ARTIFICIAL INTELLIGENCE IN FASHION DESIGN: A CASE STUDY ON SLEEPWEAR DESIGN

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ABSTRACT: *Generative artificial intelligence (AI) is rapidly transforming the fashion industry, enabling designers to generate visual concepts from textual inputs or data with unprecedented speed and flexibility. This study investigates the application of generative AI in sleepwear design, focusing on autumn–winter two-piece pyjamas comprising a long-sleeved top and long pants. Drawing on findings from a comprehensive consumer survey that identified pyjamas and nightgowns as the most preferred sleepwear types, the study integrates user preferences directly into the design process. A generative AI model (HiDream-I1 FULL) was employed to create visual sleepwear designs based on text prompts, illustrating the potential of AI-assisted design to align product development more closely with consumer demand.*

Keywords: *Artificial intelligence (AI), fashion, design, sleepwear, consumer behaviour, consumer perceptions.*

VEŠTAČKA INTELEGENCIJA U MODNOM DIZAJNU: STUDIJA SLUČAJA O DIZAJNU ODEĆE ZA SPAVANJE

APSTRAKT: *Generativna veštačka inteligencija (VI) brzo transformiše modnu industriju omogućavajući dizajnerima da kreiraju vizuelne koncepte iz tekstualnih unosa ili podataka sa neviđenom brzinom i fleksibilnošću. Ova studija istražuje primenu generativne veštačke inteligencije u dizajnu odeće za spavanje, sa fokusom na dvodelne pidžame za jesen-zimu koje se sastoje od majice dugih rukava i dugih pantalona. Oslanjajući se na rezultate sveobuhvatnog istraživanja među potrošačima, koje je pokazalo da su pidžame i spavaćice najpoželjniji tipovi odeće za spavanje, studija direktno integriše korisničke preferencije u proces dizajna. Generativni model veštačke inteligencije (HiDream-I1 FULL) korišćen je za kreiranje vizuelnih dizajna odeće za spavanje na osnovu tekstualnih opisa, ilustrujući potencijal dizajna uz pomoć veštačke inteligencije da bolje uskladi razvoj proizvoda sa potrošačkom potražnjom.*

Ključne reči: *Veštačka inteligencija (VI), moda, dizajn, odeća za spavanje, ponašanje potrošača, percepcije potrošača.*

1. INTRODUCTION

In recent years, artificial intelligence (AI) has gained significant traction in the fashion industry and has found its way into almost every segment of the fashion value chain. From trend forecasting and consumer behaviour analysis to concept and design development, material sourcing, 3D garments prototyping, production, logistics, and retail, AI-driven tools are enhancing creativity, streamlining the design process, improving sustainability, and better meeting consumer demands [1-3]. Fashion companies are leveraging this technology to create better-selling designs, reduce marketing costs, hyper-personalize customer communications, and accelerate processes. AI also has the potential to reshape supply chains, store operations, and organizational support functions [4]. Machine learning algorithms can process vast amounts of data to identify emerging styles and predict demand, enabling designers to make informed decisions that align with evolving consumer preferences [5, 6]. Generative AI, in particular, holds promise for reimagining garment design by producing novel patterns, textures, and colour combinations that push the boundaries of traditional aesthetics [7, 8]. Although AI is increasingly integrated into the fashion industry, its application in the field of sleepwear design remains largely unexplored. Sleepwear (also known as nightwear, sleep clothing, or nightclothes), often overlooked in fashion innovation, typically consists of comfortable and loose-fitting garments designed for sleeping or relaxing at home. Available in a variety of styles, designs, colours, and textiles, sleepwear caters to different preferences and climates. However, meeting consumer expectations for comfort, style, and seasonally appropriate features makes sleepwear design a complex challenge. According to our 2024 survey conducted in Slovenia, pyjamas and nightgowns (nighties or nightdresses) are the most popular types of sleepwear [9]. Despite the importance of this category, the potential of generative AI to support sleepwear design - particularly in aligning products with consumer preferences - remains largely unexplored.

This study addresses that gap by investigating the integration of generative AI into the design process for autumn-winter sleepwear. Guided by the results of a comprehensive consumer survey - which identified pyjamas and nightgowns as the most favoured sleepwear types - the research focuses on developing two-piece pyjamas composed of a long-sleeved top and long pants [9]. By employing a generative AI model (HiDream-I1 FULL) to generate design visuals from text prompts, this study demonstrates how AI can be leveraged to create consumer-informed sleepwear designs that respond to seasonal needs and market demand.

