, g = .328	W = 117.0, p = 1.0, g = .228	W = 147.5, p = 1.0, g = -.081	W = 132.0, p = 1.0, g = .178	W = 161.5, p = 1.0, g = -.129	W = 118.5, p = 1.0, g = -.046	p = 1.0, $\chi^2 = 2.291$
Frustration	W = 110.0, p = 1.0, g = -.064	W = 131.5, p = 1.0, g = -.062	W = 114.5, p = 1.0, g = -.0	W = 115.5, p = 1.0, g = .017	W = 137.0, p = 1.0, g = .088	W = 116.5, p = 1.0, g = .085	p = 1.0, $\chi^2 = .380$
Workload	W = 148.5, p = 1.0, g = .039	W = 110.5, p = 1.0, g = -.096	W = 119.0, p = 1.0, g = -.141	W = 98.5, p = 1.0, g = .12	W = 117.5, p = 1.0, g = .087	W = 102.5, p = 1.0, g = .215	p = 1.0, $\chi^2 = 3.098$
	W = 184.0, p = 1.0, g = .071	W = 204.0, p = 1.0, g = -.026	W = 171.5, p = .812, g = -.101	W = 159.5, p = 1.0, g = .104	W = 231.5, p = 1.0, g = .04	W = 180.0, p = 1.0, g = .131	N/A

4.4 Qualitative Feedback

Qualitative feedback gathered through the comment field on the session and the exit questionnaire revealed that participants generally favored higher levels of lushness, describing the more embellished game versions as "beautiful" and "more immersive." The moderate lushness level was commented on as the "best," and "most beautiful." On the other hand, participants described the no- and low-lushness versions as feeling "very empty" and "unfinished."

Furthermore, several participants noted that added lushness, especially in the extreme lushness level, introduced "clutter" that occasionally detracted from their immersion. One participant reflected: *"The background was sometimes too cluttered – in some places, it looked like assets were just thrown in without considering the overall composition (e.g., in the scene where you finish the game). The changes weren't all negative, but the visual clutter pulled me out of the immersion a bit."*

Repeated gameplay across conditions appeared to reduce novelty and curiosity over time. One participant noted: *"The first time I played, I was much more excited and curious about what would happen. After that, I already knew how the level played out."* Another appreciated the repetition and getting used to playing in the study setting: *"I just wanted to add that as time went on, I became more familiar with both my surroundings (in real life) and the game, which made everything feel more pleasant. At first, I was a little nervous."*

Participants also reflected on the effect of time constraints and study conditions on their experience. One participant noted: *"Some of my feelings and impressions were influenced by the fact that I could only play for a limited time. I was also generally more 'interested' in knowing what was coming because of the study setup. Normally, when I play something, I already have an idea or a reason for playing that's directly tied to the game. Here, it was more of a surprise."*

5 DISCUSSION

The aim of this study was to conceptualize and empirically evaluate the role of lushness, a novel term describing non-interactive decorative visual elements in digital games, in shaping PX. The findings highlight that lushness significantly enhances the aesthetic appeal of game environments, improving Audiovisual Appeal, Identity, Stimulation, and overall Attractiveness, but does not affect other dimensions of PX, Pragmatic Quality, or cognitive load. Below, we discuss these results in the context of the research questions and hypotheses, providing a more in-depth interpretation and reflection on the limitations of the study and broader implications for game design.

5.1 RQ1: How Can Lushness Be Conceptualized in Digital Game Design?

Addressing RQ1, this study provides strong evidence that lushness can be conceptualized as a distinct design concept, separate from established terms such as juiciness and game junk. Juiciness, which refers to dynamic feedback linked to player input, engages players through interactive sensory feedback, making games feel more responsive. By contrast, lushness exists passively within a game, enhancing its visual richness without responding to player actions or influencing gameplay mechanics.

The differentiation between lushness and game junk is particularly important. While game junk refers to non-functional graphics or superfluous elements, lushness contributes positively to the overall game environment by providing aesthetic depth. Rather than detracting from the player experience, as game junk might, lushness enhances the perceived quality and atmosphere of the game, as evidenced by its significant effects on Audiovisual Appeal, Hedonic Quality, and overall Attractiveness, as well as the qualitative descriptions of participants as "more beautiful" and "more immersive". Thus, this study establishes lushness as a purposeful strategy that serves to enhance the visual design of a game.

5.2 RQ2: How Does Lushness Influence the Player Experience?

This study found that lushness does significantly influence PX. We nuance this finding by examining how specific PX factors are

influenced by the addition of lushness and thus, to which degree our previously posited hypotheses are supported.

5.2.1 Overall Impact on Player Experience. Generally, PX quality is rated higher with addition of lushness: When comparing versions of a game with no lushness to any amount of lushness, results show beneficial results for relevant dimensions of PX. This is also supported by the participants' comments, generally favoring lush versions of the game over the no-lushness version. Significantly increased ratings for hedonic aspects of the game and visual appeal without significant decrease in any of the other measures suggest support of **H1**.

