Deciphering Still Life Artworks With Linked Open Data

Bruno Sartini[1]

[1]Ludwig-Maximilians-Universität München, Germany

Abstract

The still life genre is a good example of how even the simplest elements depicted in an artwork can be carriers of deeper, symbolic meanings that influence the overall artistic interpretation of it. In this paper, we present an ongoing study on the use of linked open data (LOD) to quantitatively analyze the symbolic meanings of still life paintings. In particular, we propose two different experiments based on (i) the theory of the art historian Bergström, and (ii) the impact of the Floriography movement in still life. To do so, we extract and combine data from Wikidata, HyperReal, IICONGRAPH, and the ODOR dataset. This work shows promising results about the use of LOD for art-historical quantitative research, as we are able to confirm Bergström's theory and to pinpoint outliers in the Floriography context that can be the objects of specific, qualitative studies. We conclude the paper by reflecting on the current limitations surrounding art-historical data.

Keywords

Linked Open Data, Floriography, Still Life, Quantitative Analysis, Symbolism, Semantic Web, Digital Humanities

1. Introduction

Still life is an artistic genre characterized by the depiction of inanimate objects such as fruits, vegetables, game, jewelry, and other items as the main subjects of artworks [15]. Although examples of still life can be found already in the Greco-Roman period, it emerged as a standalone genre only in the late 16th century in the Netherlands [15]. Many art historians have debated the content of artworks belonging to this genre, initially considered *subjectless* [33], and then reinterpreted considering the depicted inanimate elements as potential vessels to deeper symbolic meanings such as abundance, death, mortality, resurrection, life, the transience and fragility of life [33, 12, 18]. Among them, Ingvar Bergström introduced the concept of *Disguised Symbolism* in still life while analyzing the relationship between this genre and Christian symbolism [5]. According to his theory, the depiction of prominent Christian characters in early Baroque and Renaissance art, such as the Virgin Mary (portraits depicting her are also referred to as *Madonna Paintings*), is often accompanied by more mundane elements like fruits and vegetables, which convey Christian symbolic meanings [5]. For example, apples are related to the original sin, a cracked nut shell symbolizes the wood of the Cross (*lignum crucis*), and the sweet kernel represents the divine nature of Christ [6]. Bergström argues that

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b.sartini@lmu.de (B. Sartini)

0000-0002-9152-4402 (B. Sartini)

these elements, when appearing in still life paintings without the Christian characters, can still represent Christian symbolism [5, 6].

Furthermore, during the Victorian age, Floriography emerged as a cryptic language that used flowers and plants to communicate secret messages [20]. People used to send different bouquets with flowers and plants to communicate to secret lovers or enemies, since flowers and plants had both positive and negative connotations. For example, basil is a symbol of hatred and poverty in the context of Floriography, while the honey flower was the symbol of secret love and the ivy a symbol of fidelity [17]. This cryptic language adds yet another different lens of interpretation to still life artworks.

To the authors' knowledge, no quantitative analysis on the deeper meanings of still life artworks has been performed yet. This paper leverages Semantic Web Technologies and Linked Open Data (LOD) to conduct quantitative analyses on artworks in this genre. We perform our analysis by reusing and mixing data taken from four different datasets: Wikidata [31], the ODOR dataset [37], IICONGRAPH [22], and HyperReal [26]. Specifically, we aim to answer the following research questions (RQ):

RQ1 How can LOD be used to verify Bergström's theory about Christian symbolism in still life? To what extent is Christian symbolism represented in still life artworks?

RQ2 To what extent did Floriography impact the still life genre? Is there a meaningful variation in symbolism within the context of Floriography before and after its spread? Which specific symbolic meanings emerge as more popular after the spread of Floriography?