2. METHODOLOGY

2.1. Survey data

The first part of study was conducted in 2024 and explores various aspects, including consumer perceptions and preferences regarding sleepwear textiles, details, colours, and styles [9]. A quantitative research study was conducted by interviewing to examine consumer habits related to wearing sleepwear. A random sample was used in data collection. The total number of respondents who carried out a survey was 437. Of these,

298 respondents answered the question regarding gender and age, 4 % (11) were men and 95 % (283) were women, 4 respondents were unspecified regarding gender.

2.2. AI-driven generation of sleepwear design images

The initial experimental phases involved exploring image generation models. We began with trials in various generative environments, such as Stable Diffusion and Flux, which are two leading models in this space [10]. We used Stable Diffusion 3.5 LARGE model in our previous research [11], which is why we opted to use new open-source image generative foundation model HiDream-I1 FULL [12]. These models enable designers to create images from text prompts, which is why we used the survey results to guide prompt generation.

Figure 1: The complete Hidream-I1 FULL workflow pipeline inside ComfyUI

HiDream-I1 [12] is a 17 billion parameter open-source model, released under the MIT licence [13], released in April 2025, which features a new sparse diffusion transformer, making it function differently from established diffusion-based models like Dall-E3, Midjourney or Stable Diffusion. It also has a companion E1 model, which allows for semantic understanding of natural language image editing in the style of current commercial models like Imagen4, which runs inside Gemini 2.5 Pro and GPT-Image-1, which runs inside ChatGPT. Using advanced text encoders like LLAMA 3.1 allows for complex prompt interpretations with advanced spatial reasoning, while the sparse diffusion transformer allows for usage of specialized sub-models, resulting is high adherence to longer detailed prompts, which demonstrates leading performance in benchmarks like GenEval and DPG-Bench [14]. It’s also important to know that unlike Flux.1 (which is an extremely capable T2I model), HiDream allows for negative prompts in the text encoding. We have opted to integrate the HiDream-I1 FULL inside a node-based generative AI interface called ComfyUI. It allows for complete control over the entire T2I inference pipeline, from model checkpoints, variational autoencoders, text encoders, samplers and optional additional detailers and upscalers. HiDream’s sparse diffusion transformer architecture, multi-encoder semantic processing and optional distillation techniques,

combined with complete control over the entire node-based pipeline inside ComfyUI [15] allows us to leverage its capabilities in diverse applications, as is represented in Figure 1. During the trial phase, we input various combinations of selected words into the program and experimented with variations and word order combinations. As a starting point, we used the input phrase: two-piece pyjamas, long-sleeved top, long pants with an elastic waistband, sleepwear for women, loose cut design and material for autumn/winter season. Based on the survey results, we defined ten input prompts that served as the foundation for generating AI-driven sleepwear designs. Subsequently, we added the following variations to the initial phrase:

- Prompt 1: round neckline, one-piece sleeves without rib knit wristband, no prints on the top and pants, long pants without rib knit hem, light blue colour, made of cotton material.
- Prompt 2: V-neckline, raglan sleeves with rib knit wristband, no prints, long pants with rib knit hem and without drawstrings in the waistband, blue colour, cotton material.
- Prompt 3: round neckline, set-in one-piece sleeves or raglan sleeves with rib knit wristband, long pants with rib knit hem and without drawstrings in the waistband, no prints, made of cotton terry cloth material.
- Prompt 4: round neckline with polo slit and buttons, set-in one-piece sleeves, long pants with rib knit hem and drawstrings in the waistband, pastel rosa colour, small heart prints in contrasting colour, made of cotton material.
- Prompt 5: top with gathered scoop neckline, one-piece sleeves or raglan sleeves, long pants with an elastic waistband and without drawstrings in the waistband, beige or nature colour, small printed motifs on the fabric, made of cotton material.
- Prompt 6: light grey coloured long-sleeved top with keyhole neckline, the top fabric features small black star prints, black coloured long pants with rib knit hem, made of bamboo material.
- Prompt 7: long-sleeved light blue coloured top with round neckline and raglan sleeves, the top fabric features small dot motifs/prints in contrasting colour, long pants are in dark blue colour, made of cotton material.
- Prompt 8: long-sleeved shirt with collar, front part with placket with buttons and pocket, set-in one-piece sleeves without cuff, long pants without drawstrings in the waistband, white colour, made of silk material.
- Prompt 9: long-sleeved shirt with standing mandarin collar, front part with placket with buttons and pocket, set-in one-piece sleeves without cuff, long pants without drawstrings in the waistband, mint pastel colour, made of silk material.
- Prompt 10: long-sleeved shirt with collar, front part with placket with buttons and pocket, set-in one-piece sleeves without cuff, long pants without drawstrings in the waistband, violet colour, small printed motifs on the fabric, made of satin material.