5.2.2 Impact of Lushness on Visual Appeal. Considering **H2**, the results show that lushness significantly improves the visual appeal of a game, with notable increases in the PXI scale Audiovisual Appeal, and AttrakDiff's overall Attractiveness, HQ-Stimulation, and HQ-Identity. The addition of lushness was perceived by players as adding visual depth and richness, confirming the hypothesis that lushness enhances the aesthetic dimensions of PX. However, diminishing returns were observed beyond the moderate lushness condition, as the difference between moderate and extreme lushness was not significant, and qualitative participant feedback hinted at a decrease in PX. This suggests that while lushness adds to audiovisual appeal up to a certain threshold, additional embellishments beyond this point offer no further improvements, with participants' comments even suggesting it may be perceived as visual clutter which is in line with previous work [4].

5.2.3 Limited Effect of Lushness on Immersion. Despite its positive effect on visual appeal, lushness did not significantly impact Immersion, contrary to **H3**. This result suggests that the visual richness provided by lushness operates at a surface level, influencing players' appreciation of the game's aesthetic quality without deeply engaging them on an emotional or psychological level – at least in a game setting such as the one in our study. This contrasts with the effects of juiciness, which prior research shows can significantly increase immersion by creating a more interactive, responsive game [13]. The lack of a significant effect on immersion may stem from the passive nature of lushness. Because it does not respond to player actions, it may not foster the same level of engagement as interactive elements. Immersion often depends on dynamic feedback loops that draw players into the game by responding to their inputs [19]. In the case of lushness, while players appreciated the visual richness, it may not have deepened their connection to the game and, on the contrary, might have even distracted them in the increased lushness levels, as qualitative participant feedback suggests.

5.2.4 No Significant Effect on Cognitive Load. The absence of any significant effect of lushness on cognitive load measured with the NASA-TLX suggests a lack of support for **H4**, which assumed that lushness would increase mental demand. This finding is important for game designers because it indicates that lushness can be added to the environment of a game without increasing the cognitive demands on players. Lushness, as a decorative element, exists "in the background", meaning players are not required to actively focus on these details. As such, lushness can contribute to a richer visual environment without disrupting gameplay or requiring additional cognitive effort from the player. Still, these results need to be

viewed cautiously. Visual complexity has, for example, been studied to be increasing task difficulty in shooting games [6], and participants in our study found higher levels of lushness to be distracting. This leads to the assumption that the type of game and game mechanics need to be considered when assessing the drawbacks from additional visual embellishments.

5.3 Contrasting Lushness, Juiciness, and Game Junk

Embellishments in interface design serve primarily to enhance the aesthetic appeal of a system. These embellishments can include decorative icons, animations, and patterns that improve the user experience by making the interface more visually appealing and engaging. Similarly, the concept of lushness, as developed in this study, adds to the vocabulary of game design by offering a way to describe passive, non-interactive visual elements that enhance the aesthetic richness of a game. To contextualize lushness within the broader spectrum of visual embellishments, we contrast it with established concepts juiciness and game junk.

5.3.1 Lushness vs. Juiciness. Juiciness and lushness both contribute to the overall aesthetics of the experience. However, they do so in fundamentally different ways. Juiciness directly engages players through reinforcement of the game's feedback which makes the game feel responsive and alive. With this, juiciness contributes to the game's ability to immerse players [22]. In contrast, lushness addresses the game's atmosphere that contributes to the aesthetic appeal but without an effect on immersion. Furthermore, both lushness and juiciness exhibit a saturation point beyond which their benefits diminish, and negative consequences for PX show. Effects like decreased attention, as described by [25], or player motivation, as indicated in [22], when applying high levels of juiciness, have not explicitly been measured in this study but participants' comments indicate that extreme lushness could lead to similar issues. At the same time, a lack of both juiciness and lushness also generally leads to poorer player experiences. This emphasizes the need for a sweet spot in the design of embellishments, which may drastically differ across diverse use cases.

5.3.2 Lushness vs. Game Junk. Game junk, as introduced by Gerling et al. [12], refers to graphical elements in games that do not contribute to gameplay and are often perceived as superfluous, such as unnecessary, excessive visual effects [12]. We propose a more nuanced notion of game junk: We suggest that any embellishments — whether passive like lushness or interactive like juiciness — can become game junk when they overwhelm players and lead to unintended negative effects on PX. This would be the case, e.g., in the extreme lushness version in our study, where participants experienced irritation that they attributed to excessive amounts of decorative elements which they found overwhelming. Similarly, in other contexts, excessive juiciness, such as an overabundance of particle effects, screen shakes, or flashing animations, could distract players and hinder gameplay clarity, demonstrating how both passive and interactive embellishments can contribute to game junk.

