Exploring and Visualizing Italian Advertising Fliers and Posters through an Iconographical Lens with Linked Open Data

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Abstract

This paper explores Italian fliers and posters through an iconographical lens, leveraging Linked Open Data (LOD) from IICONGRAPH, a KG that extends the iconographical and iconological statements of ArCo. First, we examine the findings of a qualitative study on fliers and posters and assess them with SPARQL queries and visualizations, producing results that match with claims in the study. We also investigate annual promotion trends of fliers and posters through temporal analysis, identifying shifts in advertising themes and iconographical representations. Then, we conduct a small-scale study on gender representation, examining how male and female figures co-occur with specific elements in fliers and posters, highlighting variations in visual composition and associations to specific types of advertisements. Finally, we analyze the statistical dependency between promotional themes and depictions using the chi-square test. This study demonstrates how structured iconographical data can bridge qualitative insights with empirical validation in cultural heritage research.

Keywords

Linked Open Data, Iconography, Advertisements, IICONGRAPH, Knowledge Extraction, Data Visualization

1. Introduction

Linked Open Data (LOD) and Semantic Web technologies have been used increasingly over the last two decades to publish information and enrich tools and applications across various domains, including cultural heritage (CH) [1, 2, 3, 4, 5]. Although the versatility of LOD offers significant advantages in representing the complexity inherent in CH data [6], its implementation often fails to fully capitalize on these benefits. For example, in specialized subdomains of CH, particularly in iconographical and iconological studies, many knowledge graphs (KG) exhibit limitations in their ability to represent data at a high level of granularity [7]. A well-structured representation of the CH information ensures semantic richness and enables quantitative analyses that uncover broader trends, patterns, and relationships within datasets. This enhances the scope of cultural heritage research beyond traditional qualitative assessments. The development of the IICONGRAPH [8] KG aimed to improve the quality of two KGs: ArCo[2], the Italian cultural heritage KG, and Wikidata, a general domain KG, refining their iconographic and iconological statements according to the structure of the ICON ontology [9, 10, 11].

In this paper, we leverage representations of Italian advertising fliers and posters from IICONGRAPH[1] to conduct an exploration of their iconographical and iconological elements, focussing on four themes. First, we report insights from a qualitative study of posters and fliers [12] that highlights a spike in creativity of their content after the WWII, and verify these observations by performing quantitative analyses on IICONGRAPH data and generating corresponding visualizations. This approach bridges qualitative interpretation with structured data analysis, allowing systematic validation of existing hypotheses and claims about visual materials using metadata. Second, we explore the dependency between the content depicted and the types of promotions featured in fliers and posters. To do so, we integrate knowledge extraction with statistical analysis using the Chi-square test [13] as a way to

SemDH 2025: Second International Workshop of Semantic Digital Humanities. Co-located with ESWC 2025, June 02, 2025, Portoroz, Slovenia.

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[1]The original data being a re-engineering of part of ArCo's content

measure how iconographical elements and promotional strategies are related. Third, we analyze gender representation in Italian fliers and posters by identifying co-occurring elements linked to male and female depictions and their contexts. Using SPARQL queries, we explore how gendered depictions connect to promotional themes, revealing socio-cultural dynamics. Finally, we investigate annual promotion trends in the dataset with data aggregation and visualizations, showcasing changes in themes, styles, and iconographical elements over time. We provide our data and methods for reproducibility.[2]

2. Background and Motivation

In this section, we explain the background of the work, both from a historical and a technological point of view. For each explanation, we then emphasize on the specific objectives of this work.

2.1. Historical Background

Italian advertising posters and fliers evolved from the late 19th century to post-World War II, reflecting shifts in art, communication, and society. Early designs featured Art Nouveau's elegance, then adopted Art Deco's geometric style [12]. The 1920s and 1930s saw bold graphics, photography, and modern typography, influenced by Futurism and Rationalism [12]. During the Fascist era, advertising served consumer and political propaganda purposes [14]. Post-war, visuals became abstract, playful, and conceptual, with designers like Armando Testa redefining commercial graphics [12]. According to Villari [12] , creativity, imagination, and novelty gained prominence in Italian posters and fliers after World War II. To assess this claim quantitatively, we analyzed whether there was a notable shift in the diversity of depicted subjects over time. This led us to the following research question:

RQ1: Did the range and variety of subjects depicted in posters and fliers expand after World War II, reflecting a broader evolution in creative expression?

