Analysis and Visualisation of Complex Familial Relationships in Greek Mythology

Yaya Chenyue Lu

A thesis submitted for the degree of
Software Engineering
The Australian National University

June 2020

© Yaya Chenyue Lu 2020

Except where otherwise indicated, this thesis is my own original work.

Yaya Chenyue Lu
29 June 2020

to my dearest grandma, you always have, and always will be my greatest inspiration

Acknowledgments

To my supervisors Ben and Greta, for their unrelenting enthusiasm, consistently helpful advice, and unwavering support throughout this project.

To my wonderful mentor, Dr Graeme Faulkner. You are a huge inspiration to me, and a wonderful rubber ducky. I could not have completed this thesis without your constant encouragement and insights.

To Ted and Nina, for teaching me kindness and perseverance during this period of stress, and for bringing me joy when I needed it the most. Also to Pat, Chris, and Jarrah for being a constant source of support and entertainment whilst I've been stuck in my writing ruts.

To my family, even though you're across the Tasman sea, you're still close to my heart. I miss you every day.

Abstract

This thesis has an accompanying digital artefact that is live at: https://yayalu.github.io/greekgraphs, and the codebase for the interface is at https://github.com/yayalu/greekgraphs. Family relationships in Greek myth are currently displayed graphically using conventional genealogical chart structures (e.g. Gantz [1996] and Smith et al. [2007]). Such family trees privilege genetic models of inheritance rather than the messier intersections between human beings observable in contemporary family units; certainly they do not easily accommodate the complexities of mythic data. Although some attempts have been made to represent complex family relationships, none are able to represent autochthony, parthenogenesis, incest, intergenerational relationships, uncertainty, contestation, and any of the other non-standard relationships that occur in the Greek mythic storyworld.

This project uses data from MANTO, an expertly-curated relational dataset of connections, passages and entities from Apollodorus' *Library* and *Epitome* (2nd c CE) to build a public web interface that allows users to navigate these genealogies—and their inherent complexities—in an intuitive, generous manner. The design process proceeds through two rounds of user tests with domain expert researchers and students, as well as members of the general public. By deliberately highlighting the relational complexities of Greek myth, this interface reveals the ways in which an agent is bound up in interactions between family members while revealing the gaps inherent in traditional conceptions of genealogy.

Contents

Acknowledgments **vii**

Abstract **ix**

1 Introduction **1**
1.1 Background . . . 1
1.2 Motivations . . . 2
1.3 Research Questions . . . 3
1.4 Roadmap . . . 3

2 Related Works **5**
2.1 Considerations for Greek Mythology Genealogies . . . 5
2.1.1 Contested traditions . . . 5
2.1.2 Unusual births . . . 6
2.1.2.1 Autochthony . . . 7
2.1.2.2 Born from an object . . . 7
2.1.2.3 Created by an agent . . . 7
2.1.2.4 Creation without parents . . . 7
2.1.2.5 Parthenogenesis . . . 7
2.1.2.6 Contested unusual births . . . 8
2.1.3 Incestuous relationships . . . 8
2.1.4 Collectives . . . 8
2.1.5 Other significant genealogies ("dies without children") . . . 8
2.2 Existing Representations of Greek Myth Genealogies . . . 9
2.2.1 Existing attempts to generate digital ontologies for Greek myth . 10
2.2.2 Digital inadequacies in representing Greek mythic genealogy . 12
2.3 Existing Genealogical Visualisation Techniques . . . 14
2.3.1 TimeNets: a timeline-sensitive genealogy charting solution . . . 14
2.3.2 The Nauvoo Marriage Project: addressing the complexities of Mormon family units . . . 14
2.3.3 GeneaQuilts: a matrix genealogical representation technique . . 17
2.3.4 Other unusual relationships throughout history . . . 18
2.4 Open-Source Data Structures for Representing Genealogical Data . . . 19
2.5 Existing Genealogical Graphing Software . . . 21
2.5.1 Legacy 9 . . . 21
2.5.2 FamilySearch.org . . . 23
2.5.3 RootsMagic . . . 23

2.5.4 Ancestry.com . . . 24
2.5.5 Other software and summaries . . . 25
2.6 Existing Graph Visualisation Tools . . . 25
2.6.1 D3.js . . . 25
2.6.2 GraphViz . . . 26
2.6.3 HTML Canvas . . . 26
2.6.4 KonvaJS . . . 27
2.7 Summary . . . 27

3 Contributions to the MANTO Ontology 29
3.1 Background of MANTO . . . 29
3.1.1 Inspiration for MANTO . . . 30
3.1.2 MANTO's linked data structure . . . 30
3.2 Modifications to the Data Structure of MANTO . . . 31
3.3 Extraction of Genealogical Information from MANTO . . . 33
3.3.1 Exporting the relevant MANTO databases . . . 33
3.3.2 Filtering MANTO for genealogical predicates . . . 33
3.3.3 Restructuring and optimising the filtered genealogical data . . . 35
3.4 Conversion to a publicly accessible platform . . . 35
3.4.1 Design motivations and generous interfaces . . . 37
3.4.2 Search function . . . 38
3.4.3 Data cards and content . . . 39
3.4.3.1 Agent data cards . . . 39
3.4.3.2 Episodic collective data cards . . . 41
3.4.3.3 Genealogical collective data cards . . . 42
3.4.3.4 Miscellaneous collective data cards . . . 42
3.4.3.5 Representation of unusual relationships within data cards . . . 43
3.4.4 Other additions . . . 47
3.5 Summary . . . 47

4 Graph Design Phase 1 49
4.1 Motivations . . . 49
4.2 Initial Prototypes and Design . . . 50
4.2.1 Prototype 1 . . . 50
4.2.2 Prototype 2 . . . 51
4.2.3 Alternative visual layouts . . . 54
4.2.4 Interaction diagram . . . 56
4.3 User Interviews Round 1 . . . 57
4.3.1 Background and motivations . . . 57
4.3.2 Format of the user interview . . . 58
4.4 Responses from User Interviews Round 1 . . . 59
4.4.1 Feedback for the MANTO website, data cards and search function 59
4.4.2 Feedback for the graph prototypes . . . 60

4.4.3 Feedback for the interaction diagram 61
4.4.4 Overall feedback for the system 62
4.5 Summary 63

5 Graph Design Phase 2 65
5.1 Updates Based on Feedback from User Interviews Round 1 65
5.1.1 Modifications to the data cards 65
5.1.2 Modifications to the genealogical graph 66
5.1.3 Modifications to interactions from the interaction diagram 66
5.2 Prototype 3 68
5.2.1 Traditional genealogical chart format 68
5.2.2 Contested tradition 68
5.2.2.1 Contested parentage 68
5.2.2.2 Contested parentage information page 70
5.2.2.3 Contested unusual births 73
5.2.2.4 Contested lineage 74
5.2.3 Unusual births 75
5.2.3.1 Autochthony 75
5.2.3.2 Born from an object or body part 76
5.2.3.3 Created by an agent 78
5.2.3.4 Creation without parents 78
5.2.3.5 Parthenogenesis 78
5.2.4 Incestuous relationships 80
5.2.4.1 Sibling-spousal (same-generational) incest 81
5.2.4.2 Intergenerational incest 81
5.3 User Interviews Round 2 84
5.3.1 Background and motivations 84
5.3.2 Format of the user interview 85
5.4 Results from User Interviews Round 2 86
5.4.1 Responses to part 1 - personal details 86
5.4.2 Responses to part 3 - exploration of the website 87
5.4.3 Responses to part 4 - general feedback and suggestions for improvements 89
5.5 Summary 91

6 Project Limitations and Future Work 93
6.1 Prospective Modifications to MANTO based on User Interviews Round 2 93
6.2 Other Future Work 94
6.3 Overall Project Limitations 96
6.4 Summary 96

7 Conclusion **97**
7.1 Evaluation of Our Contribution 97
7.2 Summary 98

Appendix A - Questions for User Interviews Round 1 **105**

Appendix B - Interview Insights from User Interviews Round 1 **109**

Appendix C - Questions for User Interviews Round 2 **125**

Appendix D - Responses to User Interviews Round 2 **131**

List of Figures

2.1 Another example of multi-generational linkeages for incestuous relationships [ludios, 2004] 10
2.2 An example of "+" icons used to denote incestuous and traditional spousal connections [Smith et al., 2007] 11
2.3 The index card system for Aphrodite from Wikipedia [Wikipedia, 2020a] 13
2.4 TimeNets: Kim et al.'s representation of genealogies with a temporal axis [Kim et al., 2010, p. 241] 14
2.5 Higher-level genealogical flow chart developed by [Hott et al., 2018, pp. 314-7] 15
2.6 Chord diagram representing a Mormon family unit by [Hott et al., 2018, pp. 314-3] 16
2.7 Legend for Hott et al. chord diagrams [p. 314-4] 16
2.8 Representation of the Greek Pantheon ontology using GeneaQuilts, by [Bezerianos et al., 2010, p. 1073] 17
2.9 A graphical representation of the incestuous ancestry of King Charles II of Spain [Khan, 2020] 19
2.10 A derivation of the GEDCOM data structure layout, proposed by FamilySearch.org [FamilySearch.org, 2020a] 20
2.11 Pedigree chart depicting the descendants of Greek entities Chaos and Nyx, generated using Legacy 9 22
2.12 Error messages when the father-daughter incestuous relationship between Aether and Ge is imported into Legacy 9 23
2.13 The Person object generation interface in FamilySearch.org, depicting the range of permitted attributes 24
2.14 Example of duplicated nodes when depicting incestuous ancestry, generated using RootsMagic 24
2.15 The Person object generation interface in Ancestry.com, depicting the range of permitted attributes 25
2.16 A graph generated by kennedyanc, using GraphViz's "dot" graph format [Kalia, 2020] 27

3.1 A list of all predicates used to extract genealogical data from MANTO . 34
3.2 A list of all JS objects used to store the extracted genealogical data from MANTO 36
3.3 MANTO homepage with a search facility 38

3.4 MANTO website data card for Eurypylos, grandson of Heracles (ID: 8188361) . . . 40
3.5 Example of contested parentage in the MANTO website, using the data card for Asopos, river god in Sicyon (ID: 8187838) . . . 40
3.6 Example of child grouping in the MANTO website, using a snippet of the data card for Zeus, an Olympian god (ID: 8188419) . . . 41
3.7 Example of an episodic collective representation in the MANTO website, using the data card for The Greek Contingent at Troy (ID: 8190050) . . . 42
3.8 Example of a genealogical collective representation in the MANTO website, using the data card for The Danaids, daughters of Danaos (ID: 8190325) . . . 43
3.9 Example of a miscellaneous collective representation in the MANTO website, using the data card for The Muses, the personification of poetry and music (ID: 8189170) . . . 44
3.10 Example of a data card representation of "autochthony" in the MANTO website, using Cecrops, first king of Athens (ID: 8187960) . . . 44
3.11 Example of a contested data card representation of "autochthony" in the MANTO website, using Pelasgos, eponym of the Pelasgians (ID: 8189143) . . . 45
3.12 Example of a data card representation of "parthenogenesis" in the MANTO website, using Hephaistos, Olympian god (ID: 8188476) . . . 45
3.13 Example of a data card representation of "created without parents" in the MANTO website, using Ge, personification of Earth (ID: 8188388) . 46
3.14 Example of a data card representation of "created by an agent" in the MANTO website, using Pandora, the first mortal woman (ID: 8189114) 46
3.15 Example of a data card representation of "born from an object" in the MANTO website, using Athena, an Olympic god (ID: 8187870) . . . 47
3.16 Example of a data card representation of "dies without children" in the MANTO website, using Asterios, king of Crete (ID: 8187843) . . . 48

4.1 Prototype 1: a dynamically-generated hierarchical DAG built using dagre-d3. Example: the immediate ancestors and descendants of Apollo, Olympian god . . . 50
4.2 Prototype 1: the lack of t-shaped connections and the forced directionality results in unintuitive node layouts (e.g. Artemis at Apollo's child depth) . . . 52
4.3 The standard t-shaped connection used by traditional pedigree charts, and our newly-proposed staggered u-shaped layout for Prototype 2 . . 52
4.4 Adaptations of our Prototype 2 layout for different types of traditional connections . . . 53
4.5 Representations of unusual relationships for Prototype 2. Icons were used to denote unusual birth, and incestuous connections were made obvious through implicit loops . . . 53

4.6 Representations of disputed relationships for Prototype 2 54
4.7 Prototype 2: The dynamically-generated graph of Apollo's genealogy, using HTML canvas 55
4.8 Prototype 2: The dynamically-generated graph of Zeus' genealogy, using HTML canvas. This is far less readable. 55
4.9 Prototype 2: A diagram of the proposed interactions that users can have with the graphs in MANTO. 57

5.1 The "How to use" modal popup on the MANTO website 66
5.2 Contested parentage as shown in the MANTO website data cards, using Asclepios, god of healing as another example (ID: 8187834) . . . 69
5.3 Prototype 3, Version 1: All parents in the same connected line, gives the impression that this exists in the same timeline 69
5.4 Prototype 3, Version 2: Staggered contested connections are an effective representation format for a small number of parentage permutations 70
5.5 Prototype 3, Version 3: A nested contested parentage structure. This is difficult to implement but has benefits for exploring the flow-on effects of alternative ancestors. 71
5.6 Prototype 3, Version 4: Adding "OR" between nodes, useful for a small number of permutations only 71
5.7 Prototype 3, Version 5: Adding "OR" inside of the contested nodes. This is clear, concise, indicates the existence of alternatives, and is also simple to implement. 72
5.8 The information page for "contested parentage", using Asclepios, god of healing as an example (ID: 8187834) 72
5.9 A contested unusual graphical representation when the connection is untouched, using the contested autochthony of Pelasgos as an example (ID: 8189143) 73
5.10 A contested unusual graphical representation when the traditional part of the connection (i.e. not unusual, not contested, and not incestuous) is hovered over, using the contested autochthony of Pelasgos as an example (ID: 8189143) 73
5.11 A contested unusual graphical representation when the unusual part of the connection is hovered over, using the contested autochthony of Pelasgos as an example (ID: 8189143) 74
5.12 The graphical representation of "dies without children", using the example of Aigialeus, son of Inachos, who has no children (ID: 8182075) 74
5.13 A contested "dies without children" graphical representation when the contested connection is hovered over, using Asterios, king of Crete, as an example (ID: 8187843) 75
5.14 MANTO website's graphical representation of autochthony using Cranaos, early king of Athens, as an example (ID: 8188080) 76

5.15 MANTO website's info page popup for autochthony when the unusual connection is clicked, using Cranaos, early king of Athens, as an example (ID: 8188080) 77
5.16 MANTO website's graphical representation of contested "born from an object" using Athena, Olympian god as an example (ID: 8187870) . . 77
5.17 MANTO website's info page popup for "born from an object" when the unusual connection is clicked, using Athena, Olympian god, as an example (ID: 8187870) 78
5.18 MANTO website's info page popup for "created by an agent" when the unusual connection is clicked, using Pandora, first mortal woman, as an example (ID: 8189114) 79
5.19 MANTO website's info page popup for "created without parents" when the unusual connection is clicked, using Ge, personification of Earth, as an example (ID: 8188388) 79
5.20 MANTO website's info page popup for parthenogenesis when the unusual connection is clicked, using Hephaestus, Olympian god, as an example (ID: 8188476) 80
5.21 A graphical representation of sibling-spousal incest when the connection is untouched, using the relationship between Zeus and Hera as an example (ID: 8188390) 81
5.22 MANTO website's info page popup for sibling-spousal incest when the connection is clicked, using the relationship between Zeus and Hera as an example (ID: 8188390) 82
5.23 MANTO website's info page popup for inter-generational incest when the connection is clicked, using Eurynome, mother of Charites, as an example (from the entity page of Asopos, river god of Sicyon) (ID: 8187838) 83
5.24 The distribution of user types interviewed for round 2 86

1 Results of question 1.4 132
2 Results of question 1.7 132
3 Results of question 1.8 133
4 Collated quantitative responses to question 3.2 133
5 Collated quantitative responses to question 3.3 135
6 Collated quantitative responses to question 3.4 136
7 Collated quantitative responses to question 3.5 137
8 Collated quantitative responses to question 3.6 138
9 Collated quantitative responses to question 3.7 140
10 Collated quantitative responses to question 3.8 141
11 Collated quantitative responses to question 3.9 141
12 Collated quantitative responses to question 3.10 142
13 Collated quantitative responses to question 3.11 143
14 Collated quantitative responses to question 3.12 145
15 Collated quantitative responses to question 3.13 146

16 Collated quantitative responses to question 3.14 147
17 Collated quantitative responses to question 3.15 147
18 Collated quantitative responses to question 3.16 148
19 Collated quantitative responses to question 3.17 149

Chapter 1

Introduction

"... When the time came for the birth to take place, Prometheus or, as others say, Hephaestus, smote the head of Zeus with an axe, and Athena, fully armed, leaped up from the top of his head at the river Triton."