All prompts left the pose data open, allowing the generative model to generate a random unique pose. The pose itself could be additionally controlled either by describing it in the text prompt or using additional neural network structures like ControlNet [16], which adds spatial conditioning controls to a text-to-image diffusion model.

3. RESULTS WITH DISCUSSION

3.1. An analysis of survey results

As sleepwear and textiles can vary by seasons, our first question focused on whether consumers wear sleepwear during summer and winter. Of the 432 responses, 72 % of respondents stated that they wear sleepwear in the summer, while 84 % wear sleepwear in the winter. Due to the variety of sleepwear styles a1 seasons, we focused only on sleepwear worn during the autumn/winter in the following. In winter, consumers primarily wear two-piece sleepwear, such as pyjamas (set of shirt/top and pants), or a combination of a long-sleeved top with long pants or leggings. It has also been established that the majority of the respondents like small prints e.g. dots, hearts, teddy bears, etc. (46 % of respondents) and flower prints or motifs from nature (31 %). The results also show that about 30 % of respondents do not like patterns and prints at all and 68 % of the respondents do not like details nor the accessories that seem insignificant to them (e.g. buttons, pockets, flounces, ruffles, zippers etc.). About 31 % of the respondents do not mind anything on their sleepwear, while 37 % are bothered by buttons, 36 % by zippers, and 20 % by strings and ribbons. It was also found that 22 % of the respondents like lace details, 17 % like pockets, 10 % like trims (e.g. satin), and 10 % like strings and ribbons. Consumers wear primarily blue sleepwear, followed by grey, black, white and beige sleepwear. It was also found that the respondents primarily like light shades, followed by pastel and dark shades. In winter, the respondents often wear cotton, and also flannel and terrycloth sleepwear, but less often silk, satin, modal and lace sleepwear [9].

3.2. An analysis of AI-driven sleepwear designs

Figure 2 presents the results of AI-generated two-piece women’s pyjamas made of light blue cotton material for the autumn/winter season. The loose-cut pyjamas consist of a long-sleeved top and long pants with an elastic waistband. From the generated pyjamas shown in Figure 2, only minor differences among the models can be observed, such as variations in the pyjamas’ colour (which was defined as light blue), the colour of the drawstrings in the waistband (either white or light blue), and the presence of pockets on the pants, a feature not specified as an input parameter in the prompt. All pyjama tops feature a round neckline and set-in one-piece sleeves with rib knit wristbands, which were defined as negative parameter. However, a few examples include raglan sleeves, which were not specified in the input prompt. The pants are mostly loose-cut with a consistent design, all including drawstrings in the waistband. It is also notable that none of the pants feature rib knit hems, as this was defined as a negative parameter. Since the round neckline was not explicitly specified, it is unsurprising that necklines do not display contrasting piping.

Figure 2: AI-generated pyjamas created using Prompt 1

Figure 3: AI-generated pyjamas created using Prompt 2

AI-generated blue-coloured loose-cut women's pyjamas, made of cotton material for the autumn/winter season, are shown in Figure 3. The two-piece pyjamas consist of a long-sleeved top and long pants with an elastic waistband. From the results shown in Figure 3, only minor differences among the models can be observed, such as slight variations in the pyjamas' colour (defined as blue), and the presence of pockets on the pants - a feature not specified as an input parameter in the prompt. In the input prompt, the pants were defined as having an elastic waistband without drawstrings, and with a rib knit hem. However, as seen in Figure 3, most pants lack rib knit hems, and all include drawstrings in the waistband - despite this being specified as a negative parameter. All pyjama tops feature a V-neckline and raglan sleeves with rib knit wristbands, with only one example including a V-neckline with a slit and buttons (e.g., Figure 3c).