2.2. IICONGRAPH

IICONGRAPH[3] (IIG) is a KG formed by re-engineering Wikidata's and ArCo's iconographical and iconological statements[4] using the ICON ontology. For ArCo, ICON is used to link artworks to subjects via three properties: `icon:preiconographicallyDepicts` links to pre-iconographical depictions (e.g., house, tree); `icon:iconographicallyDepicts` to iconographical subjects with proper names (e.g., Rome, Hercules); and `icon:iconologicallyRepresents` to deeper cultural meanings. Here, iconological meanings equal the flier or poster-advertised products/events (e.g., promoting 20th-century Italian tourism). Artworks' dating, not stored in IIG but in ArCo, was added to IIG for easier temporal analysis, avoiding federated queries [5]. We used cidoc-crm `P82b end of the end property` to link artworks to dates, formatted as YYYY. A data model example for IIG with ArCo's artwork *Dogado Louge. Dolce Vita Italian Party*, available at https://dati.beniculturali.it/lodview-arco/resource/HistoricOrArtisticProperty/0500715968.html, is in Figure 1.

The standardized structure of IIG[6] enables the assessment of relationships between categorical data, such as the connection between pre-iconographical elements and promotional contexts. This capability led us to explore the following research question:

RQ2: To what extent are the pre-iconographical elements of a poster or flier associated with its promotional context?

[2]The material is available in this a github repository at https://github.com/br0ast/IICONGRAPH_FLIERS_EXPLORATION

[3]IICONGRAPH (without dating information) is available on Zenodo at https://doi.org/10.5281/zenodo.10294588. The version with the dating for this study is available in the GitHub repository linked in footnote 2

[4]For more information about the re-engineering, please refer to IIG documentation or paper [8]

[5]IICONGRAPH already stores all the artworks contained in ArCo for the analysis [8], so there was no need for other entity linking matching for this step

[6]We emphasize this aspect because, in ArCo's version, these statements were embedded in textual descriptions, making structured analysis more challenging and requiring natural language processing. Refer to [8] for more details on the transformation

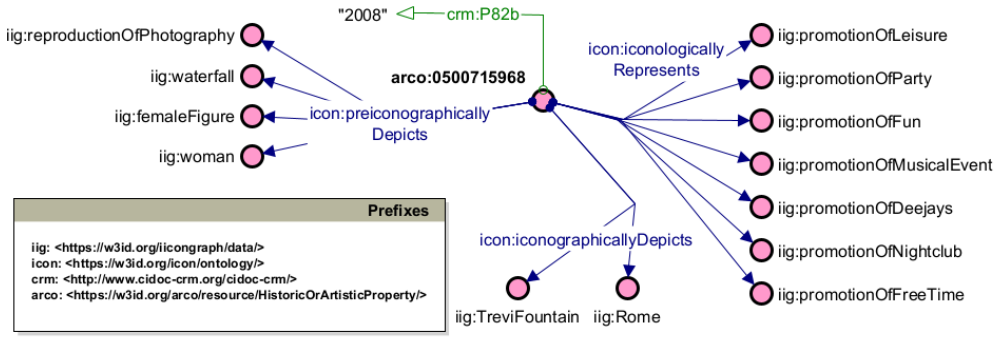

Figure 1: Example of the application of IICONGRAPH data model to *Dogado Louge. Dolce Vita Italian Party*

2.3. Italian fliers and posters: starting data

Table 1 details the dataset, covering 22,580 posters and fliers. Each poster, on average, is linked to five pre-iconographical subjects and five promotional aspects. The scarcity of iconographical subjects might be due to the focus on general elements over specific imagery or the data collection approach prioritizing pre-iconographical and promotional content. This is an exploratory study, and a more detailed analysis of the datasets to clarify this lack of iconographical subjects will be the object of a future study. For this reason, the current study primarily focuses on the relationship between pre-iconographical and iconological/promotional aspects, occasionally merging pre-iconographical and iconographical elements when analytically relevant. The most frequently occurring pre-iconographical elements in the posters and fliers are *male figure(s)* and *female figure(s)*. Specifically, 6486 artworks depict only female figures, while 7391 depict only male figures[7]. This observation provided a strong foundation for one of the key objectives of this paper: analyzing gender representation in these posters and fliers. To address this, we formulated the following research question: **RQ3: To what extent do posters and fliers depicting female figures differ from those depicting male figures (and vice versa) in terms of the co-occurrence of other (pre-)iconographical elements and promotional contexts?**

From a chronological perspective, the posters and fliers in the dataset span from 1844 to 2011. However, as illustrated in Figure 2, the majority are concentrated between 1900 and 1960. This period, marked by significant historical shifts, prompted us to explore the evolving trends in promotional contexts over time.