Apollodorus, p. 1.3.6

1.1 Background

Genealogies are fascinating; it is postulated that the act of investigating one's own ancestry provides a positive psychological reference and a feeling of orientation [Fischer et al., 2010]. The understanding of how one's current state is impacted by the actions of past family members provides a sense of agency, and satisfies a fundamental biological curiosity.

The genealogies that exist in the Greek mythic storyworld are no exception. The function of mythology is to answer the question "Where do we come from?"[Caldwell, 1993], so investigating the genealogical connections in these myths has a similar appeal. The fantastical and captivating plots of these mythologies also provide a much-desired insight into the religious practices and cultural values of the ancient Greeks [Sailors, 2007].

By exploring the interactions between entities and the relationships that form as a result, scholars of Greek myth can obtain a unique perspective of ancient Greek family structures. The unusualness of the manner in which many of the mythical entities romance, fight or conceive, are not only used as comparisons to modern-day, but also as a word of caution about relationships in general. Myths were integral and revered in ancient Greece, as the interweaving storylines - in addition to the inherent divine inspiration - conveyed important messages to the people about the value of interconnectedness and influence [Evans, 1991].

The nuances of the storylines detailing the creation of an entity's genealogy can also be used in lessons of morality. Examples range anywhere from the castration of Ouranos during the Titan War [Hesiod, pp. 175-185], to Zeus' seduction of Leda [Euripides and Allan, 2008, pp. 16-21 257-259], to the origins of Oedipus – the entity commonly associated with parent-child incest [Mcleod, 2018]. Additionally, the way the mythologies morph over time can be aligned with the cultural fluctuations of

the Greeks during that period of history. In other words, myths can be seen as "traditional tales relevant to society" and were abstract reflections of issues pertinent to the day, hence the persistent fascination from scholars. [Bremmer, 1986, p. 7].

1.2 Motivations

There is an ever-growing market for genealogical information retrieval, whether it be the analysis of DNA to uncover one's geographical ancestry [AncestryDNA, 2020] or open-source and commercial software that automatically displays past family relationships in the form of pedigree charts. These pedigree charts – otherwise known as genealogical tree graphs - provide a unique overview of the flow of relationships from past to present.

Due to the commonality and thus familiarity of these pedigree charts, it is natural for scholars in Greek mythology to desire similar visualisations of these mythological relationships. Unfortunately, there are no recorded instances of pedigree charts drawn by the ancient Greeks, so scholars often stylise their own interpretations of the genealogies. To do this they abstract the genealogical information derived from ancient poetry and prose texts and attempt to conform them to the traditional hierarchical nodes and edges layout found in modern pedigree charts. Often they then display these graphical derivations using a static medium, either in their own published texts or as an image in academic presentations. This format intrinsically does not do justice to the dynamic, heavily-intersecting and frequently-contested nature of mythological relationships. Of the few attempts to make this dynamic – take Theoi.com for example - the visualisations still have few interactive elements, despite the potential for highly-interactive, dynamic content on digital platforms. It seems incredibly unintuitive – and yet it is unfortunately the case - that those who choose to generate digital representations of mythological relationships often do not exploit the capabilities of the digital realm.

This thesis also argues that interfaces developed for representing genealogies should be made not only for research and teaching, but also for discovery. By providing multiple representation formats, the user has a higher chance of discovering new information about the mythologies, by the implicit addition of new navigation mechanisms [Whitelaw, 2012]. However very few resources contain multiple representations of the same data, namely, both in textual and graphical forms, especially in the realm of Greek mythology. Those who do – again taking Theoi.com as an example – are far too generalist, as the graphs only contain high-level subgroups of entities rather than render comprehensive visualisations based on each individual entity.

The desire for appropriate genealogical representation is made even clearer once one delves deeper into the complexities of Greek myth. The frequency of unusual interactions – by modern European standards – in these stories, as well as the contestations of the plotlines, provide a unique insight into their culture. Yet, most

attempts at visualising these complex interactions involve needless whittling of data to its bare essentials, and forces them to conform to familiar standardized formats such as in pedigree charts (see Section 2.2). Constructing a better medium for both familiarity of representation and accommodation of the unusual / contested allows for not only additional crucial insight into the lives of the Greeks, but also indirectly increases societal recognition of the potential for non-standardised genealogical connections. This is of particular interest to the modern day, for recognising existing cultures that have "non-standard" ideas of relationships – such as polygyny and polyamory – and the ever-expanding research on alternative reproduction mechanisms such as artificial insemination and cloning.

1.3 Research Questions

Based on the limitations of the resources that are currently available (see Chapter 2), there are three primary questions to be answered for this project:

1. How can we organise raw references from Greek mythology in a way that is systematic, consistent, and accessible?
2. How do we design an intuitive interface that represents complex, non-traditional genealogical data?
3. How do we provide genealogical data in a format beneficial to those invested in Greek and Latin literature?

1.4 Roadmap

The remainder of this thesis is organised as follows:

Chapter 2 highlights the complexities of the Greek mythic storyworld and explores genealogical representations of these myths in existing resources. It also explores methods used by existing software to tackle unusual genealogies, and acknowledges open-source data structures, genealogical graphing software and graph visualisation tools that could prove compatible for Greek genealogies.

Chapter 3 discusses the project's contributions to the MANTO ontology developed by Dr Greta Hawes and Prof. R. Scott Smith, as well as the technical considerations behind its conversion to a digital platform.

Chapter 4 explains the first set of prototype graphs designed for the system, as well as the feedback received from qualitative user interviews on these prototypes.

Chapter 5 explains the creation of a follow-up graphical prototype in response to this feedback, as well as providing context for a second round of user interviews.

Chapter 6 responds to the feedback for the second round of user interviews, discusses the limitations of the current stage of the prototype, and explores potential avenues for future work.

Chapter 7 then provides an evaluation of the project's contributions to the field of digital humanities in Greek myths and concludes the thesis.

One of the primary contributions of this research is a live artefact – a publicly-accessible reference tool – that is available at https://yayalu.github.io/greekgraphs. This artefact is referenced consistently throughout the thesis and is used to support the design decisions in the later chapters.

Chapter 2

Related Works

In this chapter, we dive into existing resources and related works that could be used as inspiration for this project, and discuss the limitations of each. Section 2.1 highlights the plethora of complex relationships that occur in Greek myth, and emphasizes the need to accommodate these complexities in any representations of it. Section 2.2 explores the limitations of textual and graphical representations of Greek myths generated by scholars, and critiques an existing attempt to generate a digital ontology for Greek myth. Section 2.3 examines research conducted into the graphical representation of complex genealogies in general. Section 2.4 investigates open-source genealogical data structures for their ability to handle complexity. Section 2.5 explores genealogical charting software for their ability to handle complexity. Lastly, Section 2.6 investigates general graphing frameworks to determine their potential for producing genealogical graphs, before concluding this chapter in Section 2.7.

2.1 Considerations for Greek Mythology Genealogies

As mentioned in the background, understanding genealogical relationships helps with obtaining insights of the values and beliefs of a culture. This is especially the case when exploring ancient cultures, where the insight is obtained primarily through surviving texts, art, and archaeology and there is no possibility of interviewing members of the ancient culture. Therefore, in order for us to both display and properly understand the complexities of Greek myth, we must first acknowledge the nuances of these stories.

2.1.1 Contested traditions

In Greek mythology, as in all mythologies there can be inconsistencies between retellings. In Greek, the word "myth" or "mythos" meant originally a story that is told aloud [Bremmer, 1986, p. 4]. The earliest examples of Greek myth were told in the form of oral poetry, where audiences would gather and listen to the tales spun by the narrator. These stories adhere to a standard set of plotlines, however they would have adapted to the issues pertinent to the day, as well as what exhilarated the particular audience at the time [Bremmer, 1986, p. 4]. As a result, the nuances

of the plot and the level of involvement of entities within these plots could have been minorly altered [Bremmer, 1986, pp. 3-7]. Even when these stories were written down, innovations and variations continued to occur. The same story might be told differently in different regions, or in different contexts, or by different storytellers, or under different political leaders or systems. There was never one single authoritative set of data for Greek myth. Instead, as Richard Buxton has said, one fundamental aspect of it is its 'tolerance of plurality' [Buxton, 1996, p. 177].

As such, it is abundantly clear that to truly appreciate the stories of Greek mythology, one must highlight the possibility of contestation whenever possible. Some authors do this by actively acknowledging disputes between authors within their own text, such as Apollodorus in his *Library* and *Epitome*. An example is the recount of Hephaestus' birth, where Apollodorus states "Hera gave birth to Hephaestus without intercourse with the other sex, but according to Homer he was one of her children by Zeus" [Apollodorus, p. 1.3.5]. By highlighting contests, scholars can use this information to infer the cultural changes in ancient Greece during this period of change, as well as how these changes propagated to future versions of the story. For instance, disputes expressed about the existence of an entity in the mythic storyworld impact the certainty of the lineage of their descendants whose existence may not be contested.

2.1.2 Unusual births

There are many cases of unusual births in Greek mythology, which are ironically not unusual in the realm of the mythologies themselves. In this thesis, "unusual" is defined as untraditional, non-heteronormative births that do not require both a mother and a father to give birth to a child. In other words, these are types of births that either do not naturally occur – or if they do, the occurrence is exceedingly rare - or do not conform to humanity's understanding of what is biologically possible. The fantastical manners in which these entities are born into the storyworld spark both fascination and shock in its audience, exploring a world where the usual laws of biology and physics do not apply, and explicitly contrasting the regularity and biological consistency of the historical present.

Given the definition of mythology and its basis in the Hellenic religion, it is unsurprising that a lot of the notable entities in Greek mythology are gods. These gods - like a lot of other deities in the Western world - are immortal and possess superhuman skills such as command over the elements. There are also heroes; Greek men and women, often demigods, who possess an enhanced skill set in mortal form. In the storyworld, these heroes and gods often encounter or create monsters, some being human-animal hybrids: centaurs (half human, half horse), gorgons (women with snakes for hair) and the Sirens (half human, half bird). Others exhibit unusual characteristics, such as the nine-headed Hydra that grows two heads in place of every one sliced off. Naturally, this means that a lot of the births do not adhere to conventional expectations.

Based on research conducted on Apollodorus' *Library* and *Epitome*, the following

are five forms of unusual births within the mythic storyworld that this thesis will focus on displaying:

2.1.2.1 Autochthony

Autochthony depicts the birth of an entity from the ground. Often the autochthonous birth is also associated with a place or a landmark, and strengthens a community's claim to long and uncontested ownership of a territory. An example is Cecrops, the first king of Attica, a half-serpent, half-man creature born "from the soil" [Apollodorus, p. 3.14.1].

2.1.2.2 Born from an object

This is also referred to as "born from a body part". There are cases of entities born from a body part of another entity. The body parts in question are not the ones associated with biological reproduction (e.g. the genitals) however in some cases the genitals themselves are a catalyst for the creation. Aphrodite was born from the foam of the castrated genitals of Ouranos as they fell into the ocean [Hesiod, pp. 190-200].

2.1.2.3 Created by an agent

This is also referred to as "created by someone else". Unlike being "born from a body part / object", which involves some form of biological connection to the birthed entity, an entity can be created by an agent consciously through non-biological means. An example is Hephaestus, who fashioned the first mortal woman Pandora out of clay.

2.1.2.4 Creation without parents

The Hellenic religion - like many other forms of religion - has an explanation that accounts for the birth of life itself, from immortals, to mortals, to monsters. Naturally, the first entities in the mythical universe – the personifications of Earth and Sky (Ge and Ouranos, respectively) - were created without parents. There are few entities that have this "created without parents" birth story, but it is still a notable birth since this distinguishes from the category of entities where their parents do exist, but are not known.

2.1.2.5 Parthenogenesis

Parthenogenesis occurs when a singular female entity conceives without need of insemination from a male entity. Hera's birth of Hephaestus is the most commonly associated case of parthenogenesis in the Greek mythic storyworld. Out of all five kinds of unusual births outlined in this thesis, parthenogenesis is the only birth type with reported occurrences in humans [Jose de Carli and Campos Pereira, 2017], plants [Vijverberg et al., 2019], and animals [Holtcamp, 2009], though the occurrence is exceedingly rare.

2.1.2.6 Contested unusual births

Like many of the other stories in Greek myth, unusual births can be contested. Authors can disagree on the status of the birth itself, or have conflicting opinions on the parentage of an entity. In the case of Orion, Apollodorus recorded him as a giant born from autochthony, however Pherecydes listed him as a child of Euryale and the god Poseidon [Apollodorus, p. 1.4.3]. Similarly, the aforementioned goddess Hera was a mother by parthenogenesis of Hephaestus in one record, but conceives Hephaestus with Zeus in another [Apollodorus, p. 1.3.5].

2.1.3 Incestuous relationships

Given the immortality of a lot of the characters in Greek myth, incest is commonplace. This is particularly apparent at the beginning of creation – e.g. between Gaia and Ouranos – as due to the lack of existing entities, incest was the only possible option to populate the universe. There are also many cases of inter-generational incest as some of the entities in Greek myth are immortal, so they can interact with several generations of mortals. The idea of incest in modern day – in particular, incest within one degree of separation – is taboo and illegal in a majority of countries, so to see this unashamedly occurring between Greek entities can be confronting. What is beneficial, however, is that the act of highlighting these incestuous relationships results in an increased appreciation of the interconnectedness of families in Greek myth.

2.1.4 Collectives

In Greek mythology, there are occasions where a group of entities have a singular biological identity. These entities are often siblings, but classify as a "genealogical collective" type, with a singular name that is often more identifiable than the members' individual names. An example is the "daughters of Danaus" where this generalistic name is used more often to represent the daughters than the individual names of the entities themselves. In some cases, a plotpoint in the myth might point to a collective genealogical effort, such as the role of the Titans collective during the Titan War, however the actions of certain members might warrant a dedicated mention (e.g. the Titan Cronus in his castration of Ouranos). Other types of collectives are also prevalent in Greek myths – namely, episodic collectives and miscellaneous collectives – which are another example of a strange aspect of Greek myth that we need to consider when visualising it. These will be addressed in later chapters of this thesis.

2.1.5 Other significant genealogies ("dies without children")

A genealogical attribute that is not unique to Greek myths but is significant nonetheless, is the idea of an entity producing no children. This connection is not unusual even in Greek myths, but it is potentially rife with contestation. In different

retellings of the tradition authors can have different reports of the lineage of an entity, thereby affecting the inheritance, or even existence, of their descendants. Note that in this case, "dies without children" is only recognised when the author themselves explicitly state as such in their retelling, and it cannot be inferred.