Figure 4: AI-generated pyjamas created using Prompt 3

Figure 4 presents the AI-generated results of mint-coloured two-piece women's pyjamas made from cotton terry cloth material, intended for the winter season. The loose-cut pyjamas consist of a long-sleeved top and long pants with an elastic waistband. From the pyjama designs shown in Figure 4, only minor differences among the models are observable. Most pants have rib knit hems, and all pants include drawstrings in the waistband, which was specified as a negative parameter. Interestingly, all pants also have pockets, although this feature was neither specified as an input nor as a negative parameter. All pyjama tops feature a round neckline and raglan or set-in one-piece sleeves with rib knit wristbands. The pyjamas share a consistent light mint colour, as defined in the prompt. In this research, we were interested in whether there were noticeable differences among the defined materials. In Prompts 1, 2, 4, 5, and 7, the material was defined as cotton; in Prompt 3, as cotton terry cloth; in Prompt 6, as bamboo; in Prompts 8 and 9, as silk; and in Prompt 10, as satin. However, we did not specify whether the fabric was jersey knit or another type of knit or textile. Comparing the generated pyjama models in Figures 2, 3, and 4, we observe slight differences in the appearance of the material. In Prompt 3, the material was defined as cotton terry cloth, whereas in Prompts 1 and 2, it was simply defined as cotton, all specified for the autumn/winter season. Terry cloth is recognizable by its looped pile on one or both sides, creating a soft, plush texture that gives the fabric a somewhat bulky and absorbent appearance. It often looks thick and cozy, with a matte finish rather than a sheen. As observed in Figure 4, the pyjamas made from terry cloth material appear soft, bulky, and thick, with a visibly plush texture. We were surprised to find that the difference between cotton and terry cloth materials, as defined, was noticeable in the generated designs.

The results of AI-generated pastel rosa-coloured women's pyjamas, made of cotton material with small heart prints in a contrasting colour, are presented in Figure 5. The loose-cut pyjamas consist of a long-sleeved top and long pants with an elastic waistband. From Figure 5, only minor differences among the pyjama models can be observed. Most tops feature a round neckline with a polo slit and buttons, along with set-in one-piece sleeves and rib knit wristbands. However, a few tops display a front placket with buttons (e.g., Figure 5g), despite this detail not being defined in the input prompt. Variations in the length

of the polo slit and the number of buttons is also apparent, likely due to the absence of specific instructions regarding these elements. Notably, in Figure 5a, the upper button and buttonhole are misaligned. In some cases, the buttons on the pyjama tops differ in shape or colour, despite no such variation being specified in the input phrase. All pants feature drawstrings in the waistband, while rib knit hems appear on only some models. Interestingly, all pants are designed with pockets, even though this feature was neither specified as an input nor as a negative parameter. The input phrase specified that the pyjama fabric should contain small heart prints in a contrasting colour. As expected, the resulting patterns appear generic and lack a distinctive design identity. This is likely due to insufficient detail in the prompt regarding the specific visual characteristics of the textile pattern. Although the motif was described as small, the heart prints vary slightly in size, colour (e.g., white, dark rosa, grey), and density. When testing the input phrases, we found that specifying the size of the print motifs (e.g., 1 cm) did not produce heart prints at the intended scale. We also tested a negative phrase (e.g., "heart motifs filled with colour"), but the generated pyjamas still did not feature contoured (i.e., unfilled) heart shapes, as expected. These findings suggest that a custom textile pattern proposal may be necessary to achieve more accurate and visually refined print designs.