In particular, we focus on key moments that profoundly shaped Italy, such as World War I, the rise of Fascism, World War II, and the post-war reconstruction period. This leads us to the following research questions:

RQ4: How have the promotional themes in Italian posters and fliers evolved over time? To what extent have major historical events influenced and reshaped these trends?

Table 1
Summary of the dataset of Italian fliers and posters

	Total	Unique	Average Per Poster
Fliers/Posters	22,580	-	-
Pre-iconographical Subjects	110,362	11,651	≈ 4.88
Iconographical Subjects	10,500	3,641	≈ 0.46
Promotional Aspects	112,956	5,160	≈ 5

[7]This estimate is based solely on the two aforementioned entities. Other entities representing males and females may exist in the dataset, though they appear less frequently, as the dataset contains over 11,000 unique subjects

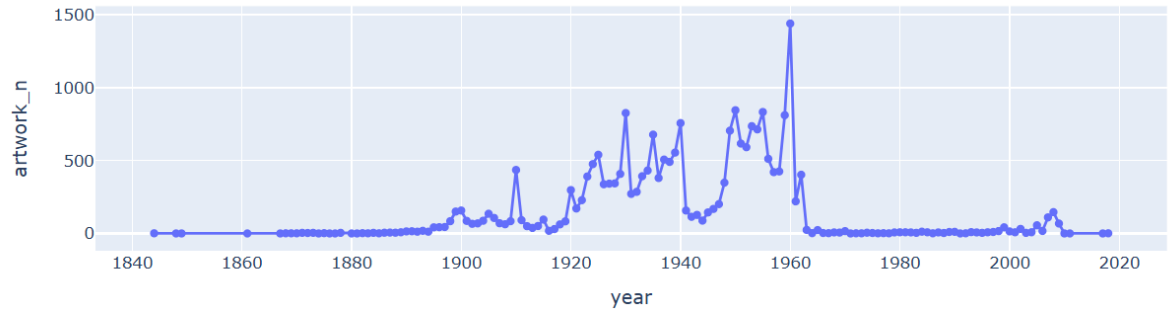

Figure 2: Number of poster/fliers dated in each year

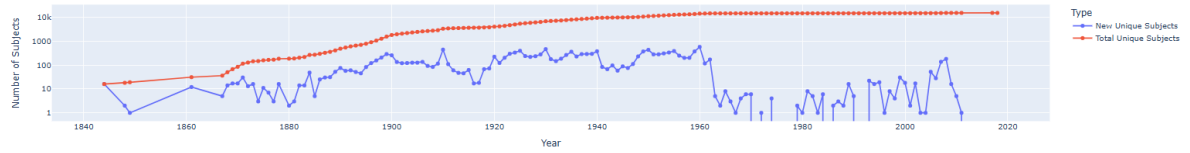

Figure 3: New unique subjects per year and the total unique subjects over time. Note: Y is in logarithmic scale

3. Experiment Setup and Results

All experiments were carried out in a Jupyter Notebook[8] for data analysis and in a GraphDB instance to execute SPARQL queries. The implementation was carried out using Python 3.12, using the following libraries: RDFLib[9] for graph processing, pandas[10] for data transformation,scipy.stats[11] for statistical analysis, and finally plotly[12], plotly express[13], and seaborn [14] for visualizations.

3.1. RQ1 - Creativity of the fliers over the years

To evaluate how the creativity of Italian posters evolved after World War II, we analyzed the introduction of new unique subjects over time, using the dataset's pre-iconographical and iconographical elements. The goal was to determine whether the diversity of depicted subjects increased, aligning with qualitative findings by Villari, who suggests a post-war expansion in creative expression.