2.2 Existing Representations of Greek Myth Genealogies

As previously identified, many reference materials for Greek mythology visualise only the high-level genealogies occurring in Greek myth. As a result, the genealogies displayed are simultaneously unnecessarily dense, and incomplete, as only the more well-known genealogies are shown. Most examples also focus on the genealogies at the start of creation, such as the immediate descendants of Gaia and Ouranos, the gods, and some of the more well-known heroes. Consequently, the lesser-known entities are omitted entirely, resulting in a biased view of the importance of some myth subgroups over others, and removing the opportunity for discovery of other avenues of research.

Most existing genealogical visualisations of Greek myth conform to the standard pedigree chart format. This hierarchical tree-like structure is most commonly used to visualise modern genealogies, and certainly has a degree of familiarity to it, hence the appeal. Unfortunately, this poses many issues when unorthodox connections such as incest appear. One method some authors have used is to draw a singular entity node and have long lines joining this node to each of their spouses, often spanning multiple generations (Figure 2.1) [Wikipedia, 2020b]. This can be unruly, especially if the entity has a large number of incestuous connections. A frequently implemented alternative is to duplicate the entity name across each of its incestuous relationships, and combine them with spouses using a generic icon, e.g. a "+". The issue with duplication is that it creates visual ambiguity about whether the same entity is repeated, or whether it is a different entity with the same name. The translation of the ancient text used for this thesis displays a dense genealogical graph formatted in this manner (Figure 2.2). In response, this thesis argues that graphs of Greek myths should complement its complexities, rather than be forced to conform to modern society's genealogical expectations.

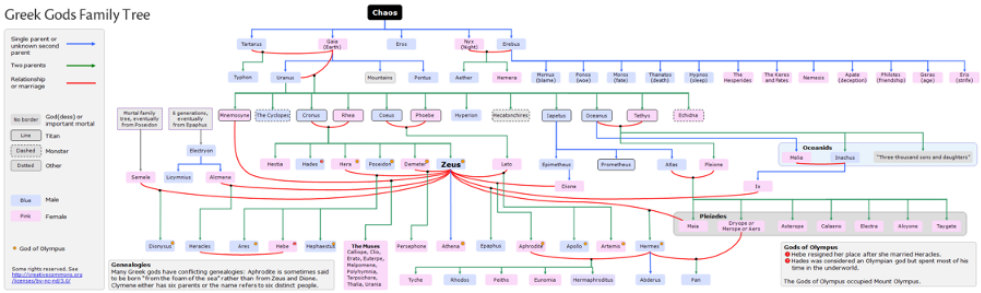

Figure 2.1: Another example of multi-generational linkeages for incestuous relationships [ludios, 2004]

2.2.1 Existing attempts to generate digital ontologies for Greek myth

There is no existing way of dealing with the data of Greek myth in a machine-readable form that is systematic, consistent, and accessible. MANTO is an attempt to do that, but it is still under construction, and this project is part of the development of MANTO's ontology (see Section 3.1). There is a previous attempt by Syamili and Rekha entitled *Developing an ontology for Greek mythology* [Syamili and Rekha, 2018], which for various reasons is inadequate for the material.

In Syamili and Rekha's paper , the authors attempted to "illustrate and develop an ontology for the heroes of the ancient Greek mythology and religion" [Syamili and Rekha, 2018, p. 119]. Similar to this project, they recognised the lack of ontologies available for epics and myths, and the inherent need to represent the genealogies of these entities in a meaningful, constructive manner to benefit "students, researchers, historians and laymen" [Syamili and Rekha, 2018, p. 122]. It can also be argued that their desire to exploit the capabilities of the Semantic Web, is akin to our own interests in developing a publicly-accessible platform integrated with the digital realm.

In other words, on a superficial level, their paper aims to fill the same gaps in Greek mythical data representation that we are. However, there are several flaws in Syamili and Rekha's approach to replicate this data, which indicate a fundamental lack of understanding of the nuances of the storyworld.

Syamil and Rekha in this paper interpret Greek mythology to be a primarily religious and cultic phenomenon, which is an old-fashioned perspective. They extract information from reference texts that are about the divine world and that relate to the religious aspect of divinity rather than consulting the primary source material, like Apollodorus. This is particularly evident in their ontology, as the focus is on the nature of gods, as well as their sphere of influence and the division between gods and mortals. On the other hand, MANTO, in keeping with more recent approaches, treats Greek myth as a narrative phenomenon that creates and enforces cultural networks. In other words, Syamil and Rekha's paper comes from an etic perspective, whereas experts in Greek myth and the MANTO team believe an emic approach to mythology to be more beneficial.

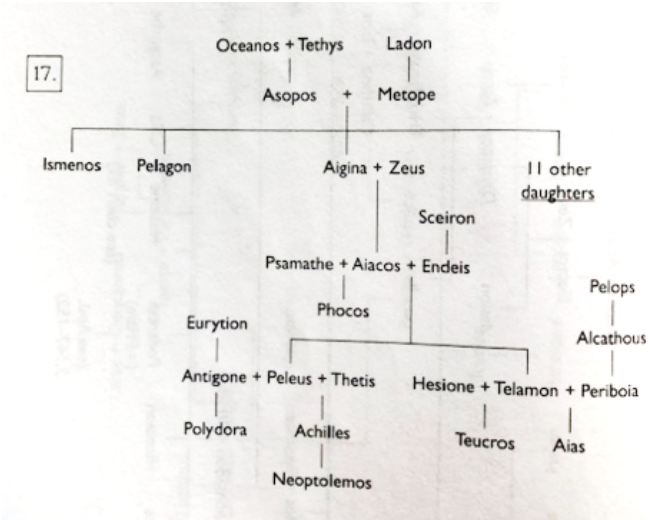

Figure 2.2: An example of "+" icons used to denote incestuous and traditional spousal connections [Smith et al., 2007]

The resources used by Syamili and Rekha are primarily encyclopaedias [Syamili and Rekha, 2018, p. 123], which can be considered secondary or tertiary resources as they are often modernised interpretations of the original texts. The effect of this is clear in their entity categorisation technique, as rather than grouping the entities by their fundamentals – such as "agent" and "collective" – and using this information to create a fuller sense of the entity's role in the mythic universe, they chose to abstract them into high-level categories such as agricultural gods and gods of the sea. As such, the data cannot be captured in a manner that preserves the antiquity and precision of the data, nor the intricacies of the interactions between agents, collectives, places, objects, and events. This top-down approach also creates more ambiguity than it attempts to resolve. For example, can entities belong to more than one category? What about heroes who were born mortal then granted immortality? Without connections to the specific texts, this ontology cannot distinguish between the way stories were told in different literary contexts, or at different points in history, or in different places.

Delving into the ontological structure the authors proposed, they attempted to extract basic genealogical data such as parent-child relationships, spouses, and twins from reference texts. Unfortunately, the strict focus on gods meant they omitted the genealogies of the considerably-more-common types of entities in the mythic universe, namely mortals and other forms of non-mortals. This resulted in an incomplete and reductionist representation of the connections in the universe.

This reductionist approach further highlighted the paper's lack of understanding of the myth's inherent complexities. Their consistent use of the phrase "widely accepted fact" [Syamili and Rekha, 2018, p. 127] indicates an inability to handle variants in the data, and overlooks these complexities. It is also unclear whether their proposed solution could handle the unusual circumstances

that make Greek mythology so appealing as a narrative, such as disambiguating mythical figures, agents who are also members of different kinds of collectives, and the uncertainty and contestation expressed either within or between reference materials. Most importantly, they do not systematically capture the unusual births that are a key element of intrigue in Greek myths.

The user research conducted for the ontology was also deeply flawed. This was evidenced by its low correctness rating of 62%, answering only 76 out of the 123 of their own questions correctly [Syamili and Rekha, 2018, pp. 129-130]. A majority of their questions – though seemingly simplistic – actually had multiple valid answers. The contestation between different authors' versions of the mythology, as well as the plethora of alternative spellings of entities due to cultural adaptation, mean that asking questions such as "Who is king of Athens?" is extremely ineffective. For example, depending on the time frame in the mythical period, the answer could be Actaios, Cranaos, Amphictyon, Erechtheus, Pandion, Pandion again, Cecrops, Theseus, Demophon, or so on. The assumption of a singular answer demonstrates an ignorance of the complexities of Greek myths.

Overall, despite its similar goal, the paper's approach to Greek mythology is old-fashioned, and they develop their ontology using outdated datasets that are not expertly-curated. Their use of unnecessarily-restrictive – rather than explorative - questions as an indicator of success, the reductionist higher-level categorisation procedure, and the strict focus on gods shows a fundamental lack of understanding of the nuances of Greek myth. There is also no indication that their project is live, or where users can access any of the data from their system. In other words, for an ontology meant as a guide to students, researchers and historians, their system is lacking in all the specifics and references required to be a usable reference tool.

2.2.2 Digital inadequacies in representing Greek mythic genealogy

In addition to restrictive formatting concerns for Greek mythic graphs, very few modern scholars exploit the capabilities of the digital realm. With the increase in popularity of genealogical charting software, integrating Greek mythology storylines with the capabilities of digital interfaces seems like a natural step.

Theoi.com [Atsma, 2019a] is one of the few examples of a searchable online index that attempts to integrate Greek mythology with the digital realm, in the form of digitized genealogy charts. However, these graphs are rudimentarily interactive, as the only interactive elements are the nodes in the graph, which merely redirect to the reference page for that entity [Atsma, 2019b]. They do not attempt to integrate the more notably complex elements of these genealogies, for example contested lineage. Some attempts have been made to address unusual circumstances of birth, but these are displayed in note form and are inconsistent with the benefits of graphs as a visual representation of data. They are also similar to the static forms of Greek mythologies in reference texts, in that only the more debatably noteworthy groups of genealogies are provided with graphs. In the case of Theoi.com, graphs are grouped into high-level categories such as Olympian gods, sea gods and monsters, and nymphs, which

Aphrodite

Goddess of love, beauty and sexuality

Aphrodite Pudica (Roman copy of 2nd century AD), National Archaeological Museum, Athens

Abode	Mount Olympus
Symbol	Dolphin, Rose, Scallop Shell, Myrtle, Dove, Sparrow, Girdle, Mirror, Pearl and Swan
Personal information	
Parents	In the *Iliad*: Zeus and Dione[2] In *Theogony*: Uranus's severed genitals[3]
Siblings	Aeacus, Angelos, Apollo, Ares, Artemis, Athena, Dionysus, Eileithyia, Enyo, Eris, Ersa, Hebe, **Helen of Troy**, Hephaestus, Heracles, Hermes, Minos, Pandia, Persephone, Perseus, Rhadamanthus, the Graces, the Horae, the Litae, the Muses, the Moirai, *or* the Titans, the **Cyclopes**, the Meliae, the Erinyes (Furies), the Giants, the Hekatonkheires
Consort	Hephaestus, Ares, Poseidon, Hermes, Dionysus, Adonis, and Anchises
Children	With Ares: Eros,[1] Phobos, Deimos, Harmonia, Pothos, Anteros, Himeros, With Hermes: **Hermaphroditus**, With Poseidon: Rhodos, Eryx, With Dionysus: Peitho, The Graces, Priapus, With Anchises: Aeneas

Lovers and children

Aphrodite's family

Consort	Offspring	Consort	Offspring
Ares[98][189]	Phobos[189]	Hephaestus[88][105][189]	*no known offspring*
	Deimos[189]	Hermes	Hermaphroditos[190]
	Harmonia[120][189]		Priapus[121]
	The Erotes, viz.[189] 1. Eros[d][1][111] 2. Anteros[d] 3. Himeros[111] 4. Pothos	Poseidon	Rhodos[191]
		Adonis[140][141]	Beroe
			Golgos[192]
			Priapus (rarely)[121]
		Butes[193][194]	Eryx[195]
			Meligounis
Dionysus	Hymenaios		*several more unnamed daughters*[196]
	Iacchus		
	Priapus[121]	Phaethon[197][198]	Astynous[199]
	Charites (Graces), viz. 1. Aglaea 2. Euphrosyne 3. Thalia	*Unknown consort*	Peitho

Figure 2.3: The index card system for Aphrodite from Wikipedia [Wikipedia, 2020a]

makes searching for the genealogies of specific entities an arduous and convoluted process.

Another digital platform with a well-researched collection of Greek mythology genealogies is Wikipedia. This community-based encyclopedia platform contains extensive information about the major Greek mythology entities, such as the Olympic gods, monsters and heroes. As a result there are detailed genealogical index cards and an exhaustive list of resources for each connection (Figure 2.3). These index card formats are used throughout the Wikipedia platform and are an easily-recognisable format to display a list of attributes. This would make Wikipedia's index card format ideal for minimalistic but impactful textual representations of genealogy, however it is still not an ideal digital platform for Greek myths overall. Like Theoi.com, Wikipedia provides high-level and categorised genealogical graphs. Unlike Theoi.com it also contains pedigree charts for mythic figures, but these are not dynamically generated and are only available for the more well-known figures. This applies for many of the other features in Wikipedia's pages on Greek myths; the community-input-based nature of this website means that only the more popularized entities in Greek myth have detailed, dedicated pages, and entities that are only mentioned once or twice in reference texts are often ignored entirely. There is also no clear rationale for the disambiguation of characters with the same names, indicating that these facts were compiled in a haphazard manner.

In conclusion, there have been efforts to graphically represent Greek mythology genealogies; some of which attempt to integrate with but only scrape the surface of the capabilities of the digital realm. Most fundamentally, the lack of interactivity in these digital graphs, the inability to filter for desired entities and the blind adherence to standardized genealogical formats provides an unnecessarily

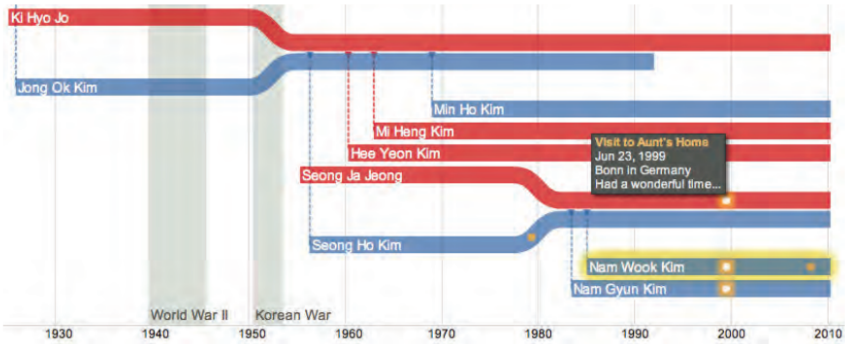

Figure 2.4: TimeNets: Kim et al.'s representation of genealogies with a temporal axis [Kim et al., 2010, p. 241]

constrained representation of the complexities of the storyworld.

2.3 Existing Genealogical Visualisation Techniques

If we direct our attention away from the Greek aspect of digital genealogical representation, we can explore other attempts to visualise complex lineages. By doing so, we can determine the applicability of their solutions to the Greek mythic storyworld.

2.3.1 TimeNets: a timeline-sensitive genealogy charting solution

Kim et al. proposed a visualisation technique for genealogical data called TimeNets [Kim et al., 2010]. TimeNets works on the premise that genealogical representations should also contain the timelines in which the relationships occur, not just the relationship hierarchies themselves. Kim et al. claim that with timelines between entities converging due to marriage and diverging due to divorces, the connections between these entities can become too complex and unintuitive. To address this, they proposed the addition of a temporal axis, that can cross-reference relationship catalysts – such as divorce, remarriage and plural marriages - with no hierarchical ambiguity (Figure 2.4). This idea would work well for realistic representations of ancestry, however the immortality of most entities in the Greek mythic universe, as well as the uncertainty of timelines – for example, the date of the start of creation – makes this an implausible suggestion for this project.