The paper is structured as follows. Section 2 provides an overview of the datasets used and their content. Section 3 outlines the methodology. Section 4 describes and offers a discussion of the results. Section 5 briefly reviews related work. Finally, Section 6 concludes the paper by highlighting current limitations and suggesting directions for future research.
To ensure the reproducibility of the results, all scripts developed for the analysis of this paper are released in the following GitHub folder: https://github.com/br0ast/still_life_analysis

2. Datasets

This section describes all the datasets that have been used to perform the quantitative analysis. Wikidata is a collaborative knowledge base that contains information about several domains, art included [31]. Digital humanities scholars have used it extensively for quantitative analysis [3], entity linking, and knowledge discovery [34]. We extract information about Wikidata from its SPARQL portal,[1] filtering artworks that depict, have as main subject or as theme the concept of still life.[2]

The Object Detection for Olfactory References (ODOR) dataset contains more than 4000 artworks annotated with olfactory elements divided into 226 categories, including specific types of flowers, fruits, and other typical elements depicted in still life. The annotation was performed

[1] https://query.wikidata.org
[2] Query available at https://w.wiki/AduD

automatically by a computer vision algorithm. We downloaded the dataset dump from Zenodo[3] and filtered it by including only artworks that mention still life in their *title*, *iconography*, *description* or *keywords* fields. After filtering, we reduced the dataset to 540 artworks.

IICONGRAPH is a knowledge graph that contains an enhanced version of the iconographical and iconological statements of Wikidata, following the schema of the ICON ontology [25, 24]. We use both Wikidata and IICONGRAPH because in the latter there is no contextual information about artworks, such as the date of creation and creator, which can be used in this study to group artworks in different subsets. IICONGRAPH was downloaded from Zenodo.[4]

Finally, HyperReal is the dataset that allows us to study the deeper meanings of the extracted artworks, as it contains more than 40,000 instances of symbolism,[5] called *simulations* [26]. A simulation is the relationship that links a symbol with its symbolic meaning and the context in which it is symbolized. For instance, a frog, in the Egyptian context, is a symbol of longevity. Among the cultural contexts found in HyperReal, there are both *Christian* and *Flower Language*, which makes it an ideal candidate for a specific quantitative analysis of Floriography and Christian symbolism. HyperReal was downloaded through a data dump.[6]

3. Methodology and Experiment Setup

3.1. Entity Linking

We performed entity linking between Wikidata and HyperReal, and the Odor Dataset and HyperReal. For the Wikidata linking, we started from a previous approach [27] based on both string matching between the English labels of HyperReal and the labels of the depicted elements in artworks (in Wikidata, the depicted elements would be objects of triples following this structure: `:artwork wdt:P180 depicts :depictedElement`), and the linking between Wordnet synsets of Wikidata and HyperReal (since both datasets contain links to the specific synsets of their entites [21]). This linking was also evaluated in [23]. In Wikidata, animals, plants, and fruits are labeled with their scientific names (e.g., `wd:Q7537` is labeled as *Brassica oleracea var. botrytis*). Since scientific names could potentially not match with HyperReal labels, we also extracted the `wdt:P1843` *common taxonomy name* from the depicted elements. For instance, the common name for *Brassica oleracea var. botrytis* is *cauliflower* or *broccoli*, which matches with instances of HyperReal. Figure 1 shows a visual example of the string matching between Wikidata and HyperReal. We first reused the mapping from the literature based on normal labels, and if no match was found, we tried matching with the common taxonomy name. This additional step yielded 66 more matches which have all been manually checked. In total, out of 1566 unique depicted elements in the extracted still life dataset from Wikidata, 558 matched with HyperReal. Additionally, 3533 paintings out of 4997 depicted at least one element that matched with HyperReal.

For the Odor Dataset, we again used string matching between the labels of the detected

[3] https://zenodo.org/record/11070878, using the "instances_all.json" file

[4] https://zenodo.org/doi/10.5281/zenodo.10294588

[5] We use the term symbolism to indicate the use of specific elements (symbols) to convey a meaning that is different from a literal one. For instance, using the olive branch as a symbol of peace

[6] https://w3id.org/simulation/data/

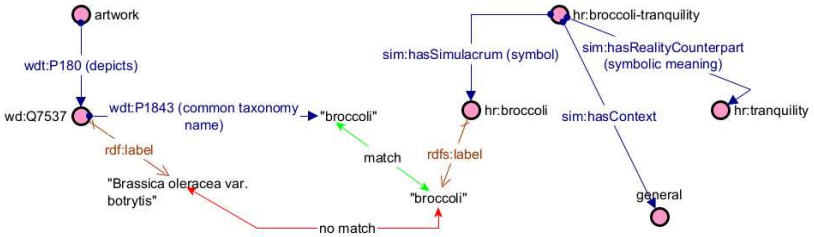

Figure 1: Example of string matching between Wikidata and HyperReal. *hr* is the prefix for the entities in HyperReal, *sim* is the prefix for the properties of the Simulation Ontology, *wd* and *wdt* are used respectively for the entities and properties of Wikidata.

categories and HyperReal. We found that 135 of the 226 categories matched, and 478 artworks out of 540 had at least one detected category that matched HyperReal.