For each poster in the dataset, we extracted its year of creation and the associated pre-iconographical and iconographical elements. We tracked (i) new unique subjects per year, which is the number of subjects introduced for the first time in a given year, and (ii) the total unique subjects over time, which is the cumulative number of distinct subjects appearing in the dataset every year. By plotting these two metrics together over the timeline, we can assess whether visual themes diversified after 1945, which would suggest a shift toward greater creativity and experimentation.

3.1.1. Results

The plotted data (shown in the figure 3) presents several trends. First, The total number of unique subjects (red line) increases steadily after the late 19th century, illustrating the growing diversity of visual themes in advertising. Second, the new unique subjects per year (blue line) fluctuate, but show relative stability between 1900 and 1960. However, considering that as time progresses, it should become

[8]https://github.com/br0ast/IICONGRAPH_FLIERS_EXPLORATION/blob/main/Scripts%20and%20data/RQ1-RQ2-RQ4.ipynb
[9]https://rdflib.readthedocs.io/en/stable/index.html
[10]https://pandas.pydata.org/
[11]https://docs.scipy.org/doc/scipy/reference/stats.html
[12]https://plotly.com/
[13]https://plotly.com/python/plotly-express/
[14]https://seaborn.pydata.org/

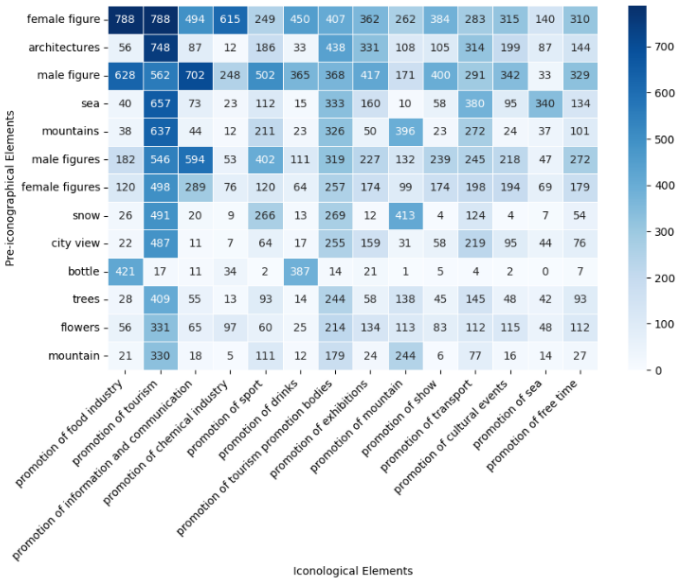

Figure 4: Top 40 co-occurrences between pre-iconographical and iconological elements in the contingency table

increasingly difficult to introduce entirely new subjects, maintaining a stable rate of innovation despite this challenge suggests a positive trend in creativity during this period. Third, after 1960, a decline is visible, potentially related to the decrease in the production of posters and fliers in those years. In fact, these trends partially align with the number of posters produced each year (as shown in Figure 2). The parallel rise in production and subject diversity (in the post WWII years) suggests an overall growth in creative output and advertising demand, further reinforcing the idea that this period was marked by innovation and expansion in visual communication, confirming Villari's claims.

3.2. RQ2 - Chi-square independence test for pre-iconographical and iconological elements

To examine the relationship between pre-iconographical and iconological elements in Italian fliers and posters, we retrieved, using RDFLib, artworks annotated with one or both categories. Given that artworks often contain multiple visual elements, a one-to-many transformation was applied, restructuring the dataset so that each pairing of a pre-iconographical element with its corresponding iconological representation (i.e., what the flier/poster promotes) was represented as a unique data point. From this, a contingency table was generated, capturing the frequency of co-occurrences between these categories. As an example, the sea co-occurs 657 times with the promotion of tourism, but only 14 times with the promotion of a textile industry. Figure 4 presents the top 40 co-occurrences in the contingency table. To quantify the strength of the relationship between iconological and pre-iconographical elements, we performed a chi-square independence test[15], a statistical approach used to determine whether two categorical variables are significantly associated[13]. Due to the large dataset size, Yates' correction for continuity was omitted, as it is typically applied to smaller contingency tables [16].