2.3.2 The Nauvoo Marriage Project: addressing the complexities of Mormon family units

Hott et al. attempted to visualise the complexities of Mormon marriages in Nauv, Illinois in the mid-1800s [Hott et al., 2018]. During this period Mormons "participated in both polygynous and polyandrous marriages to create desired

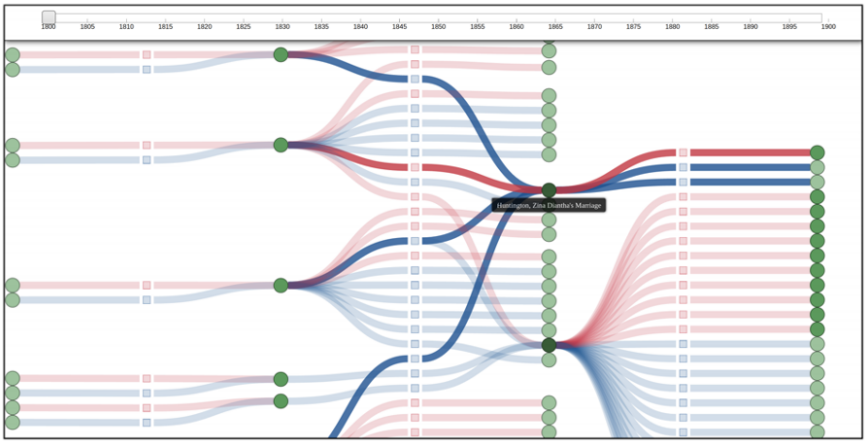

Figure 2.5: Higher-level genealogical flow chart developed by [Hott et al., 2018, pp. 314-7]

family units, kinship, and religious lineages" [Hott et al., 2018, pp. 314-1]. Multiple recognised unions between people created further complexities with visualising this data. There were government-recognised civil union marriages – akin to the marriages recognised in today's society – which were differentiated from "eternal" unions believed to persist past death, "temporal" unions lasting only during life, and posthumous unions performed by proxy. Other symbolic marital unions occurred, such as those that tie relationships to their religious lineage network and family units, for example aunts maritally attached to their nephews. Hott et al. recognised that the visualisation of these unions was crucial to understanding the social constructs of the Mormons.

The author similarly acknowledged the constraints of the standard pedigree chart layout and developed a chord diagram format as an alternative. Each family member represents a section of a circle, with the members ordered from top to bottom chronologically (Figure 2.6). Each circle represents a single family unit and the circles are nodes in a higher-level genealogical flow chart (Figure 2.5). Unfortunately, it is still restrictive in its representation of families; it assumes all children are connected to exactly two parents, where even the process of adding step-parents to the diagram would require an additional categorisation system. This may be a restriction unaffected by Mormon traditions, however it is not easily expandable to other forms of genealogy. By this logic alone, it would be unable to handle the multitude of genealogical complexities that occur in Greek mythology.

This system does however provide insights into potential avenues for interactivity of digital genealogical graphs. In the extension section the paper explores the use of different colours and gradients to distinguish between different relationship types, as this "disseminate[s] the information on first glance" [Hott et al., 2018, pp. 314-4]. However, the immense number of different relationship types in the Mormon culture still makes distinguishing between these types difficult, even with use of a legend (Figure 2.7). This can be rectified by limiting distinctive colours to a higher-

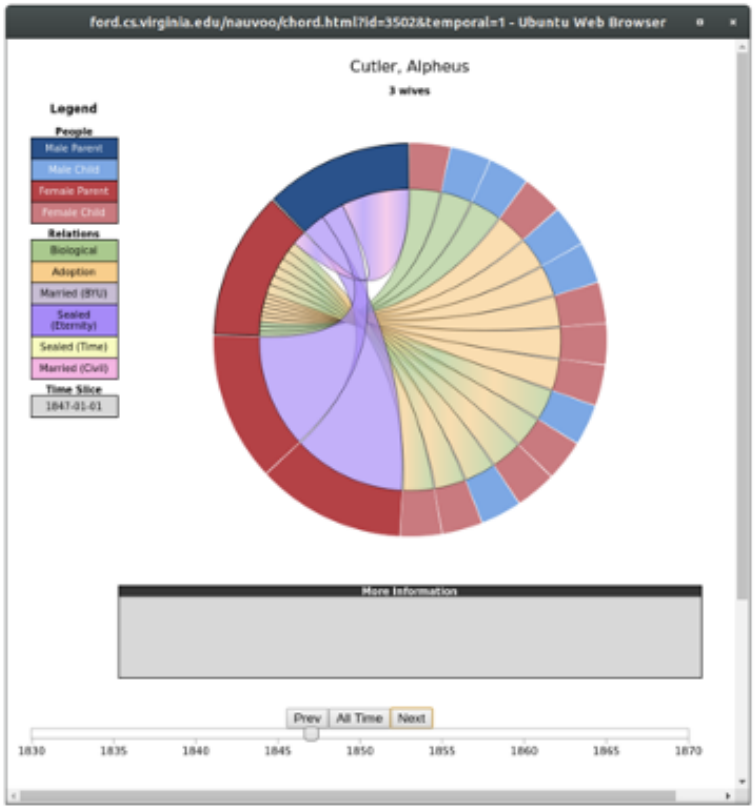

Figure 2.6: Chord diagram representing a Mormon family unit by [Hott et al., 2018, pp. 314-3]

Color	Definition
red/pink	Female individual
blue	Male individual
purple	"Eternal" sealing
yellow	"Temporal" sealing
light pink	Civil marriage
light gray	Unknown marriage type
gold	Adopted child-parent relationship
light green	Biological child-parent relationship (chord diagram)
dark green	Family unit (lineage flow diagram)

Figure 2.7: Legend for Hott et al. chord diagrams [p. 314-4]

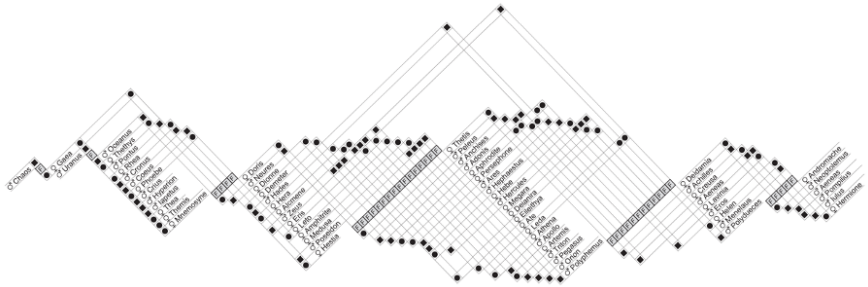

Figure 2.8: Representation of the Greek Pantheon ontology using GeneaQuilts, by [Bezerianos et al., 2010, p. 1073]

level set of categories – in our case: traditional, unusual, incestuous and contested connections – and finding some other meaningful way to distinguish connections within these categories.

Another interactivity feature in this paper that we could incorporate in our genealogical graph design is the hover effect. Hovering over a connection also highlights the other relationships relevant to that connection. Mouseover focus capability also prompts information boxes about that particular connection to appear.

2.3.3 GeneaQuilts: a matrix genealogical representation technique

GeneaQuilts is an alternative genealogical representation technique developed by Bezerianos et al., where the aim is to display a large set of genealogies at once [Bezerianos et al., 2010]. It claims that the traditional pedigree chart format can not "visualise a large dataset in a legible way" [Bezerianos et al., 2010, p. 1075] due to the messiness of overlapping edges, meanwhile GeneaQuilts can support several thousand individuals in one diagram. To achieve this GeneaQuilts uses a diagonal matrix to store the connections.

In their paper, Bezerianos et al. offer examples of GeneaQuilts operating on the Greek Pantheon ontology (Figure 2.8). It draws comparisons between existing node-link representations of these mythologies and the capability of GeneaQuilts.

It is clear that GeneaQuilts is superior to both of the aforementioned papers when dealing with Greek myth genealogies. In GeneaQuilts it is possible to represent both sibling-spousal incest and inter-generational incest without unnecessary duplication of entities. These occurrences of incest are also visually impactful, as represented by the lines exceeding the top of the graphs. GeneaQuilts does not, however, demonstrate handling of contested traditions and unusual entity births. The graph appears only to handle parent-child and spousal connections, so accommodating unusual birth and contested tradition could impact the overall readability of the graph. Even with different colours denoting the different traditions or births, contested tradition could create overlapping and association errors in the graph impacting its readability.

Overall the matrix graph design of GeneaQuilts integrates well with the more complex incestuous connections in Greek mythology. However, the unfamiliarity of the diagram format, as well as the difficulty in addressing unusual births or contested traditions, still means the technique is inadequate for the project. Additionally, the ability to handle several thousand connections in one diagram is impressive; however this is only beneficial if there is a possibility for a large number of connections per graph. Even with Zeus' plethora of offspring, the chance of reaping benefits from GeneaQuilts' efficiency is not high.

2.3.4 Other unusual relationships throughout history

There are many other kinds of unusual relationships in history, yet surprisingly few papers address the visual representations of these unusual elements. Most research conducted on genealogy visualisations – in the computer science field especially – focus only on edge minimisation layout algorithms within the scope of a pedigree chart [Holten, 2006] [Henry and Hudson, 1991]. In order to better understand what the public desires from a complex graph, we need to explore historical relationships through the eyes of an amateur history-enthusiast, not necessarily through an academic resource.

The idea of marriage between siblings or between parents and their children, is a taboo subject. However, in many countries royalty were exempt from this rule e.g. ancient Egypt, Inca Peru, and the Spanish Hasburgs [Khan, 2020]. There are debates on the reasons for this behaviour; some say that the royals believed "incest sets them apart" [Dobbs, 2020] and if the gods could marry relatives then so could they. Others insist it was for the protection of assets, since marriage between family members would keep riches, privilege and power within the family. Some societies with overlapping cultures chose to marry extended family members from other cultures in order to forge alliances.

It is no wonder that these kinds of connections are fascinating for the general public. Many attempts have been made to display these lineages in a format that complements these incestuous connections, rather than hide them by duplicating entities. An example is Figure 2.9, a graphical representation of the incestuous lineage of King Charles II of Spain. Although the incestuous connections themselves are not highlighted, the occurrence of incest here is unmistakeable. The sheer number of fully-enclosed shapes in this graph make the impact of incest extremely apparent and are enough to cause shock value. This is a method that we can use for representing incest in the Greek genealogy charts, although some liberties may need to be taken with large gaps in intergenerational incest due to the immortality of gods.

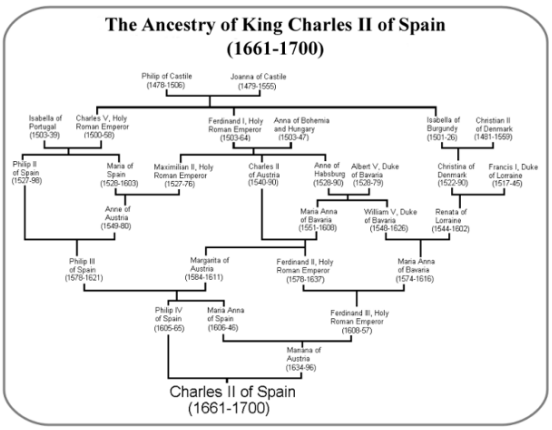

Figure 2.9: A graphical representation of the incestuous ancestry of King Charles II of Spain [Khan, 2020]

2.4 Open-Source Data Structures for Representing Genealogical Data

To represent the Greek mythology genealogies in an appropriate manner, we referred to the data structures that are currently available for genealogies. This was a minor consideration for our project but an important one nonetheless, as useful out-of-the-box data structures could have provided ease of development and increased adaptability between platforms.

GEDCOM (GEnealogical Data COMmunications) is considered the de facto standard for the exchange of genealogical data between genealogy software and uses bipartite graphs to represent this data [Harten, 2020]. It was first released in 1987 by the Church of Jesus Christ of Latter-Day Saints to record relationships between members of a family unit and to aid in genealogical research [FamilySearch.org, 2020b]. GEDCOM's additional purpose was to save these relationships to computer disks for storage, but with the advancement of genealogical software, a derivation known as GEDCOM-X was created to exchange the same genealogical information in the digital realm [GEDCOM-X, 2020]. The GEDCOM files (.ged suffix) are in plain-text format, compatible with UTF-8, ANSEL or ASCII character sets, and stores information about each entity as well as metadata linking the records [FamilySearch.org, 2020b]. In other words, GEDCOM files are supported by the majority of genealogy-charting software and operating systems.

A fundamental flaw of the GEDCOM data structure is that it can only recognise traditional relationships. This is expected as the primary use for GEDCOM is to store relationships that exist in the real world, but they are also restricted to only what is accepted by the Church of Jesus Christ of Latter-Day Saints. In other words, connections that are lawful (e.g. marriage), religious (e.g. confirmation and baptism), and generally accepted by society (e.g. adoption), are

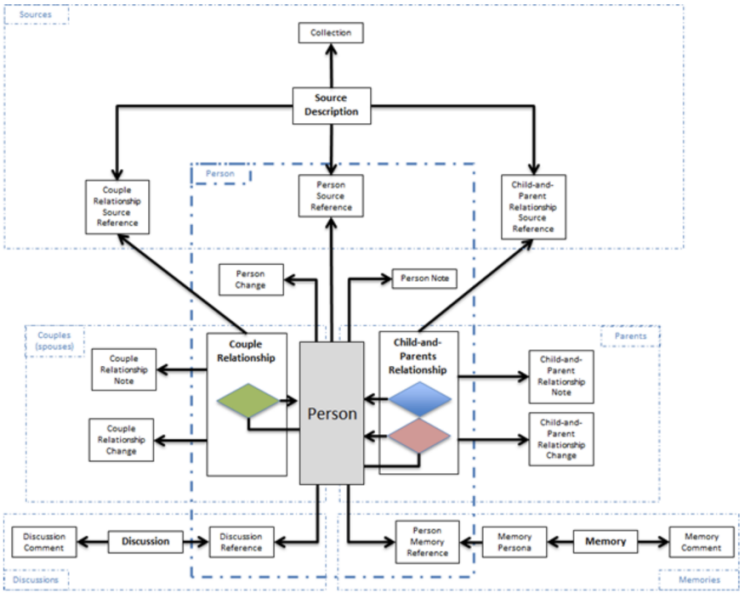

Figure 2.10: A derivation of the GEDCOM data structure layout, proposed by FamilySearch.org [FamilySearch.org, 2020a]

GEDCOM-compatible, but they cannot accommodate the complexities such as uncertain parentage, incest and contestation that are needed for this project. By default, this means that most software that is GEDCOM-compatible is not able to address these complexities either.

The restrictive simplicity of this GEDCOM format has also been recognised by other researchers, attempts have been made to restructure the format for more intuitive representation. For example, the Family Tree Data Model proposed by FamilySearch.org splits the GEDCOM file data into several categories for ease of reference. Each member of the family tree is a Person object, that holds the person's statistics, relationships (parent-child and spousal) and even notes about their life such as memories [FamilySearch.org, 2020a]. These Person objects are linked with other Person objects by their relationship attributes (Figure 2.10). This updated format has a lot of potential because it allows for greater flexibility in the lineage of the entity, but the number of relationship categories available to it is still not complex enough.

In summary, within the scope of this project we have found no pre-defined genealogy data structures that could accommodate for the complexity of some relationships in Greek mythology. This implies that despite the promise of adaptability with well-known data structures, this project would benefit more from a bespoke data structure that allows for more ambiguity of lineage.

2.5 Existing Genealogical Graphing Software

As the standard genealogical data structures did not support the complexity of Greek myths, research on out-of-the-box solutions migrated to genealogical graphing software. The hope was that these existing graphing platforms also recognised the limitations of GEDCOM and added extra functionality in their frontend to address this. If an existing graphing software was able to satisfactorily accommodate for these complexities, they would have simplified the creation of graphs for this project.