Figure 5: AI-generated pyjamas created using Prompt 4

AI-generated beige or natural-coloured loose-cut women’s pyjamas, made of cotton material for the autumn/winter season and featuring small motifs or prints, are presented in Figures 6 and 7. The two-piece pyjamas consist of a long-sleeved top with a gathered scoop neckline and long pants with an elastic waistband. From Figure 6, it can be observed that most pants follow a similarly loose-cut design with elastic waistbands and drawstrings, although drawstrings were specified as a negative parameter. Some pants are again designed with pockets, even though this feature was neither specified as an input nor as a negative parameter. The majority of tops display a gathered scoop neckline and raglan sleeves, as shown in Figure 6. However, some designs include additional elements such as slits, buttons, or drawstrings at the neckline (Figure 7), as well as sleeves finished with either gathered (Figure 6f) or ribbed wristbands (Figure 7a) - features not specified in the input prompt. We also observed that gathers and slits appeared inconsistently in the neckline of some tops, as presented in Figure 7. Since the motif for the print was not defined

in terms of colour, shape, or placement, the generated motifs appear visually appropriate for the overall pyjama design. Although the motifs are not rendered with high precision, discernible elements include small floral, nature-inspired, and other ornamental forms. The colours of the pyjamas are predominantly beige, with motifs in brown or light brown tones, contributing to a cohesive visual impression.

Figure 6: AI-generated pyjamas created using Prompt 5

Figures 8 and 9 present the results of AI-generated designs for loose-cut women's pyjamas featuring small star and dot prints. The two-piece pyjamas shown in Figure 8 are made from bamboo fabric and consist of a light grey, long-sleeved top with small black star prints and a keyhole neckline. They are paired with black long pants. As seen in Figure 8, minor variations exist among the pyjama models. The pants are generally loose-cut, some feature white star motifs and pockets, and others differ in hem design, lacking rib-knit finishes. This suggests that certain input parameters were not consistently followed. The keyhole neckline also varies among the models. In all cases, it features grey piping; however, its shape and detailing differ - appearing as a teardrop, incorporating a string, or rendered as a simple slit - none of which were specified in the original input phrase. As we can see from Figure 8, the star motifs on the tops are approximately the same size, but the pattern density varies slightly. We also observed that the textiles lacked the characteristic subtle sheen. Bamboo jersey is generally known to have a silk-like sheen and falls more softly than cotton. However, in Figure 8, this shine is not apparent, as the material appears more similar to cotton. In our previous research using the Stable Diffusion model, we observed subtle differences between cotton and bamboo materials [11].

Figure 7: AI-generated pyjamas created using Prompt 5, illustrating deviations from the input parameters and inaccuracies in design details

Figure 8: AI-generated pyjamas created using Prompt 6

The pyjamas made from cotton material, shown in Figure 9, include a light blue long-sleeved top, paired with dark blue long pants. The fabric of the top features small dot motifs in a contrasting colour. From Figure 9, it can be observed that most pants follow a similar loose-cut design, featuring an elastic waistband. Interestingly, most pants also include pockets and drawstrings in the waistband in varying colours (e.g., white or blue), even though these features were not specified as either input or negative parameters. Some pants also feature dot motifs, even though this was specified as a negative parameter. All tops feature a round neckline and raglan sleeves, along with rib-knit wristbands - a detail that

was not specified as an input or negative parameter. A few tops feature round necklines with contrasting piping (e.g., Figure 9g), although this feature was not explicitly specified, whereas others display round necklines with light blue piping. Additionally, the small polka dot pattern varies slightly in density, dot size, colour (e.g., dark blue, white, grey, rosa, etc.), and composition. Although the input prompt did not precisely specify the small dot pattern, a greater degree of diversity and variation in the resulting designs was expected.

Figure 9: AI-generated pyjamas created using Prompt 7

Figures 10 and 11 present AI-generated two-piece loose-cut women's pyjamas made of silk, designed for the autumn/winter season. Among the white pyjama designs shown in Figure 10, minor differences can be observed between the models. All pants follow a similar loose-cut design with an elastic waistband. Notably, most pants include pockets - a feature that also appears on some shirts (e.g., Figures 10c and 10f) - despite not being specified as either an input or a negative design parameter. The shirts share a similar design, featuring a front placket with white buttons, a notched collar (rever), and a rectangular chest pocket - this detail was not specified in the input prompt. The hems of the shirts are either straight or slightly shaped, with minor variations in length. Some set-in sleeves are finished with loose-cut cuffs, another element not specified in the design prompt. From Figure 10, the distinct sheen of the material is noticeable, consistent with the specification that the pyjamas are made of silk. Silk textiles are known for their exceptional sheen, which results from their smooth surface that reflects light, giving them a luxurious and radiant appearance.