3.2.1. Results

With a Degree of Freedom of ≈60M and a Chi-Square Statistic of ≈116M, the P-value assumes a value of 0.0[15], well below the significance threshold of 0.05. This shows a strong statistical dependence between pre-iconographical and iconological elements, suggesting that the basic visual features (pre-iconographical elements) present in the fliers and posters significantly influence their promotional values and interpretations. At the same time, the contingency table can be used to highlight outlier scenarios

[15] An approximation from scipy.stats that means the number is very close to 0

where the pre-iconographical elements are unusually placed within some promotional contexts, such as the use of snow in posters/fliers that promote the sea and beach-like activities. These results can then foster new qualitative studies that analyse these phenomena.

3.3. RQ3 - Gender Representation

To analyze gender representation within the dataset, we executed two SPARQL queries to extract elements (pre-iconographical, iconographical and iconological) disproportionately associated with male and female figures. Specifically, we measured the relative frequency (in percentages) of elements appearing in artworks depicting only men and compared them to those featuring only women. We then ranked the results by difference in percentage and ratio,[16] highlighting the degree of gender disparity in visual representation, and providing insights into the types of subjects more commonly depicted alongside each gender. The query (that can be adapted for either female or male) is available in the Appendix A.

3.3.1. Results

In terms of ratio, certain elements are significantly more associated with male figures than female ones. Pipes are 51.6 times more likely to appear with male figures, followed by knights (46x), soldiers (42x), farmers (38.36x), and workers (35.53x). In promotional contexts, newspapers are 42 times more frequently associated with male figures, followed by the armed forces (24.76x), national defense (24.5x), and patriotic/fighting associations (23.42x).Examining absolute percentages, some elements remain consistently more prevalent in male-associated artworks. Horses, for example, appear in 4.74% of artworks depicting male figures versus 0.67% for females. Similarly, soldiers are depicted in 2.33% of male-associated artworks but only 0.05% of female ones. Regarding promotional themes, sports appear in 14.91% of male-focused posters, compared to 4.58% of female-focused ones. Information and communication are relatively common in both, but still appear more frequently with male figures (18.27% vs. 9.31%). Other notable disparities include competitions (8.5% vs. 2.17%), politics (6.97% vs. 2.69%), and war (4.57% vs. 0.69%).

However, elements more frequently associated with female figures reveal a different thematic focus. Flowers appear in 7.87% of female-associated artworks compared to only 0.98% for males. Other notable differences include swimsuits (2.46% vs. 0.06%), the sea (5.87% vs. 3.5%), beaches (2.33% vs. 0.58%), and scarves (2.58% vs. 0.42%). In promotional contexts, the chemical industry is featured in 15.35% of female-associated artworks but only 4.26% for males. Similarly, tourism (17.72% vs. 10.58%), food industry (17.99% vs. 12.47%), and personal hygiene (4.24% vs. 0.5%) all lean toward female representation. When looking at ratios, some elements are overwhelmingly more common in female-associated artworks. Peasants are 55.4 times more likely to appear with female figures, followed by veils (49.2x), soap bars (49.28x), swimsuits (39.03x) and jewelry (35.76x). In promotional contexts, laundry detergent is 51.76 times more likely to appear with female figures, followed by sewing machines (39.42x), care facilities (32.04x), and soaps/detergents (31.8x).

These findings reflect historically gendered advertising portrayals, where men are linked to power, industry, and warfare, while women are more often associated with domesticity, beauty, and leisure. They are to be taken in the perspective that this is a historical analysis in which most of the data dates between 1900 and 1960. Thus, these biases reflect historical trends rather than contemporary advertising norms, the analysis of which (the current norms) is out of the scope of this study.

3.4. RQ4 - Evolution of promotional themes

To analyze how promotional themes evolved over time, we extracted the top five most common promotional contexts for each year from 1844 to 2012. Using RDFLib, we retrieved all posters and fliers

[16] The ratio represents how many times more likely an element is to appear in posters featuring only men compared to those featuring only women (or vice versa)

with a recorded creation date and identified their associated promotional themes from the IICONGRAPH knowledge graph. This data was then aggregated by year and visualized in line plots divided into decade series, allowing us to track how promotional priorities changed over time. The 17 resulting visualizations are available on https://github.com/br0ast/IICONGRAPH_FLIERS_EXPLORATION/tree/main/promotion_charts%20top%205.