2.5.1 Legacy 9

Legacy 9 is a "family history computer program" [Legacy9, 2020a] that converts genealogical data – such as data from GEDCOM files – into varieties of genealogical graph formats; these include ancestry booklets, timeline charts, ancestor fans, and horizontal and vertical pedigree trees. It is capable of displaying up to 60 children per parent, which is useful for entities with a large number of offspring e.g. Zeus. Each person can have any number of parents, which is useful for cases of adoption and unsure parentage. The user is also able to specify the desired number of generations, or whether ancestors or descendants are shown (but not both). Homosexual relationships are also allowed – with "Husband" and "Wife" attribution being automatically changed to "Partner" – and people of non-binary identification are listed as "Unknown".

Of particular interest are Legacy 9's multiple visualisation formats. Having a variety of charting options implicitly provides multiple perspectives or interpretations of the same data. This was useful for determining the most effective graph type for the first round of user interviews, see Sections 4.2.3 and 4.4.2. Unfortunately, graphs from Legacy 9 are rendered automatically using an internal layout algorithm, and thus cannot be structurally customized. This means that adding extra connections for cases of unusual birth or alternative lineages is not possible.

The standard version of Legacy 9 is free to download, however the deluxe version costs $34.95 USD, adding features like textual descriptions for the relation between any two entities (e.g. X is the 2nd great-grandnephew of Y), and user-customizable terminology for unions (e.g. the default "spousal" and "marriage" can be changed to other terms like "partnership"). The deluxe version even offers multiple types of parent-child relationship - biological, adopted, guardian, sealed, step - and contains a "Challenged" and "Disproved" tag to record if the relationship is uncertain [Legacy9, 2020b]. This is a point in favour of the use of Legacy 9 for this project, as it addresses the ambiguity of some mythological relationships, as well as the potential for contestation.

There are several other concerns with the functionality of Legacy 9. The software assumes that every entity is human– an understandable requirement given its usual target audience but not ideal for Greek myths – and can not handle unusual births

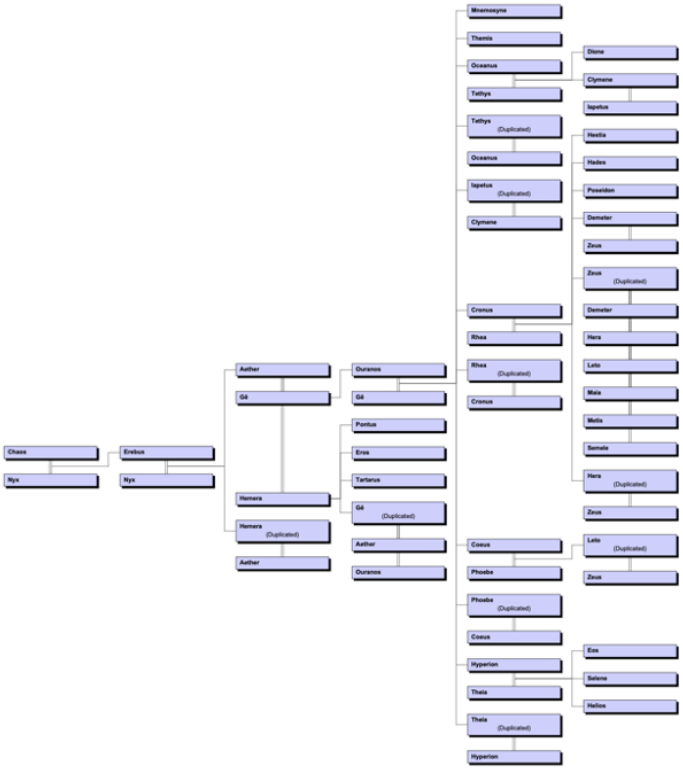

Figure 2.11: Pedigree chart depicting the descendants of Greek entities Chaos and Nyx, generated using Legacy 9

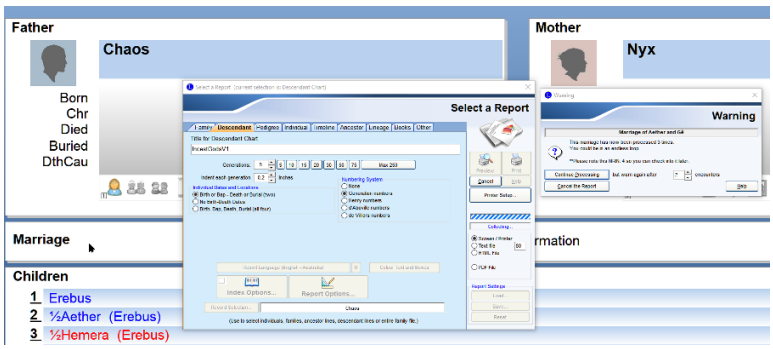

Figure 2.12: Error messages when the father-daughter incestuous relationship between Aether and Ge is imported into Legacy 9

such as autochthony. Legacy 9 also has trouble integrating incestuous relationships, resulting in either duplicated nodes, or as shown in Figure 2.12, the graph rendering engine is unable to generate the graph due to "endless loops".

2.5.2 FamilySearch.org

FamilySearch is a non-profit website that stores and retrieves genealogical records, and is considered the largest genealogy organisation in the world [Noyce, 2017]. The website offers a genealogy chart-generation feature; users can either enter the genealogies manually, or use the search function to locate existing graphs generated from the organisation's records. These charts are available in multiple formats, such as vertical or horizontal pedigree trees, and ancestor fans.

Like the GEDCOM data format, FamilySearch.org is owned and operated by The Church of Jesus Christ of Latter-day Saints; meaning most representations of relationships adhere to conventional expectations. This is particularly apparent when adding nodes to the graph, as the only valid attributes are name, gender, status (living or dead), birth place and date, death place and date (Figure 2.13). There is no option to add uncertainty or conditions of birth, and in the context of Greek mythology, "status", "birth date" and "death date" are either unknown or irrelevant to the storyworld.

2.5.3 RootsMagic

RootsMagic is another genealogy-charting software, first released in 2003. It is compatible with most OS and like Legacy 9 has free and paid versions ($27USD). The paid version offers more graph formats such as box charts, timeline charts, and hourglass charts, as well as a multitude of output formats, even the ability to export to a website [RootsMagic, 2020].

These factors would make RootsMagic the ideal software for generating a genealogical chart website. However, there are many incompatibilities with the layout of the data. In particular, the pedigree charts provided by the system are not

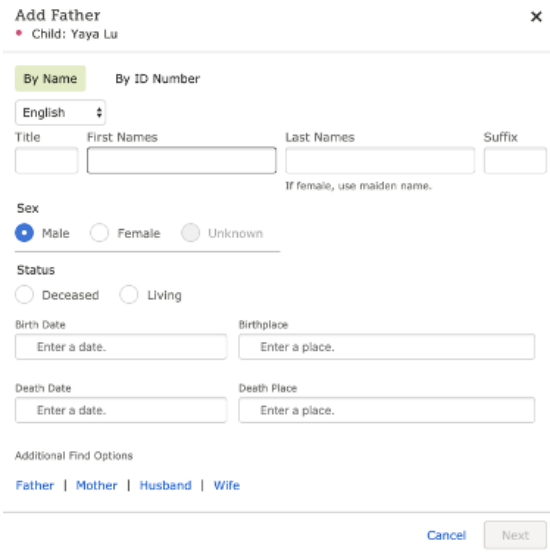

Figure 2.13: The Person object generation interface in FamilySearch.org, depicting the range of permitted attributes

able to easily address incest, so incestuous entities – particularly near the start of creation – are automatically repeated in the graph (Figure 2.14).

2.5.4 Ancestry.com

Ancestry.com is the largest for-profit genealogy company in the world. It is similar in functionality to FamilySearch.org in that it is able to access a lot of historical records and visualise those in genealogical graphs. It offers a 14-day trial and upon conclusion of the trial period, it is $19.99USD per month for ancestry data only from the US, and $34.99USD per month for access to international records.

Ancestry, like the others, is compatible with GEDCOM files, and the attributes

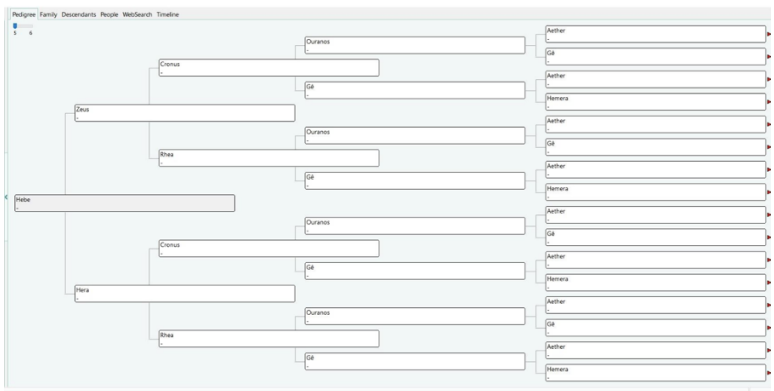

Figure 2.14: Example of duplicated nodes when depicting incestuous ancestry, generated using RootsMagic

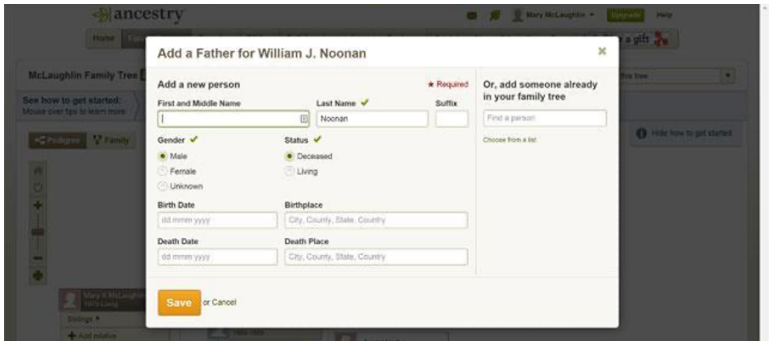

Figure 2.15: The Person object generation interface in Ancestry.com, depicting the range of permitted attributes

allowed for each entity is similar to FamilySearch.org. Only name, gender, status (deceased or living), birth date and place, and death date and place, are permitted as values (Figure 2.15). As a result, this software has the same disadvantages as FamilySearch.org, in that it is unable to deal with unusual births and contested traditions.

2.5.5 Other software and summaries

There are many other marketed genealogy chart formatters, for example Gramps which uses GraphViz and DOT notation, ScionPC, MyHeritage Family Tree Builder, Brother's Keeper, and Ancestral Quest Basics. Regardless, all of these software produce similar effects. Some are like Ancestry.com and FamilySearch.org, where the data is limited to the GEDCOM format scopes. Others have the limitations of RootsMagic and Legacy 9, where incest and contested tradition wreak havoc on the graph renderer. In other words, no genealogy software in the market is able to satisfyingly integrate the complexities of Greek mythology.

2.6 Existing Graph Visualisation Tools

2.6.1 D3.js

D3.js is an open-source platform designed to bind data to a Document Object Model (DOM), and apply transformations to the data to generate alternative formats [D3.js, 2020]. For example, D3.js can be used to generate HTML tables from numbers, or use the same numbers to create high-quality graphs and charts with transitions and interactive elements. Of the available D3.js visualisation formats, their hierarchical diagrams such as the tidytrees, cluster dendrograms, radial diagrams, and force-directed trees are of the most interest to this project.

D3.js is compatible with common web frameworks such as HTML, CSS, and image representation formats like SVG. This means that the elements in D3.js can be customized like any HTML element with CSS, and animations are even supported.

There is also a lot of support in the development community for D3.js, so there are many community-developed components that make it compatible with other JS frameworks such as ReactJS, TypeScript and AngularJS.

D3.js is also compatible with many different data structure inputs, such as DOT notation, JSON, and GraphLib. It is not, however, directly compatible with the GEDCOM file format but there are plugins available that convert GEDCOM files to D3.js-compatible JSON files [misterblanket, 2020].

Other frameworks can be used in conjunction with D3.js rendering techniques. An example is the Dagre JS library that helps with the layout of directed acyclic graphs that use D3.js [lutzroeder, 2020a]. The React component version of this library is dagre-d3, which is the framework used for Prototype 1 (see Section 4.2.1) [lutzroeder, 2020b].

All-in-all, D3.js is able to efficiently render a wide range of graph formats and is highly adaptable due to the development community's constant support. However, the layouts of the graphs are not customizable, which created issues with accurately representing genealogical data. See Section 4.2.1 for a more detailed explanation.

2.6.2 GraphViz

Similar to D3.js, GraphViz imports textual data structures (e.g. DOT notation) and renders them as visual graphs. These visuals are exportable to image file formats such as SVG and include interactive elements. Like D3.js, the graphs are customizable due to their integration with CSS, with stylisations that include colour, line styles, hyperlinks and shapes. The most familiar graph for genealogical charts is their directed hierarchical graph, known as their "dot" graph format.

An example of a dot graph developed using GraphViz is shown in Figure 2.16. Each node allowed a variety of content formats, including images, dates, names and explanations. However, the layout algorithm is not customizable as input is only permitted in text form with customizable node and line styles. This means the graphs cannot be modified to appear in other tailored format, such as pedigree charts, or representations of unusual connections [Kalia, 2020].

2.6.3 HTML Canvas

HTML canvas is a graphics-drawing system that is highly customizable, but does not have any associated layout algorithms. This is a standard HTML element tag, able to display any arrangement of lines, shapes and images on a plain "canvas" on a webpage. This format is compatible with any data structure, as long as this data has an adequate extraction process in the backend, converting it to canvas-compatible elements. The resulting output is a static image and does not have explicitly interactable elements. As such, the output is fast-rendering and highly customizable for whatever unusual representation is desired, but the static nature of the canvas would not explore any of the benefits of a digital platform.

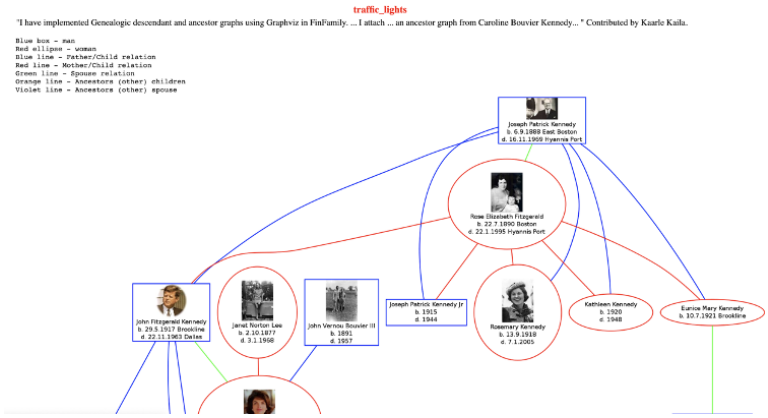

Figure 2.16: A graph generated by kennedyanc, using GraphViz's "dot" graph format [Kalia, 2020]

2.6.4 KonvaJS

KonvaJS attempts to address the interactivity limitations of the HTML canvas tag. It applies the standard HTML canvas layout-customizability options but adds animation support to the elements in the canvas. The elements are also compatible with CSS and use event-driven architecture, that allows the canvas to react to events such as mouseover and drag-and-drop. The graph is rendered in layers and stages, and each layer is customisable. It also uses techniques such as node caching and color-map hashing to assist with draw performance and event handling response time optimisation.

KonvaJS is also well-recognised as a graphing tool in the online development community, so there are many add-ons and imports available to developers. For example, there are React-compatible libraries available for KonvaJS that convert the attributes in the library to React components, known as react-konva. Overall, KonvaJS is a good combination of the highly-customizable benefits of canvas, and the interactivity provided by DOM-based graph visualisation tools such as D3.js and GraphViz.

2.7 Summary

In summary, there are a variety of options available for generating genealogical graphs, whether it be commercial software, use of genealogical data structures such as GEDCOM, or development frameworks such as D3.js. There are also several existing attempts to portray Greek genealogical data, and some attempts to visualise complex genealogical data in general. Although initially promising, when faced with the complexities outlined in Section 2.1 none of these options could accommodate all of the necessary complexities in a satisfactory manner. These limitations provided the basis for the creation of the MANTO ontology.

