CHAPTER 1

Introduction

Iconography investigates the subject matter and meanings of works of art and their evolution over time and place. To this aim, art historians study the stylistic conventions of a certain period, the literary sources that the artist may have known, and the iconographic types used to depict certain subjects or concepts. In some cases, artists propose a visual rendering based on a specific literary text or on an *iconographical program* (i.e., what a work of art should represent, usually written by a humanist in the court of the patron commissioning the painting). Iconology moves from the results obtained by an iconographical description, pushing the research forward to the understanding of deeper meanings expressed, such as the artist's or a nation's attitude, or social, religious, and cultural practices.

Such characteristics make the domain complex, in which knowledge has different grades of certainty, and the scholars' personal points of view have a relevant role in knowledge construction. For these reasons, iconographical-iconological analysis is usually stored in a free text field in catalogs, which makes domain-specific information retrieval challenging. Furthermore, as it is intimately related to their authors, this knowledge is connected to the references in which such interpretations are expressed, mainly available in printed format. The traditional knowledge, well known to art historians, is nowadays stored in scholarly literature, with little possibility of online content retrieval. Interpretation includes artworks highly different for what concerns their type (e.g., prints, painting, sculpture, coins, illuminations), period, style, and place of conservation, making the possibility to compare items fragmentary and limited.

However, the increasing application of computational methods to the field of cultural heritage could change the situation. The recently born discipline of Digital Art History (DAH) highlighted the benefits and need for computational methods in art history. Yet, the application field and the limits of the discipline are still under discussion.

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Among the technologies adopted in the fields of CH and DAH, semantic web technologies offer means to represent complex domains of knowledge in a structured format. The semantic web was designed by Tim Berners Lee, one of the founders of the World Wide Web, as an extension of the hypertext web (Berners-Lee et al., 2001). Its basic principle is the description and unique identification of data, which allows one to establish relations with the specific *datum*, conceiving ontologies and RDF as the core means to achieve such a structured knowledge representation. The flexibility offered by the graph data structure (corresponding to the web of data and their relations) raised the interest of many domains, including the humanities, which recognized the technology as a suitable tool for expressing the semantic complexity embedded in humanistic knowledge.

Notably, interest in exploiting the computer for tasks related to museum collections maintenance and art history was already expressed in the 1960s. Lindsay (1966) envisioned a rapid adoption in cataloging practices and the creation of collaborative collections through shared standards, but imagined a reticence of art historians to adopt the computer and make information democratically available. To date, the majority of institutions and international associations (e.g., the International Council of Museums (ICOM) and PHAROS, the International Consortium of Photographic Archives) have embraced the potential of computers in cataloging and aggregating data, providing shared standards of description (e.g., CIDOC-CRM, the guidelines *Categories for the Description of Works of Art* and *Cataloguing Cultural Objects*), aggregators (e.g., Europeana), and some museums datasets publicly available.

The use of computers for art history analytical studies was initiated by Prown, who unveiled the potential of computation for addressing domain research questions. To date, several studies have used computational methods to study artworks better and provide insights from another perspective, seeing computer-based and quantitative analyses as a support for traditional, qualitative research. Such examples are more frequent in economic and social studies of art. Among them, the work by Greenwald (2021) expressed a methodological reflection highlighting the importance that data-driven art history can have for advances in research.

According to several Digital Humanities scholars, semantic technologies can even go beyond being a powerful support tool for scholars. By performing pattern discovery and serendipitous knowledge discovery, the system could detect research problems that still need to be addressed (Hyvönen, 2020).

To the author's knowledge, little attention has been paid to the production and analysis of iconography and iconology data. To fill this gap, the current work addresses how computational methods can be helpful for iconographical-iconological domain-specific information representation, retrieval, and analysis. We refer to semantic web technologies as they are feasible tools for expressing the complexity embedded in

iconographical and iconological interpretations described above. Furthermore, we aim to pursue the research line of quantitative art analysis proper of the field of art economics and social studies to another subdomain of art history, namely iconological studies, expressed in semantic data.

To this end, three research problems are addressed in the thesis:

- **RP1**: the formal representation of art historians' interpretations in the iconographical and iconological domain of knowledge
- **RP2**: the description of real-world iconographical and iconological interpretations in structured data
- **RP3**: the definition of approaches according to which a domain-specific analysis can be performed quantitatively

Each research problem has a corresponding research objective that this thesis aims to achieve:

- **RO1**: providing reusable means for iconography and iconology formal description
- **RO2**: providing a semantic dataset of domain-specific art interpretations
- **RO3**: addressing domain research questions in a quantitative way to prove the usefulness of the approach for iconographical-iconological inquiries

To achieve such objectives, we formulate the following main questions:

- **MQ1**: How can ontological modeling of iconographical and iconological interpretations represent the domain features to foster the access, analysis, and retrieval of iconographical and iconological content?
- **MQ2**: What would be the advantages of browsing and quantitatively analyzing a semantic network of iconographical and iconological interpretations?

In the current study, we apply the research questions to the case study of the art historian Ervin Panofsky. For the relevance that his theoretical approach had in the definition of the discipline, he is an authoritative reference for its formalization. Furthermore, by providing a dataset describing his interpretations expressed according to the formalization he proposed, we have the chance to quantitatively characterize his approach and verify to which extent the theory emerges when practically applied in real research. However, to provide a descriptive model that can represent art interpretations by other scholars, this study will consider other theoretical approaches and a domain study that includes interpretations by different art historians.

The thesis is structured as follows. Part I provides the state of the art concerning the iconographical and iconological theoretical background and its representation in current technologies. In detail, Chapter 2 provides an overview of the iconographical-iconological domain of study, furnishing information about the most influential scholars and theoretical approaches that have been proposed. Chapter 3 illustrates the current digital tools that can be used for the description of the subject and a survey assessing the presence and quality of iconographical and iconological statements in the currently available Knowledge Graphs. Part II, composed of Chapters 4 to 9, describes the newly conducted research. While Chapter 4 provides an overview of the adopted approach, Chapter 5 describes the domain study and the development of a new purpose-specific ontology. The creation of the Panofsky interpretation dataset is treated in Chapter 6. The quantitative analysis is conducted in Chapter 7, treating both traditional questions quantitatively addressed and the new inquiries that the novel approach allows. Chapter 8 is dedicated to the evaluation of the dataset and the ontology. The results of the current work are discussed in Chapter 9.

A final part is dedicated to in-progress applications. Specifically, it addresses how art historians and general users can effectively retrieve semantic data about specific artworks. We propose an initial study for an interface for information retrieval in which users can build their interpretation of a work of art by retrieving and integrating the knowledge currently available in Knowledge Graphs.

Part of the work presented in this thesis has already been published. In detail, the survey of the extent to which iconographical and iconological statements are represented in current knowledge graphs, presented in Section 3.6, was published in Baroncini, Sartini, et al. (2023). The description of the ontology, treated in Chapter 5, is published in three papers, concerning its development (Sartini et al., 2023) and its extensions (Baroncini & Sartini, 2024; Sartini & Baroncini, 2023). A presentation of the dataset is proposed in Baroncini, Daquino, and Tomasi (2023b), while part of the results of the data analysis discussed in the chapters 7 and 8 are published in Baroncini, Daquino, and Tomasi (2023a). Finally, the in-progress application presented in Chapter 10 was published in Baroncini, Steels, and Trijp (2023).