The mint pastel pyjamas shown in Figure 11 feature a long-sleeved shirt with a stand-up mandarin collar and loose-cut, full-length pants with an elastic waistband. The mandarin collars are characterized by their rounded edges, consistent with the typical design of this collar style. The shirts fasten with a button placket and include a chest pocket - either on the right or left side - although this detail was not specified in the input. The hems of the shirts are either straight or slightly shaped, with minor variations in length. In some designs, an additional button is visible at the collar (e.g., Figure 11f). Certain set-in sleeves are finished with loose-cut cuffs (e.g., Figures 11a and 11f), a feature also not specified in the original prompt. Most pants again include pockets, which are likewise present on some shirts (e.g., Figures 11b and 11c), despite this detail not being indicated in the input

parameters. As observed in Figure 11, the distinctive sheen of the material is also evident, aligning with the specification that the pyjamas are made of silk.

Figure 10: AI-generated pyjamas created using Prompt 8

Figure 11: AI-generated pyjamas created using Prompt 9

Figure 12 displays the results of AI-generated loose-cut women’s pyjamas made of light violet satin material with small prints. This two-piece set comprises a long-sleeved shirt featuring a collar, front button placket, and a chest pocket, paired with long pants that have an elastic waistband. The pyjama models in Figure 12 closely resemble those shown in Figure 10, differing primarily in colour and print. Since the print motif was not defined in terms of colour or shape, the generated designs appear visually harmonious with the pyjamas’ colour. Although the motifs are not clearly visible, certain small floral and other ornamental elements remain recognizable. As observed in Figure 12 (e.g., Figure 12f), a subtle sheen characteristic of satin is noticeable on some pyjamas, reflecting the fabric’s smooth and lustrous surface; however, on most pyjamas, the sheen is not apparent, and the fabric resembles cotton in appearance.

Figure 12: AI-generated pyjamas created using Prompt 10

4. CONCLUSION

This study explores the application of generative AI in women's sleepwear design, drawing on survey data to capture consumer perceptions and preferences. Through an analysis of AI-generated pyjama models, it offers insights into the potential of generative models to support the creative process in fashion design, while also identifying their current limitations.

Overall, the AI generally adhered to fundamental design parameters such as garment type, silhouette, and fabric colour - successfully producing loose-cut, two-piece pyjamas with long-sleeved tops and elastic-waistband pants. However, minor deviations emerged in certain design features, such as the inclusion of pockets and drawstrings, even when these elements were either unspecified or explicitly excluded. This indicates an inconsistency in the model's ability to interpret negative input parameters. Similarly, sleeve finishes (particularly knit finishes and cuffs), pant hem details (e.g., knit finishes), and neckline styles occasionally strayed from prompt specifications, suggesting either interpretive bias on the model's part or insufficient clarity in the instructions. These deviations highlight the challenges of relying solely on prompt-based instructions to accurately capture detailed garment construction features, as vague or incomplete prompts can lead to misinterpretations. Consequently, achieving greater accuracy in generated apparel designs may require more explicit and detailed input specifications or the integration of custom pattern and construction elements. Such approaches could help ensure that both visual and structural features are accurately represented in the final outputs.

Material differentiation was partially successful. Cotton terry pyjamas exhibited the expected plush and voluminous texture, clearly distinguishing them from those made of standard cotton. Silk - and in some cases, satin - pyjamas generally reflected their characteristic sheen. In contrast, bamboo knitwear did not exhibit its typical silky softness and sheen, appearing more similar to cotton. These results show that while AI can represent some textile properties effectively, it struggles with subtler or less familiar materials. The generation of printed motifs (e.g., polka dots, stars, hearts) revealed limitations in prompt-based control over pattern precision and identity. Outputs tended to appear generic, with

variations in size, colour, and composition - particularly when prompts were vaguely defined (e.g., small prints). This suggests that achieving high-fidelity textile prints may require the integration of custom textile pattern inputs, rather than relying on descriptive prompts alone.

In summary, generative AI shows promising potential as a creative tool in fashion design, capable of producing visually compelling garments. Nonetheless, the inconsistencies observed - particularly in material depiction, motif precision, and detailed construction elements - highlight the need for improved prompt engineering and model refinement. Future research should focus on increasing input specificity and exploring hybrid workflows that combine AI generation with human oversight to enhance design precision, material realism, and overall output quality.

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