Chapter 3

Contributions to the MANTO Ontology

To provide tools for interactively exploring the genealogies in the Greek mythic storyworld and achieving the stated goals of the project, we first need to turn the unstructured data (Greek myth as found in surviving ancient texts) into a form of structured data that is sensitive to the nuances of the original tradition.

In this chapter, we introduce and provide an overview of the MANTO ontology, which contains the data used for the genealogical connections in this project. Section 3.1 provides the background and inspiration for MANTO, as well as information about its linked data structure. Section 3.2 details the modifications to the MANTO ontology as a result of this project. Section 3.3 explains how the genealogical ties are extracted from the MANTO database for use in this project. Section 3.4 explains how we then display this extracted data in our new publicly-accessible reference tool, in the form of "data cards" and a searchable web interface. Conclusions are then made in Section 3.5.

3.1 Background of MANTO

The data for genealogies in Greek myth was extracted from the MANTO (Modelling Ancient Narratives, Territories, and Objects) ontology developed by Dr. Greta Hawes (ANU) and Prof. R. Scott Smith (University of New Hampshire) [Hawes and Smith, 2020]. MANTO is a method for extracting from ancient literature relational data, which expresses how entities related to one another in the Greek mythical storyworld and how this impacted on the historical landscape of the Mediterranean. This thesis uses a subset of its current dataset: the disambiguated lists of mythical agents and collectives, and the ties expressing genealogical relationships derived from Apollodorus' *Library* and *Epitome*. We based this visualisation project on a limited range of data in order to focus on the specific problems of genealogical visualisations that this data required without involving unnecessary complexity. We selected the data from Apollodorus as this author gives the fullest surviving account of the full range of Greek genealogical traditions and includes examples of all of the unusual births and contested traditions that this project is designed to integrate.

This project creates the first publicly accessible digital interface for MANTO.

3.1.1 Inspiration for MANTO

Based on reviews of other data representations of Greek myths, it is clear that other attempts to record such data resulted in overly-broad, unsubstantiated and unimpactful outputs. This is completely understandable, as the storyworld is "created out of the improvisation and negotiation of thousands of disparate communities and hundreds of individual writers and artists over more than a millennium" [Hawes and Smith, 2020, p. 5]. The plethora of complex connections between entities in the Greek mythic storyworld, and the inherent contestation that occurs with multiple renditions of the same story is what makes Greek myths so intriguing and dynamic, but this in turn makes them difficult to quantify. MANTO challenges these difficulties, by drawing inspiration from existing source texts to generate the optimal ontology for the database. By doing so, we can simplify the process of generating a set of interfaces that appeal to those in the humanities. MANTO is able to not only recognise, but also highlight the inherent messiness that is prevalent in Greek myths, and in turn visualises the genealogical aspects of these complexities in a manner befitting to the digital realm.

3.1.2 MANTO's linked data structure

The ontology for MANTO is outlined in the MANTO Bible [Hawes and Smith, 2020]. MANTO is a disambiguated dataset of named entities, each with a unique id, collected from a set of antique texts depicting Greek myths. The MANTO databases are stored on NodeGoat, and contain several sub-databases with supporting information for the connections. Three of the MANTO databases used for this thesis are: *Entities*, *Passages*, and *Ties*. Each cell in each database has a corresponding automatically-generated MANTO ID, which can be cross-referenced with other MANTO-generated databases to extract relevant information. For example, the MANTO ID for an entity *X* in the *Ties* database, can be found with the same MANTO ID in the *Entities* database.

The *Ties* database contains a list of every connection, or "tie" that occurs within the reference texts. Each tie contains the following information: *Passage Start* and *Passage End*, *Subject*, *Predicate*, *Direct Object*, *Indirect Object*. In essence, they record who did what action, and possibility with whom, in which place. It also associates the connection with the text and passage that it came from.

There is a predefined list of predicates that are permitted, curated by Dr Greta Hawes. These are grouped into several different categories, such as blood relationships, birth, death, transformations, interactions and physical altercations. These predicates are actions conducted by entities, and are in the form <*Subject*> <*Predicate*> <*Direct Object*> (<*Indirect Object*>). Examples include "X fights Y", "X takes form of Y", and "X gives in marriage Y to Z".

Entities is a database of all discovered entities in the mythical universe. These are

manually added when entering each connection from the text, to discourage bias for more popularized entities. If the entity exists in the text, then there is an entity object assigned to it in MANTO. There are many types of entity, which are represented by their commonly-recognised forms in the mythic world. These encompass agents (any entity that has agency, such as immortals, mortals, hybrids and monsters), collectives (recognisable groups of agents), objects, landmarks, places and events. As this project's focus is on genealogy, it will use the entities of type *agent* and *collective* as its primary entity data set. Each entity row has attributes such as *name* (as well as all its alternative names), *identifying information*, and *type*, and each type of entity has a different set of additional attributes, such as *gender* for agents and collectives.

Passages is a database of all references and passages used in the MANTO ties. These are essential for linking back to a digital copy of the original text in ScaifeViewer (Scaife.perseus.org) through URN links.

3.2 Modifications to the Data Structure of MANTO

The MANTO ontology is the product of iterative development and is still being altered. It has strongly benefitted from insights gained through this project. In the process of visualising this data, I have suggested improvements to the data structure which have been implemented across the ontology. These changes have had the advantage of simplifying both the data structure, and the data collection process.

The data in MANTO is collected and imported manually by a team of researchers from the Australian National University and the University of New Hampshire. Data collected in this manner is painstakingly comprehensive, however it can also be prone to human error. As such, some connections could be repeated, some ties from the text could be overlooked, and the preference for lower-level information import could overlook healthier higher-level alternatives for database structure.

Originally, the gender of entities was stored as a connection in the Ties database. In other words, "is female/male/undefined" was an identified predicate. If an entity named X was listed as female in the original text, then "X is female" would become a connection that is entered into the *Ties* database. This made searching for the gender of an entity – as well as the gender of its individual parents – an unnecessarily arduous task, especially since every entity in the Greek mythic storyworld only has one corresponding gender. To address this, I proposed a move of all gender ties in Ties to the Entities database as a new column.

After the move, I realised *Ties* could be abstracted away from gender entirely, as every entity in *Ties* also existed within *Entities* so gender could be easily cross-referenced. This also limits the number of genealogical comparisons required on the website frontend. Consequently, all cases of gendered identity were removed from *Ties* and replaced with a more generic predicate. For example, "is daughter of" and "is son of" became "is child of". All cases of "is sister/brother of", "is wife/husband of", and "is father/mother of" were changed to "is sibling of", "is spouse of", and

"is parent of", respectively.

Connections that had a relational difference of greater than one were truncated. The original MANTO ontology had "is grandparent/grandfather/grandmother of" and "is grandchild/granddaughter/grandson of" predicates, yet this could easily be inferred from the other connections in the database. For example, if "X is parent of Y" and "Y is parent of Z" exists in the database, then "X is grandparent of Z" is a superfluous connection. This would however, be beneficial in theory if either the parents were unknown or the "is grandparent of" connection was consistently used, however more often than not, direct connections such as parents and children are used, and grandparents are merely inferred. In a similar calibre, other indirect relations in the original MANTO ontology were also removed, for example "is aunt/uncle of" and "is nephew/niece of", as these could be directly inferred from siblings of parent connections.

Ambiguous pseudo-generational relationships were removed, such as "is older/younger than" and "is companion of", due to their lack of specificity and overall use.

Duplications or confusing representations of the same idea were removed to ease the filtering process. For example, the predicate "creates" was originally used to denote both the creation of agents and the creation of objects. This resulted in confusing outputs as object creation – a far more common occurrence in Greek myth – became synonymous with the unusual birth type "created by an agent". Hence, the creation of a new predicate "creates [agent]" for cases specific to unusual birth.

After all these modifications were made, I suggested further modifications for efficiency. I realised that the predicate "is parent of" is superfluous when "is child of" exists. As such, all "is parent of" connections were flipped to "is child of", a simple task as the remaining attributes in the connection (passage references, involved entities) remained the same. This also revealed previously undiscovered cases of repetition within the database, as the same parent-child connection could have been referenced in two different passages in different formats. This simplified the relationship-filtering process on the frontend.

These alterations were impactful, but this project commenced after a large part of Apollodorus' *Library* and *Epitome* had already been entered, therefore most of the changes took place reactively and were primarily used in later connections. An attempt was made by the MANTO team to filter through and modify existing connections, however due to human error some of these connections were missed. For example, at the time of this thesis submission, some "is parent of" connections still existed in the updated database, so the frontend still had to conduct some filtering and reversing of these connections in post. It is also worth acknowledging that this database is constantly being updated, so these predicates may change once even more reference texts are entered.

3.3 Extraction of Genealogical Information from MANTO

Genealogical data was extracted from the MANTO database in the following manner. The codebase used for both the extraction and the development of the frontend can be found at: https://github.com/yayalu/greekgraphs/. The accompanying live digital artefact can be found at https://yayalu.github.io/greekgraphs.

3.3.1 Exporting the relevant MANTO databases

The *Ties* database was exported from NodeGoat as a Comma-Separated Values (CSV) file. The *Passages* and *Entities* files were also exported to assist with cross-referencing for each of the relations. As the frontend was to be coded using various JavaScript frameworks, all of these files were converted from CSV to the more JavaScript-compatible format JSON. The keys for *Entities* and *Passages* were their respective MANTO IDs, whereas the *Ties* JSON file used a rudimentary iterative index as its keys because the order was unimportant. The choice of JSON as opposed to more commonly recognised genealogical data structures such as GEDCOM was purposeful, due to the highly restrictive nature of GEDCOM as mentioned in Section 2.4.

A file named *relationshipsPopulator* uses a JS file *DataCardsHandler* to iterate through all entities in the *Entities* database, and creates a *relationships* JSON file containing all the relationships of each entity. In other words, the entity MANTO IDs are the keys, and the values are all the relationships discovered for that entity based on the *Ties* database. By generating the *relationships* JSON file only when the original database CSV is updated, we save valuable rendering time, and increase the efficiency of information retrieval. Now, all relationships for an entity can be accessed directly from the frontend using their MANTO ID in *relationships*, without needing to search through the entire list of ties for each new entity page.

3.3.2 Filtering MANTO for genealogical predicates

The following are the predicates used in *DataCardsHandler* to filter for genealogical connections. Only the direct genealogical connections of each entity are in their respective relationship objects, as extra degrees of separation could be inferred from the relationships of their own relations.

Parental connections: "is child of" is the primary predicate for parental connections since it is "is parent of" but reversed. However, "is parent of", "is mother of", or "is father of" is still checked in case of human error during conversions to "is child of" in the original database. This is one of the few relations where gender is also important, as some of the unusual births only conflict with specific parent genders.

Child connections: "is child of" is the primary predicate used here. This is directly impacted by the predicate "has no children", where an entity dying without children is a significant part of the storyworld potentially rife with contestation, see Section 2.1.5.

```
let familyTies = [
  /* Parent */
  "is father of",
  "is mother of",
  "is parent of",

  /* Child */
  "is child of",

  /* Sibling */
  "is sibling of",
  "is twin of",

  /* Spouse */
  "is spouse of",
  "marries",
  "gives in marriage [dir. obj.] [ind. obj.]",

  /* Member (agent) of collective */
  "is member of",

  /* Member (collective) of collective */
   "is part of",

  /* Unusual relationships */
  "is born by autochthony [in/on/at]",
  "comes into being",
  "creates [agent]",
  "is mother by parthenogenesis of",
  "is born from [object]",

  /* Terminal point: dies without children*/
  "has no children"
];
```

Figure 3.1: A list of all predicates used to extract genealogical data from MANTO

Sibling connections: "is sibling of" and "is twin of". Note that "is twin of" is a separate predicate as twin relationships are particularly notable in the Greek mythic storyworld.

Spousal connections: "is spouse of", "marries" are the primary predicates. These are distinguishable in Ties, as "is spouse of" is often a statement by the author about an entity's existing marital status, whereas "marries" is an action that occurs in the storyline in which "is spouse of" is later inferred. "gives in marriage [dir. obj.] [ind. obj.]" is also included to a similar effect.

Membership connections: "is member of" is used for agents in a collective, and "is part of" is for collectives within collectives. Although not strictly genealogical, an entity's relationship with their collective – if they have one – can be so integral to their identity that it can be considered familial.

Unusual connections: This particular aspect of genealogy cannot be overlooked, especially in Greek myths. This is because these unusual connections often contradict the expectations of genealogy, and also conflict with parentage and offspring. These predicates include "is born by autochthony [in/on/at]", "comes into being", "creates [agent]", "is mother by parthenogenesis of", "is born from [object]". More details about these unusual connections can be found later in this chapter, or in Section 2.1.2.

3.3.3 Restructuring and optimising the filtered genealogical data

The process of filtering the *Ties* for these predicates is as follows:

Suppose the entity in focus is named X, and the name of the entity also listed in the connection is named Y. Referring back to the structure of each tie in the *Ties* database, we have <*Subject*> <*Predicate*> <*Direct Object*> (<*Indirect Object*>). Depending on the order in which the original author chose to write the connection, the connection inputted into the Ties database could be either "X <*Predicate*> Y" or "Y <*Predicate*> X". There could even be an indirect object in the connection, for example in "gives in marriage", where a connection could be listed as "Z gives in marriage Y X". In other words, Z gives Y to X in marriage, so it is inferred that Y and X are spouses. This meant that all connections needed to be filtered for genealogical predicates, as well as where X was either the subject, the direct object, or the indirect object. The other entity Y would then be added to their relevant fields in the relationship object for X.

Sometimes the relationships between entities were inferred and therefore needed to be made explicit. For example, if two entities (X and Y) were listed as siblings in the original MANTO file, naturally they would both have the same parents. However due to human recording error, sometimes only X had explicit parent ties (such as "A is parent of X", "B is parent of X") and Y had none. Extra comparisons were needed to ensure that Y also had these parent attributes recognised, and also vice versa; for A and B's recognition of Y as a child.

To store this information, there were five main data types created:

- *passageInfo*, an object that stores the URN, passage start, and passage end of a connection
- *entityInfo*, an object containing the name, NodeGoatID, passage reference/s, and type of the entity.
- *childrenInfo*, an object containing a list of children and a list of other parents. This is to address cases of multiple children being born to an entity, and to someone who is not their wife or partner.
- *relationshipInfo*, which combines all the genealogies into one object. Note that it includes some of the unusual genealogies as well, such as CREATOR and BORN FROM.
- *returningInfo*, which returns all the information for a specific entity, including its own name, id, type, *relationshipInfo*, membership of a collective (if any), and its connection to an unusual circumstance.

3.4 Conversion to a publicly accessible platform

A primary goal of this project is to provide public access to all genealogical data from MANTO. To do this, once we extracted the MANTO genealogical data using

```
type passageInfo = {
  start: string;
  startID: string;
  end: string;
  endID: string;
};

export type entityInfo = {
  target: string;
  targetID: string;
  passage: passageInfo[];
  type: string;
};

type childrenInfo = {
  child: entityInfo[];
  otherParentIDs: string[];
};

export type relationshipInfo = {
  MOTHERS: entityInfo[];
  FATHERS: entityInfo[];
  PARENTS: entityInfo[];
  CREATORS: entityInfo[];
  BORNFROM: entityInfo[];
  SIBLINGS: entityInfo[];
  TWIN: entityInfo[];
  SPOUSES: entityInfo[];
  CHILDREN: childrenInfo[];
};

type returningInfo = {
  id: string;
  relationships: relationshipInfo;
  name: string;
  members: { sub: any[]; super: any[] };
  type: string;
  validSearch: boolean;
  unusual: {
    autochthony: { tf: boolean; passage: passageInfo[] };
    createdWithoutParents: { tf: boolean; passage: passageInfo[] };
    createdByAgent: { tf: boolean; passage: passageInfo[]; agentID: string };
    parthenogenesis: { tf: boolean; passage: passageInfo[] };
    bornFromObject: { tf: boolean; passage: passageInfo[]; objectID: string };
    diesWithoutChildren: { tf: boolean; passage: passageInfo[] };
  };
};
```

Figure 3.2: A list of all JS objects used to store the extracted genealogical data from MANTO

the methods above, we developed a public-facing website to display this information. The website, data cards and graphs were developed bespoke for the purposes of this project; designed and implemented in consistent consultation with researchers, teachers and students of Greek myth (see the following sections, as well as Sections 4.3 and 5.3).