3.2. Preparation and analysis for RQ1

After the entity linking, we connected artworks with their potential symbolic meanings and symbolic contexts. We are able to do this because we have the links between the artworks and their depiction, and then the mapping between the depictions and the symbols in HyperReal. The symbols are then connected to simulations which link them to their symbolic meanings and the contexts in which they symbolize them. The example can be seen in figure 1 with the *broccoli-tranquility* simulation. Here, an artwork depicts *broccoli* and it is associated to the *tranquility* symbolic meaning. Because the *broccoli-tranquility* simulation context is *general* (there are more than 300 different contexts in HyperReal), we can infer that, **potentially**, this artwork, from a general point of view, symbolizes tranquility.. We highlight that these symbolic meanings are *potential* as it is not possible to predict the intention of the creator, whether or not they used the element symbolically. It is just possible to predict potential meanings based on the depictions. This concept is also linked to the theory of Bergström, who claims that still life artworks are permeated by Christian symbols, without questioning whether the creators of the artworks willingly decided to paint specific subjects to convey Christian symbolism or not. We then calculated the percentage of artworks depicting at least one Christian symbol for both Wikidata and the ODOR dataset. We calculated the same percentage on a random set of 3533 Wikidata artworks contained in IICONGRAPH, extracted using a SPARQL query available in Listing 1. We then compared the percentage of artworks depicting Christian symbols[7] in the still life dataset against the random dataset to determine if Christian symbolism was more prevalent in still life paintings, contextualizing the Christian influence on still life art relative to general artworks.

[7]Meaning that at least one of their depicted elements is linked to a symbol in HyperReal connected with a Simulation that is supported by the Christian context

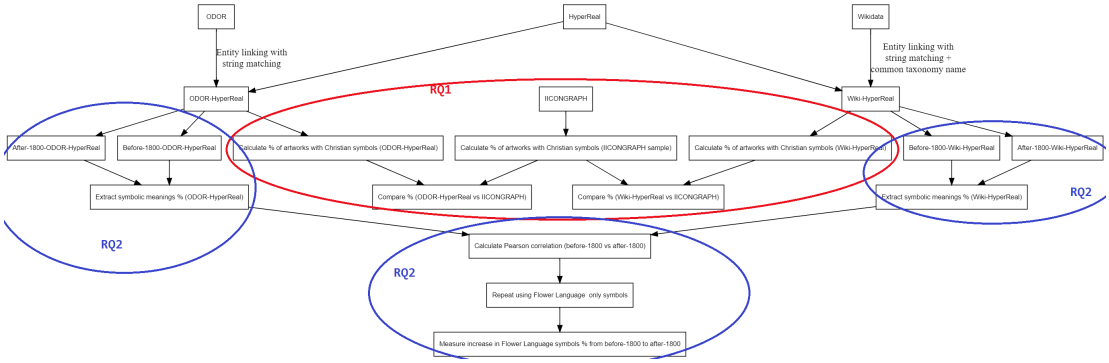

Figure 2: Workflow of the experiments presented in the paper. The RQ addressed in the steps are highlighted in red (RQ1) and blue (RQ2)

Listing 1: SPARQL query launched on IICONGRAPH to extract a random set of 3533 along with the cultural contexts of the symbolism they represent

```
PREFIX sim: <https://w3id.org/simulation/ontology/>
PREFIX icon: <https://w3id.org/icon/ontology/>
select ?art (GROUP_CONCAT(distinct ?ctx; SEPARATOR="␣@␣") as ?ctxs)
    where {
        ?art icon:iconographicallyDepicts ?simulation .
    ?simulation sim:hasContext ?ctx .
} GROUP BY ?art ORDER BY RAND() LIMIT 3533
```

3.3. Preparation and analysis for RQ2

We divided the datasets by creation date, using the 19th century as the delimiter between pre- and post-Floriography spread. Therefore, we created two datasets (before and after the 19th century) each listing symbolic meanings together with the percentage of artworks symbolizing them. We measured the Pearson correlation coefficient [19] between the two datasets to obtain an overall view of the variation before and after the 19th century. We repeated this measurement with a filtered version of the datasets, which contains only symbolic meanings in the *Flower language* context. Finally, we identified symbolic meanings in the *Flower language* context that gained popularity (that is, that increased the percentage of artworks that symbolize them) after the spread of Floriography.