This re-definition allows for a nuanced understanding that game junk is not tied to the inherent nature of the embellishment itself

but rather to the degree and context in which it is applied. Our findings demonstrate that lushness has a positive effect on aesthetic appeal without increasing cognitive load. These results suggest that, in contrast to game junk, lushness enhances PX without distracting the player from gameplay. However, our results also indicated a saturation point between moderate and extreme lushness, where additional visual embellishments no longer improved PX and, in some cases, led to clutter. This aligns with the idea that excessive decoration, even when designed to enhance appeal, can cross into the territory of game junk if it overwhelms players. Thus, while lushness serves to enrich the game environment, designers must be cautious of over-embellishing, as this can reduce clarity.

5.4 Practical Implications for Game Design

The findings of this study provide several implications for practitioners and researchers exploring the PX provided by games and game prototypes.

Most importantly, lushness can be used strategically to enhance the visual appeal of a game without negative implications for other dimensions of PX, particularly in environments where attractiveness and stimulation are important. However, designers should be mindful of the diminishing returns observed in the study — while a moderate level of lushness enhances the game experience, our study provides some indication that excessive visual detail is not appreciated by players (see section 4.4). Thus, while lushness can enhance the visual quality of a game, there is a balance to be struck. Beyond a certain point, further visual complexity may clutter the environment and reduce visual clarity. This aligns with existing principles of design, which emphasize that minimalism and clarity can be preferable over overloading a visual scene with extraneous details (see section 2.1).

Here, it is also important to reflect upon the absence of an effect of lushness on other factors relevant to PX, for example, immersion, and perceived competence (see section 4.1), which falls behind some of the effects of interactive visual embellishment such as juiciness (see section 2.2.1). In particular, that implies that lushness can be neglected at earlier stages of development, e.g., when repeatedly assessing PX through prototypes [14]. However, the impact of lushness should be critically reflected upon in settings where game prototypes are typically simplistic, e.g., in many studies within the Human-Computer Interaction and games research community that employ them as research tools [12] (e.g., see the custom-built research games by Hicks et al. [17] in their work on juiciness). While PX may not be directly impacted by the absence of lushness in such settings, it may have an impact on perceived quality of the game and subsequent player willingness to engage with games over a period of time.

5.5 Limitations and Future Work

There are several limitations to this study. First, it was conducted using a single 2D platformer game, which suggests the need for nuance when generalizing our findings to other game genres. For example, lushness may play a larger role in enhancing PX in 3D games, or may have different effects in other game genres, e.g., open world games where lushness may indicate liveliness and vividness, or first-person shooting games where lushness could contribute to

a more realistic experience, but may also be perceived as more distracting. Future studies should explore the effects of lushness across a variety of game genres, particularly those that rely heavily on environmental storytelling. Second, our study engaged participants in a short and lab-based play session, which may have constrained the depth of player engagement. Previous research suggests that immersion tends to build over longer periods of gameplay [5], so it is possible that the five-minute sessions were insufficient for players to become fully immersed in the game, even with added lushness. Future research should investigate whether extended exposure to lush environments enhances immersion, long-term player satisfaction, or leads to visual fatigue. Third, our study focused on static lushness, i.e., non-interactive visual embellishments that are not animated. However, many modern games incorporate dynamic visual elements, such as animated backgrounds or evolving environments, which may interact differently with PX. Exploring the effects of dynamic lushness and how it interacts with other audiovisual elements (e.g., sound and background music), could provide further insights into how applied lushness influences PX. Finally, we see an opportunity to study lushness in combination with juiciness, teasing apart how interactive and non-interactive visual embellishments can be leveraged to improve PX.

Overall, this study is an initial attempt to define and test lushness as an isolated design element. While the necessary simplifications in this study enabled a controlled examination of lushness, future research should explore it in more context-rich settings, accounting for its interplay with, for example, mechanics, narrative, and player expectations.

6 CONCLUSION

This study introduces and empirically explores the concept of lushness as a novel design concept in digital games, representing non-functional, decorative visual embellishments commonly found in games (e.g., decorative background images or non-interactive in-game objects). The results demonstrate that lushness significantly enhances the visual appeal and overall attractiveness of games without increasing players' cognitive load. However, in contrast to other approaches to visual embellishment such as juiciness [17], lushness does not affect other aspects of PX, e.g., immersion and perceived player competence, suggesting that while it does contribute to surface-level visual satisfaction, it does not deepen emotional or psychological engagement.

Game designers can use lushness to enrich the visual design of their games, but must be mindful of diminishing returns, as excessive lushness may reduce visual clarity. We invite researchers to build upon our initial exploration of lushness in future research, for example addressing broader application of lushness across different genres and visual styles, as well as investigating the effects of dynamic lushness in interactive environments. Thereby, we will be able to arrive at a comprehensive understanding of how the different kinds of visual embellishments in games impact different facets of PX.

ACKNOWLEDGMENTS

We would like to thank the experts who took part in the validation for their extensive and crucial insight on the topic. We are also

immensely grateful to the study participants who took part in the study and made it possible in the first place.

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