At the time of this thesis, the live link for the project website is at https://yayalu.github.io/greekgraphs, but this may be relocated to a different website hosting platform in the future. The frontend for the website was developed using a combination of ReactJS and TypeScript with SCSS, built with NodeJS. The intricacies of the display will be the focus of this section.

3.4.1 Design motivations and generous interfaces

Having looked at what is currently available in Greek mythology resources, there is an obvious desire to not only have textual representations of the storyworld, but also visual ones. Most reference texts have some form of graphical representation of genealogies to support the text, revealing an inherent desire for genealogy visualisation, or at least, a more structured and coherent representation of genealogy. Additionally, displaying multiple data formats could provide different learning outcomes for users.

We believe that the desired format for a public-facing reference website is intuitive, minimalistic and searchable. In addition, referencing Mitchell Whitelaw's philosophy of Generous Interfaces [Whitelaw, 2012], the interface should provide a variety of navigation options so the user can choose any number of methods to reach their desired outcome. We also wanted to encourage the rabbit-hole effect; the idea that the user is so intrigued by the information presented to them that they continue to navigate through more and more redirections out of pure interest. Some of the navigations we wanted were:

1. An ability to search for agents or identifying information of agents so users can be led to the pages they want
2. A tailored URL for each entity for quick-reference ability, in the format https://yayalu.github.io/greekgraphs/#/datacards?id=<EntityID>
3. The ability to redirect to a relative's page by clicking on links in an entity's genealogy list
4. The ability to redirect to a relative's page by clicking on links in an entity's graph
5. Redirection to entities with similar unusual relationships when unusual relationships are revealed.

The implementation of the graph is detailed in Chapters 4, 5 and 6. The rest of the website functionality (search function and data card formats) are discussed in the following sections.

Figure 3.3: MANTO homepage with a search facility

3.4.2 Search function

To ensure that genealogies can be accessed in an intuitive and familiar manner, a search function was added to the website. We wanted the website to address the flaws in other previously-discussed digital representations of Greek mythology, where there is only a generic overview of genealogical information and no tailored visualisations. Naturally, a search function where the user can enter a name or an identifying attribute would be more useful to locate a specific entity's data and graphs.

The search facility is the first item that greets the user when they enter the website link: https://yayalu.github.io/greekgraphs (Figure 3.3). It uses the standard search algorithm employed by the HTML search bar, which outputs the results alphabetically by name. This is problematic with an entity such as Zeus, where "Zeus: Olympian god" would appear much lower in the search results than someone such as "Adrasteia: Nurse of Zeus". Ideally, the search should be modified for name as a priority, then the greatest textual match with identifying information. This is an issue which should be resolved, however this is lower priority than the design of the data cards and graphs themselves, so this has been pushed back to a Future Work item.

Each of the search results contain the name of the entity, a list of alternative names, and identifying information. The entity's MANTO ID was omitted from the search results as this is not a meaningful attribute, and this ID can also be used to directly access the entity's page through the URL. The name of the attribute is an important search term for obvious reasons, and alternative names are necessary due to different transliterations from the Greek and translations (e.g. into Latin) and different authors using different forms of an entity's name. Identifying information was added for extra context to the entity – e.g. if X was known famously as son of Zeus, then typing Zeus would result in an appearance of X – and for distinguishing between different entities with the same name.

3.4.3 Data cards and content

Each agent in the MANTO database has ties which capture their genealogical connections. One aim of this project is to display this raw data in a systematic way, thus creating "data cards". These data cards take inspiration from previously mentioned websites with index cards such as Theoi.com and Wikipedia. This is an attempt to induce familiarity in the user, as well as provide all genealogical information in a concise, recognisable format.

The data cards are tailored to the entity type. In MANTO, the information is grouped into three distinct categories. According to the MANTO Bible [Hawes and Smith, 2020], there are multiple types of entities: agents, collectives, objects, landmarks, places and events. The ones relevant to genealogy in the scope of this project are the entities with agency, such as agents and collectives. In the case of unusual relationships, objects or places can be part of the genealogy (e.g. autochthony and born from a body part), but as they are not agents or collectives themselves, they do not have a dedicated data card in this project.

The categories of entity applicable to genealogy are as follows:

Agents: Person-like entities with agency, e.g. gods, heroes and monsters

Collectives (Episodic): Groups of agents linked by an event or task, who often disband once the task completes. This is a collective that is entirely non-genealogical, however they are still notable groups of entities and thus can be used as a navigation tool between different agents in its list of members. An example is the Greek contingent at Troy (ID: 81900500).

Collectives (Genealogical): Groups of agents identified strictly by their identical genealogy. For example, the Sons of Lycaon (ID: 9615105) where their primary identifying feature is that they are the children of Lycaon.

Collectives (Miscellaneous): Groups of agents that may or may not have a strictly-genealogical connection, but who have a primary connection with each other outside of genealogy. An example is the Centaurs (ID: 8187970), who are more commonly identified as a collective due to their hybrid horse-human nature, rather than their genealogical connection. Note that in this particular example, all of the Centaurs have the same parent apart from Chiron who was born to a different agent.

3.4.3.1 Agent data cards

Agents are the most common entity type in the MANTO dataset, and they are also the most comprehensive in terms of genealogy. At the top of the card is the name of the entity, along with its alternative names. The MANTO ID is also on the card for ease of reference, and the gender of the entity is also added if applicable.

Below that is the genealogical connections for the entity. The names in each connection redirect to that entity's page when clicked, and some also have relevant passage links to Scaife Viewer to show where that information appears in the original text. Each agent data card contains the following information:

Figure 3.4: MANTO website data card for Eurypylos, grandson of Heracles (ID: 8188361)

Figure 3.5: Example of contested parentage in the MANTO website, using the data card for Asopos, river god in Sicyon (ID: 8187838)

Grandparents (added in response to the first round of user interviews): In many cases, an agent is known for being a descendant of a god or a famous mortal, but these connections are not direct relations. By providing an ancestry of depth 2 (aka. grandparents) in the data cards, this provides some perspective for an entity's significance. For example, Eurypylos is not an instantly-recognisable entity, nor is his father Telephos, but his grandfather is Heracles, which immediately puts his significance in the mythic storyworld into perspective (Figure 3.4). The grandparent connection does not have associated passage references, as this relationship is inferred from the text (i.e. is parent of parent).

Mother and Father: This is one of the few attributes that are gendered. The nature of "mother" and "father" as opposed to just "parent" is significant, since an entity only has one mother and one father in Greek mythology. By separating the parents into two genders, we can emphasize the occurrence of contested parentage, i.e. when there is more than one recorded mother or father. The only exception is "divine father", where an entity has two fathers – one mortal and one divine – but this is still two conflicting perspectives on parentage. As a result, these connections have passage references to demonstrate where the dispute is shown within the texts, as well as how many references support one parentage over another. This is shown in the data cards as an "OR" relation (Figure 3.5).

Siblings: This is a non-gendered relationship since we decided that listing all siblings together is preferable to having separate lists of brothers and sisters, because the fact of a sibling relationship is more integral to the myth than its gendered dynamics. For all cases in which the sibling predicate "is sibling of" is

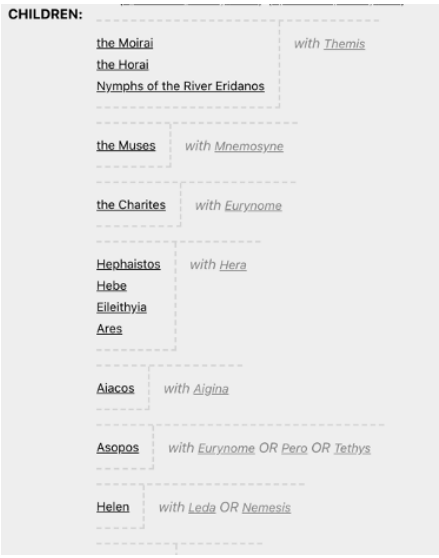

Figure 3.6: Example of child grouping in the MANTO website, using a snippet of the data card for Zeus, an Olympian god (ID: 8188419)

directly listed in the MANTO *Ties* database, the passage reference is to its occurrence in the original text. Alternatively, when the sibling relationships are indirectly inferred from mutual parentage, the passage links are to the birth of the main entity, as the original authors often list all children of an entity in the same phrase.

Twin: This is similarly non-gendered, but is a separate attribute since twin-relationships are significant to the storyworld of their own accord., and collected specifically at the data collection stage, i.e. this is a direct visualisation of a specific tie.

Children: Children attributes are particularly unique, as often an entity's children are not the product of the relationship with their spouse, and there can be multiple children per relation. As such, children are grouped by the other co-parent, in the knowledge that this parentage can also be contested (Figure 3.6).

3.4.3.2 Episodic collective data cards

Since there are minimal genealogical connections between agents in an episodic collective, this is used purely as a navigation waypoint for the entities within the collective. Consequently, it contains none of the genealogical tags (e.g. Mother, Father, Children) that the agent cards do, however it does contain a list of members. There are passage references for these memberships as well as links to the relevant member's page. Note that – as shown in Figure 3.7 – episodic collectives can be members of other collectives as well.

THE GREEK CONTINGENT AT TROY

MANTO ID: 8190050

MEMBERS:

Amphilochos (Apollodorus, *Epitome* 6.19)
Anticlos (Apollodorus, *Epitome* 5.19)
Antilochos (Apollodorus, *Epitome* 5.3)
Calchas (Apollodorus, *Epitome* 3.15)
Echion (Apollodorus, *Epitome* 5.20)
Epeios (Apollodorus, *Epitome* 4.8)
Euryalos (Apollodorus, *Library* 1.9.13)
Leonteus (Apollodorus, *Epitome* 6.2)
Palamedes (Apollodorus, *Epitome* 3.7)
Sinon (Apollodorus, *Epitome* 5.15-5.19)
Talthybios (Apollodorus, *Epitome* 3.9)
Teucros (Apollodorus, *Epitome* 5.5)
the Aitolian contingent at Troy (Apollodorus, *Epitome* 3.11-3.14)
the Arcadian contingent at Troy (Apollodorus, *Epitome* 3.11-3.14)
the Argissa contingent at Troy (Apollodorus, *Epitome* 3.11-3.14)
the Argos contingent at Troy (Apollodorus, *Epitome* 3.11-3.14)
the Athenian contingent at Troy (Apollodorus, *Epitome* 3.11-3.14)
the Boiotian contingent at Troy (Apollodorus, *Epitome* 3.11-3.14)
the Cephallenian contingent at Troy (Apollodorus, *Epitome* 3.11-3.14)
the Cos contingent at Troy (Apollodorus, *Epitome* 3.11-3.14)
the Cretan contingent at Troy (Apollodorus, *Epitome* 3.11-3.14)
the Cyphus contingent at Troy (Apollodorus, *Epitome* 3.11-3.14)
the Cyprian contingent at Troy (Apollodorus, *Epitome* 3.9)
the Doulichion contingent at Troy (Apollodorus, *Epitome* 3.11-3.14)
the Epeian contingent at Troy (Apollodorus, *Epitome* 3.11-3.14)

Figure 3.7: Example of an episodic collective representation in the MANTO website, using the data card for The Greek Contingent at Troy (ID: 8190050)

3.4.3.3 Genealogical collective data cards

Genealogical collectives are defined by their mutual genealogical connection (refer to Section 2.1.4). All members share at least one parent, and there is no dispute over the identity of this parent. Often this parent is used as part of the name of the collective (e.g. The Sons of Aigyptos) or is some derivation of the parent's name (e.g. The Danaids, daughters of Danaos). For ease of navigation, this parentage is listed in the subheading of the data cards, and also redirects to the parents themselves (Figure 3.8). Similarly to episodic collectives, members of the genealogical collective are also listed at the bottom of the data card along with their passage references. Note that gender identity is shown in the data card to provide extra context for the collective, where "Female" and "Male" indicate that all members have the same gender, and "Undefined" denotes mixed gender collectives.

3.4.3.4 Miscellaneous collective data cards

Miscellaneous collectives are collectives that do not fit into either the Episodic or Genealogical category. Often their primary defining characteristic is not genealogy-based, but rather based on appearance (e.g. The Centaurs, The Hundred-Handers, The Gorgons) or the role they play in the mythic universe (e.g. The Sirens, The Muses). Other cases of miscellaneous collectives are those who cannot be made genealogical due to contested parentage. To make this contestation particularly apparent, the standard genealogical attributes from the Agent data cards are also added to these cards (Figure 3.9).

Like genealogical collectives, the gender of a miscellaneous collective is shown in their data cards as "Undefined" if it is mixed gender, else it is "Male" or "Female".

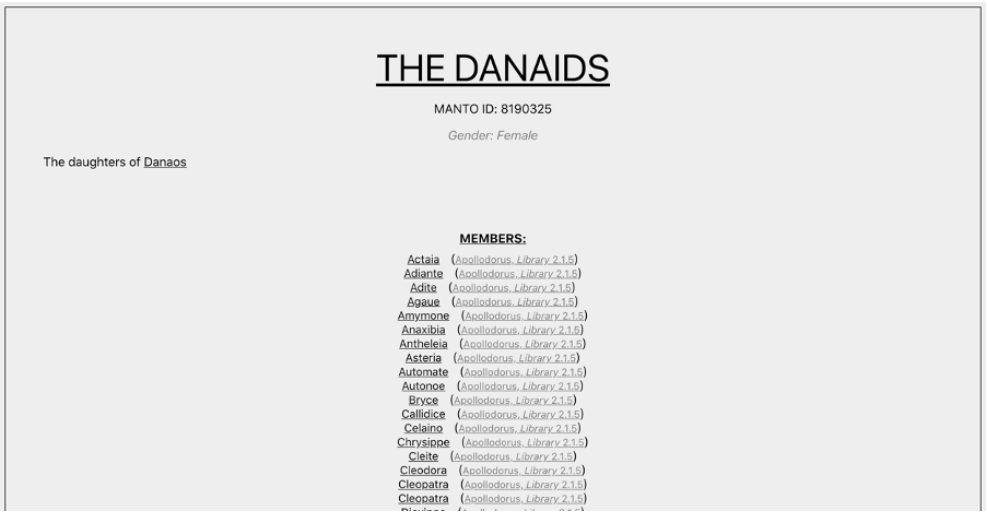

Figure 3.8: Example of a genealogical collective representation in the MANTO website, using the data card for The Danaids, daughters of Danaos (ID: 8190325)

Again, members of the collective are listed in the bottom of the data card with passage references and links to each of their respective pages for ease of navigation.

3.4.3.5 Representation of unusual relationships within data cards

As previously discussed, it is essential that the interface not only accommodates, but highlights the occurrence of unusual relationships. As these unusual relationships are arguably more visually impactful than textually impactful, the focus of these connections will be in the graphs, not the data cards. The data cards are used merely as a reference tool under these circumstances.

Autochthony: If an entity is born by autochthony, they do not have a mother and father (Figure 3.10), unless the autochthony aspect is contested (Figure 3.11) (refer to Section 2.1.2.1). Under these circumstances, it is natural for the mother and father attributes to be overridden by "autochthony". In future iterations of the prototype, autochthony may also be associated with landmarks or places.

Parthenogenesis: The only occurrence of parthenogenesis in the Apollodorus dataset is the relationship between Hera and her son Hephaestus. Hephaestus was born by Hera through parthenogenesis, but in other versions Hephaestus is the child of Hera and Zeus (refer to Sections 2.1.1, 2.1.2.5, and 2.1.2.6). Since parthenogenesis is only dependent on the mother, the father is the only part in dispute. As such the Father attribute will have the dispute expressed "OR by parthenogenesis" but the mother attribute remains intact (Figure 3.12).