All experiments, including data aggregation and mapping, were carried out in a Python environment. Figure 2 shows a graphical overview of the whole workflow explained in this section. Table 1 contains information about the content of Wikidata and the ODOR dataset for each filtering stage.

Table 1
Overview of the content of Wikidata and ODOR dataset after every filtering phase.

Dataset		Wikidata	ODOR
Initial Filtering Phase	# of still life artworks	4997	540
	# of artworks with at least 1 HyperReal match	3533	478
RQ1	# of artworks with at least 1 Christian symbol	2999	446
	% of artworks with at least 1 Christian symbol	84.91	93.3
RQ2	# of artworks pre-1800	2073	439
	with at least 1 Flower language symbol	655	226
	# of artworks post-1800	1213	38
	with at least 1 Flower language symbol	332	16

4. Results and discussion

4.1. Christian symbolism distribution in still life

Regarding RQ1, the results show that 84.9% of still life artworks in Wikidata contain at least one Christian symbol. This percentage increases to 93.3% in the ODOR dataset. In contrast, a random dataset from IICONGRAPH matched in size to the Wikidata dataset (3533 artworks), shows that only 43.54% of the artworks contain at least one Christian symbol.[8] These findings indicate that Christian symbolism is highly prevalent in still life artworks, supporting Bergström's theory. Common Christian symbols in these artworks include references to the Virgin Mary, the body of Christ, and martyrdom. We show how, by leveraging LOD, we combined perspectives from different datasets: depictions in Wikidata, detections in the ODOR dataset, and symbols in HyperReal. This integration allowed us to quantitatively measure the prevalence of Christian symbols, revealing their significant distribution in still life paintings, as hypothesized by the art historian. The result of this RQ also emphasizes how the capabilities of LOD to connect different datasets and from different viewpoints (recognized depictions, symbolism) can be used as a quantitative prove to complement qualitative art historical theories such as Bergström's.

4.2. Impact of Floriography in still life

Regarding RQ2, the correlations between the symbolic meanings pre- and post-Floriography are quite high in both Wikidata and the ODOR dataset, being 0.84 and 0.82 respectively. The Pearson correlation coefficient range from -1 to 1, both extremes represent full correlation, while 0 represents no correlation. These high correlation values suggest that there was not a major shift in the symbolic meanings of artworks before and after the spread of Floriography. When filtering the datasets to include only the symbolic meanings related to the *Flower language* context, we find a lower but still significant coefficient: 0.6 in Wikidata and 0.62 in the ODOR dataset. We also recognize that correlation is not necessarily linked to causation. In this

[8]It is also worth noting that this result is also dependent on the symbolism dataset used for the analysis. In the case of this work, HyperReal is the largest knowledge graph about cultural symbolism, so it was the most suitable dataset for this kind of analysis

case, given the very high correlation between the time-splitted datasets, we argue that the similarity in the content and symbolism of two datasets is a potential sign that Floriography has not changed how still art was portrayed in terms of specific subjects (and their symbolism). However, it is important to note that the annotations in Wikidata, which are mostly crowd-sourced, might lack precision in recognizing specific types of plants or flowers, a limitation also shared by computer vision algorithms, which might not be trained for every plant/flower specimen. Given that Floriography is mainly based on specific flowers and plants, not being able to detect them could hinder the results of the analysis. Additionally, there is a disproportion in the content of the before-and-after-1800 datasets, especially in the ODOR dataset, which has only 16 artworks depicting Floriography-related symbols after 1800, compared to 226 before 1800. In Wikidata, there is more representation, with 655 artworks before 1800 and 332 after. Therefore, we present the results of symbolic meanings that increased in popularity only using the results from Wikidata. In this context, the top five symbolic meanings that have increased in popularity are *comfort* and *affection*, which were present in 5.49% of artworks before 1800 and 12.95% after, *beauty* and *love*, which increased from 11.14% to 23.49%, and *gallantry*, which increased from 10.38% to 19.27%. Most of these meanings are related to messages of love, suggesting that after the spread of Floriography, artists or commissioners of the artworks might have used this cryptic language to send (perhaps) secret love messages through art. In summary, although the results show high correlation (i.e., less variation) between symbolic meanings in the context of Floriography before and after it spread, they also highlight patterns in the use of love-related Flower language symbolism that require further investigation in future work.