3.4.1. Results

Given the scarcity of data before 1900, meaningful trends start emerging in the 1910s. In these years, promotions for food, drinks, and information/communication dominated but declined sharply around 1912–1913, as World War I reshaped advertising priorities. By 1916–1918, war propaganda and financial security became central themes, peaking in 1918, when promotions for WWI, war, and insurance activities were the most prevalent. With the war's end, the 1919–1926 period saw a return to consumer-oriented advertising, with the food industry regaining prominence and sports and competitions emerging by 1923. Between 1927 and 1933, tourism, exhibitions, transport, and food took center stage, with sports also gaining popularity in 1933. Tourism remained dominant until 1940, reflecting economic expansion and national branding efforts. However, the outbreak of World War II (1941–1946) led to a stark shift, with tourism disappearing entirely, replaced by war propaganda, WWII, and information/communication. By 1944–1945, Fascist propaganda was among the most common promotional themes. After the war, tourism re-emerged as the leading promotional category from 1948 to 1962, alongside information, communication, and politics, which rose to second place by 1952. In more recent years, the 2004–2008 period saw a shift toward music and leisure activities, marking a growing emphasis on lifestyle branding and entertainment-focused advertising. The results confirm that promotional priorities in Italian posters and fliers were closely tied to historical and socio-political changes. War-related themes dominate periods of conflict, while tourism, food, and exhibitions flourish during economic expansion.

4. Related work

There are various qualitative and quantitative studies on the analysis of advertising posters and fliers, each employing different methodologies. Here, we provide a few examples to give an overview of the field. [12] takes a qualitative approach, while more data-driven studies apply data mining [17], deep learning [18], and computer vision [19] to analyze advertising imagery. From an iconographical perspective, LOD has also been used to study specific iconographic patterns, such as in still life paintings [20]. Unlike black-box machine learning approaches, this study relies entirely on LOD and focuses on posters and fliers, an area less explored in LOD-driven iconographical research.

5. Discussion and Conclusion

This study explored Italian posters and fliers through a structured iconographical analysis, leveraging LOD to answer key research questions regarding creativity, gender representation, promotional trends, and the relationship between depicted elements and promotional contexts.

Our findings confirmed that the range and variety of subjects depicted in posters expanded after World War II, supporting Villari's claim that creativity and novelty became more prominent in post-war advertising (RQ1).

We also examined the relationship between pre-iconographical elements and promotional contexts, revealing strong associations between depicted subjects and the themes they promoted. These dependencies suggest that iconographical choices were strategic and aligned with advertising goals, reinforcing specific narratives over time (RQ2).

Regarding gender representation, our analysis highlighted clear gendered trends in advertising imagery. Posters featuring male figures were more frequently associated with themes such as sport, politics, war, and industry, while those with female figures were more commonly linked to domestic

life, beauty, personal care, and tourism. These findings confirm historical gendered marketing patterns, emphasizing how advertising reinforced societal roles [21] (RQ3).

Finally, our analysis of promotional themes over time highlights how advertising both reflected and shaped Italy's historical trajectory. During wartime, posters prioritized propaganda, national defense, and financial security, aligning with state-driven narratives. In contrast, peacetime saw a resurgence of consumer-oriented themes such as food, sports, and tourism, signaling economic recovery and evolving social aspirations.The interwar period highlighted modernization and travel until World War II shifted focus to political messaging and war propaganda. Post-1948 advertising did not simply revert to pre-war themes but embraced political discourse and consumerism as Italy rebuilt and expanded economically. By the 2000s, advertising increasingly emphasized lifestyle branding, with a focus on music, entertainment, and leisure. The results show how advertising can be seen as a historical marker, adapting to cultural and economic changes (RQ4).

With regard to limitations, this work is based on data that was stored in ArCo, coming from digitized Italian catalogs [2]. The digitization of more posters and their content would be beneficial in improving this study, especially for those that were produced after 1960. In respect to the previous years, after 1960 we see a decrease in the production of posters, which could also be caused by the lack of digitization of posters past this year.

For future work, a web app for cultural heritage researchers is being developed to explore and visualize this dataset without needing semantic web expertise. This tool will enable intuitive analysis of iconographical trends, gender representation, and historical shifts in advertising. Future research will go beyond the current study's questions, utilizing qualitative findings and integrating computer vision and vision models to analyze visual elements. This will enhance the study of artistic styles and overlooked details by combining LOD-based and AI-driven image analysis, enriching Italian advertising research and expanding iconographical research methods.

Declaration on Generative AI

During the preparation of this work, the author used ChatGPT, and Writefull to: Grammar and spelling check, Improve writing style, Paraphrase and reword. After using these tool(s)/service(s), the author reviewed and edited the content as needed and takes full responsibility for the publication's content.

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A. SPARQL QUERIES

Listing 1: SPARQL query launched on IICONGRAPH to extract the data for the gender representation

```
PREFIX icon: <https://w3id.org/icon/ontology/>
PREFIX iig: <https://w3id.org/iicongraph/data/>
PREFIX sim: <https://w3id.org/simulation/ontology/>
SELECT ?element ?femalePercentage ?malePercentage (?malePercentage - ?
    femalePercentage AS ?difference) (?malePercentage / ?femalePercentage AS
     ?ratio)
WHERE {
  {
```

```
  SELECT ?element (ROUND((COUNT(?artwork) / ?femaleTotal) * 100 * 1000)
      /1000 AS ?femalePercentage)
  WHERE {
    {
      SELECT (COUNT(DISTINCT ?artwork) AS ?femaleTotal)
      WHERE {
        ?artwork icon:preiconographicallyDepicts ?subject .
        FILTER (?subject IN (iig:femaleFigures, iig:femaleFigure))
        FILTER NOT EXISTS {
          ?artwork icon:preiconographicallyDepicts ?maleSubject .
          FILTER (?maleSubject IN (iig:maleFigures, iig:maleFigure))
        }
      }
    }
    ?artwork icon:preiconographicallyDepicts ?subject .
    FILTER (?subject IN (iig:femaleFigures, iig:femaleFigure))
    FILTER NOT EXISTS {
      ?artwork icon:preiconographicallyDepicts ?maleSubject .
      FILTER (?maleSubject IN (iig:maleFigures, iig:maleFigure))
    }
    ?artwork ?predicate ?element .
    FILTER (?predicate IN (icon:preiconographicallyDepicts, icon:
        iconographicallyDepicts, icon:iconologicallyRepresents))
    FILTER (?element NOT IN (iig:femaleFigures, iig:femaleFigure))
          FILTER NOT EXISTS {?element sim:hasSimulacrum ?something}
  }
  GROUP BY ?element ?femaleTotal
}
{
  SELECT ?element (ROUND((COUNT(?artwork) / ?maleTotal) * 100 *1000)
      /1000 AS ?malePercentage)
  WHERE {
    {
      SELECT (COUNT(DISTINCT ?artwork) AS ?maleTotal)
      WHERE {
        ?artwork icon:preiconographicallyDepicts ?subject .
        FILTER (?subject IN (iig:maleFigures, iig:maleFigure))
        FILTER NOT EXISTS {
          ?artwork icon:preiconographicallyDepicts ?femaleSubject .
          FILTER (?femaleSubject IN (iig:femaleFigures, iig:femaleFigure)
              )
        }
      }
    }
    ?artwork icon:preiconographicallyDepicts ?subject .
    FILTER (?subject IN (iig:maleFigures, iig:maleFigure))
    FILTER NOT EXISTS {
      ?artwork icon:preiconographicallyDepicts ?femaleSubject .
      FILTER (?femaleSubject IN (iig:femaleFigures, iig:femaleFigure))
    }
    ?artwork ?predicate ?element .
    FILTER (?predicate IN (icon:preiconographicallyDepicts, icon:
        iconographicallyDepicts, icon:iconologicallyRepresents))
    FILTER (?element NOT IN (iig:maleFigures, iig:maleFigure))
          FILTER NOT EXISTS {?element sim:hasSimulacrum ?something}
  }
  GROUP BY ?element ?maleTotal
}
```

```
  FILTER (BOUND(?femalePercentage) && BOUND(?malePercentage))
  FILTER (?malePercentage > ?femalePercentage)  # Change this to go from
     man to female
}
ORDER BY DESC(?ratio) # you can also order by difference of absolute
    percentage
```