5. Related Work

The majority of recent advances in quantitative art analysis focus on object detection in artworks with different approaches, namely one-shot [16], weakly supervised models [10], transfer learning [36], deep neural networks [29] or specific approaches tailored for image retrieval [1]. We refer to [4] for a comprehensive review of the topic. The common aim of these approaches is to detect the elements depicted in artworks, but they do not try to infer deeper meanings out of their detections, which would require linking the detected entities with other datasets about symbolism. The work described in [32] studies the frequency of food depictions in art in a data set consisting of approximately 750 artworks. Although the work mentions the potential symbolic impact of food-related entities, it does not present a quantitative analysis on that matter. Several studies address the quantitative study of art to detect variations in colors, roughness, and brightness [13] or to automatically predict the styles of artworks and classify them [28, 14]. Finally, there are studies that use LOD as the main source for quantitative artistic analysis. [2] uses LOD to analyze art historians' interpretations of artworks, focusing on a manually annotated Renaissance art dataset, and [7] combines deep learning and artistic knowledge graphs for attribute prediction tasks. Neither of these two LOD-based approaches focuses on the still life genre. To the author's knowledge, previous studies on still art used qualitative methods [9, 15]. By leveraging LOD, this work can complement them by providing results that emerge from a quantitative point of view.

6. Conclusion and future work

This paper presented two experiments on LOD-driven, quantitative analysis applied to still life artworks. The recent advances in the representation of symbols and symbolic meanings in the Semantic Web by HyperReal [26] allowed us to link the depictions of still life artworks with the corresponding symbols. As a result, it was possible to connect the artworks with their potential symbolic meanings, dividing them also by the cultural contexts supporting these meanings. We used this linking to measure the distribution of Christian symbolism on the still life genre, to quantitatively verify the theory by the art historian Ingvar Bergström, and also to highlight the impact of Floriography on this genre. As mentioned in Section 4, the main limitation of this work is the lack of granularity of both the annotations and the detection from computer vision. Having a system capable of detecting specific plants and flowers would require a very high amount of training data. At the same time, finding botanical experts to annotate paintings with specific plant and flower specimens can be a long and expensive task. Recent experiments in data synthetization and diffusion-based augmentation for cultural heritage data show great potential and could be a possible solution to this problem [8]. Another limitation regards the content of HyperReal. Ingesting more symbolic data into the knowledge graph could be beneficial to capture more instances of symbolism. With recent advances in text classification and knowledge graph generation tasks by Large Language Models (LLMs), it could be possible to automatize the analysis of unstructured data on symbolism and converting it into the structure of HyperReal [35]. Moreover, the whole experiment setup is based on the hypothesis that the still life artworks were created to convey deeper meanings. This is still an open debate among art historians, as some argue that in specific cases the representation of still art was simply commissioned by people who wanted to showcase their great hunting results or boast about their possessions [15]. For future work, we plan to analyze other aspects of still life, such as the role and symbolic impact of *Vanitas*, which is another highly debated topic among art historians [9, 30]. Other theories that could be analysed in future work include the global and colonial origin of materials and objects represented in still life [11]. Additionally, we plan on extending the analysis made on Christian symbolism in still life to other cultural contexts that can be found in HyperReal, drawing comparisons between them and the Christian context analyzed in this work. Finally, given the inherent relationship between art and symbolic meanings, the quantitative analysis of art through its symbolism proposed in this work can be applied to other art genres beyond still life.

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The Overleaf Writefull plugin was used to improve the syntax and flow of some sentences. No large language model was used to generate sections or paragraphs of this paper from scratch.

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