Creation without parents: In a similar calibre to autochthony, the emphasis for "created without parents" is – naturally - that there are no parents in this connection (refer to Section 2.1.2.4). However, we do not omit the Mother and Father attributes entirely since we need to distinguish these unusual circumstances from occasions where the mother and father do exist, but they are unknown (Figure 3.13).

Figure 3.9: Example of a miscellaneous collective representation in the MANTO website, using the data card for The Muses, the personification of poetry and music (ID: 8189170)

Figure 3.10: Example of a data card representation of "autochthony" in the MANTO website, using Cecrops, first king of Athens (ID: 8187960)

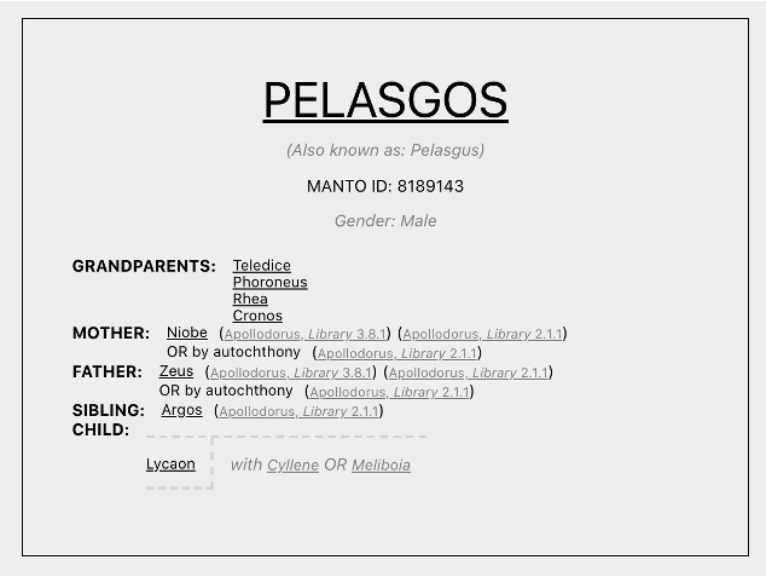

Figure 3.11: Example of a contested data card representation of "autochthony" in the MANTO website, using Pelasgos, eponym of the Pelasgians (ID: 8189143)

Figure 3.12: Example of a data card representation of "parthenogenesis" in the MANTO website, using Hephaistos, Olympian god (ID: 8188476)

Figure 3.13: Example of a data card representation of "created without parents" in the MANTO website, using Ge, personification of Earth (ID: 8188388)

Figure 3.14: Example of a data card representation of "created by an agent" in the MANTO website, using Pandora, the first mortal woman (ID: 8189114)

Created by an agent: Here, the creator – an agent - is just as important as a mother or a father in the birth of the entity (refer to Section 2.1.2.3). Since they are neither a biological mother or father, the attribute of Mother or Father cannot be used. As such we have an alternative attribution "Creator" for entities created by someone through non-biological means (Figure 3.14).

Born from an object: Similar to "created by someone else", "born from an object" is a significant genealogical connection as it details the entity's origin, even if it is not biological. Unlike "created by someone else", however, this entity does not originate from an agent; rather, an object, or a body part of an agent (refer to Section 2.1.2.2). Often this occurrence is significant enough to the Greek mythic storyworld that the object itself is created as a separate entity in the MANTO data structure. As an example, Athena sprang from the head of Zeus fully-formed and fully-armoured [Apollodorus, p. 1.3.6] so the Head of Zeus is created as a notable object commonly

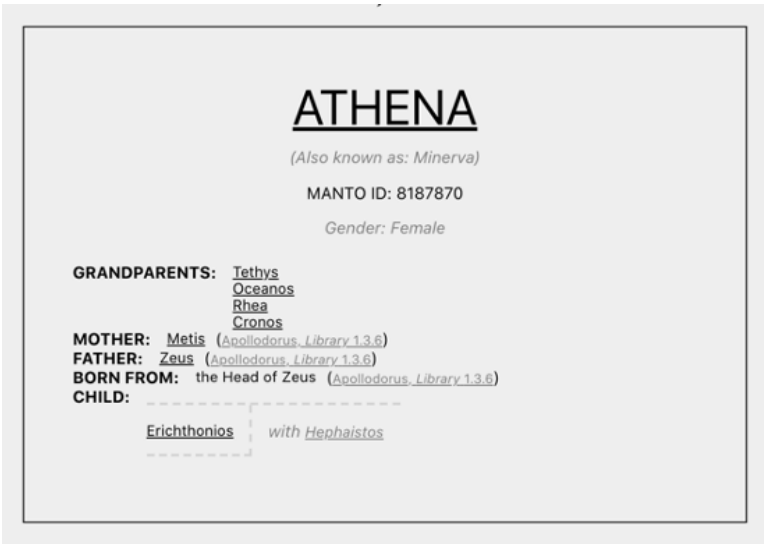

Figure 3.15: Example of a data card representation of "born from an object" in the MANTO website, using Athena, an Olympic god (ID: 8187870)

associated with the birth of Athena, but the agent Zeus is still considered her father (Figure 3.15).

Dies without children: Dying without children is not an unusual occurrence in Greek myths, however it can have a significant contribution to the storyworld as mentioned in Section 2.1.5. We want to emphasize that the entity has no children, or make it obvious that the idea of the entity having children is contested. To do so, we place the "dies without children" tag in the children section, and if this is contested, then the two sections are separated by an "OR" (Figure 3.16).

3.4.4 Other additions

The logo was generated in Adobe Illustrator. The Labyrinth maze in the background was extracted from an embossed image on an ancient Greek coin. This is particularly relevant to Greek mythology as labyrinths are recognisable landmarks from Greek myths.

3.5 Summary

In this chapter, we explained how we converted raw genealogical data from the MANTO ontology into a publicly-accessible web platform. In the process we detailed the extraction of the genealogical data from MANTO, the design of the data cards and search function to highlight the complexities of the source material, and how the ontology itself was modified in response to this project.

Figure 3.16: Example of a data card representation of "dies without children" in the MANTO website, using Asterios, king of Crete (ID: 8187843)

Chapter 4

Graph Design Phase 1

In this chapter, we design and review the first set of prototypes for MANTO's genealogical graph layout. In Section 4.1 we restate the motivations behind the development of a graphical interface for Greek myth genealogies. Section 4.2 explains the development process and design considerations for the first two prototypes, as well as a list of alternate graph layouts and proposed user interactions with the graph. Section 4.3 describes the design process for the first round of user interviews, and Section 4.4 accumulates the findings from said interviews. Finally, Section 4.5 concludes this chapter.

4.1 Motivations

As discussed in Sections 1.2 and 2.2, hierarchical genealogical trees - otherwise known as pedigree charts - are the most familiar format for visualising genealogies. These standard graph formats function more as a directed acyclic graph (DAG) than a traditional tree structure, especially as additional nodes are added throughout the tree to represent spousal connections. Designing and developing a genealogical graph structure that is also able to highlight the complexities of Greek myth is a worthwhile endeavour, as by doing so we can generate an alternative method for navigating the Greek mythic storyworld. Similarly, we postulate that highlighting these connections could provide much-needed insights for researchers and students studying Greek myth.

To substantiate these claims, it was necessary to conduct some user interviews with researchers and students in the field of Greek and Latin literature. This is our primary user base, as their background suggests an investment in Greek and Latin literature, addressing our third research question. This was also an opportunity to discuss their most desired features of a genealogical interface, and ensure the interface we develop is of a format beneficial to them.

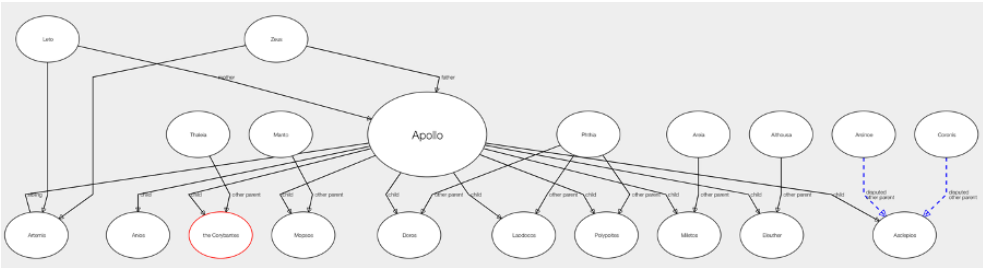

Figure 4.1: Prototype 1: a dynamically-generated hierarchical DAG built using dagre-d3. Example: the immediate ancestors and descendants of Apollo, Olympian god

4.2 Initial Prototypes and Design

Two initial prototype graphs were developed to test for the most intuitive formats for Greek genealogical graphs. Both initial prototypes were primitive, and also used opposing out-of-the-box open-source graphing solutions to test their adaptability for Greek myths.

4.2.1 Prototype 1

The first prototype's focus was to test out-of-the-box open-source directed acyclic graph layout solutions for applicability with Greek myth. For this, we used dagreD3: a JS library that renders hierarchical DAGs using D3.js; the format closest to the genealogical formats proposed by existing genealogical software such as GraphViz.

Each graph was designed to render automatically for each entity on each of their respective pages. The focus of each of these graphs was to show maximally one generational degree from the entity, which could be expanded to several generational degrees in future iterations of the project. As the entity was the main focus node, the graph was divided into three generational layers, cascading vertically like in most existing genealogical charts. The first layer held the direct ancestors (i.e. parents), the second layer held the entity itself, as well as its siblings, spouses, and the other parents to their children, and the third held the direct descendants (i.e. children). These layers were generated using the D3-compatible data structure GraphLib, which stored information such as nodes and the connections that link them.

The graphs also highlighted the different types of complex connections such as contested tradition, unusual birth, and incest. To emphasize these connections, they were expressed in different colours. In this case, blue lines were contested, red lines were unusual birth and incestuous connections (Figure 4.1).

There were several issues that were made immediately apparent with this graph-generation tool. Despite its emphasis on stylistic customizability – such as node shapes and line colours – the layout algorithm was ingrained and unmodifiable. There was no ability to modify the node hierarchies, nor was there an option to modify the points in the line to create more t-shaped connections (useful for representing a singular connection between two parents and their child). These

factors make sense in the context of normal DAGs, as by adhering to an internal layout algorithm the system is able to render the graph nodes in a uniformly-separated manner with minimal overlap. However for the purposes of this project, this made the graph confusing and messy.

Regular DAGs also have only two requirements for their data structures: each connection must have maximally two nodes on either side, and the connection must be directional. This in theory would be sufficient, since genealogical charts are inherently hierarchical (parent->child, for example). Unfortunately, the issue became more apparent when inputting same-level connections, such as sibling->sibling, and spouse->spouse. The inherent directionality of this graph data structure, and the inability to modify the layout of the graph, meant that sibling relations and spousal relations became unnecessarily hierarchical. In other words, they were mistaken by the D3 layout algorithm for parent->child connections, and the final graph rendered the spouse of the main entity at the same level as the child connections. An example is Figure 4.2, where the forced directionality of the sibling connection from Apollo to Artemis dropped the Artemis node to the same level as Apollo's children, which gave the incorrect impression that Leto and Zeus gave birth to a descendant of Apollo rather than his sister. The directional arrow could be removed, but this was a purely stylistic change and the underlying directional nature of the graph data structure remained unchanged.

The inability to render a t-shaped connection had other disadvantages as well, which made it difficult to discern combined parentage. In order to establish a co-parent relationship, each parent node needed to be attached individually to each child, with no explicit spousal connection between them due to the enforced directionality described above. Consequently, without the connection labels "father" and "mother", it was hard to determine that Leto and Zeus were both parents of Apollo, and similarly of Artemis (Figure 4.2). This was also problematic due to the space these multiple distinctive lines took up in the graph – the four separate lines between Apollo, Artemis, Leto and Zeus could have easily been represented by a singular connection like in existing pedigree charts.

Regardless, this first prototype – despite its perceived flaws – was worth conducting user tests on, as it was possible that these could prove intuitive to other researchers.

4.2.2 Prototype 2

After testing this out-of-the-box solution, we decided to generate a graph where we had more customizability over the layout. To do so we used the HTML canvas element to generate a primitive graph-rendering tool that dynamically produced graphs for each entity according to our own designed genealogical layout. The purpose was to see if we could design a bespoke yet familiar layout that also accommodated Greek myth complexities.

We decided we could not employ the standard t-shaped pedigree chart layouts used in other genealogical charting systems, due to the number of connections that

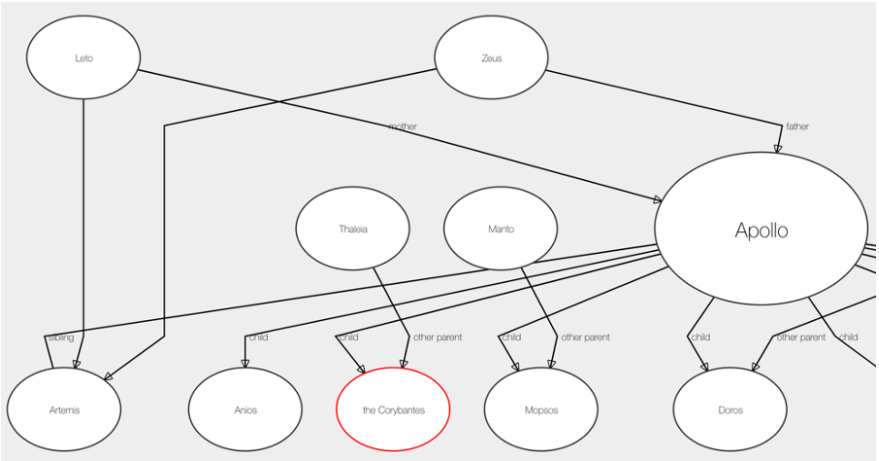

Figure 4.2: Prototype 1: the lack of t-shaped connections and the forced directionality results in unintuitive node layouts (e.g. Artemis at Apollo's child depth)

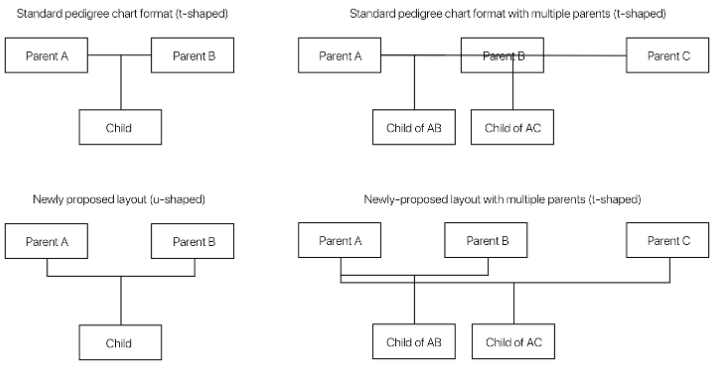

Figure 4.3: The standard t-shaped connection used by traditional pedigree charts, and our newly-proposed staggered u-shaped layout for Prototype 2

some mythical entities had. For example, Zeus had upwards of 40 children with 30 different women, so the overlap in edges would have made each connection unreadable. We could have used more edge minimisation algorithms to reduce the number of overlapping edges, however even this would not accommodate the number of connections involved in Zeus' relationships. In response, we developed a staggered u-shaped connection between entities and their significant others, where the middle point extended downwards towards the children (Figure 4.3 and 4.4).

We originally considered distinguishing spousal relationships from co-parent (aka. not married) relationships but realised that in the context of Greek myths, this distinction has very little meaning.

By having this new u-shaped, staggered style, the complexities in the graphs were also more obvious. For example, in accommodating unusual relationships, the unusualness of being born from a non-agent could be represented by icons

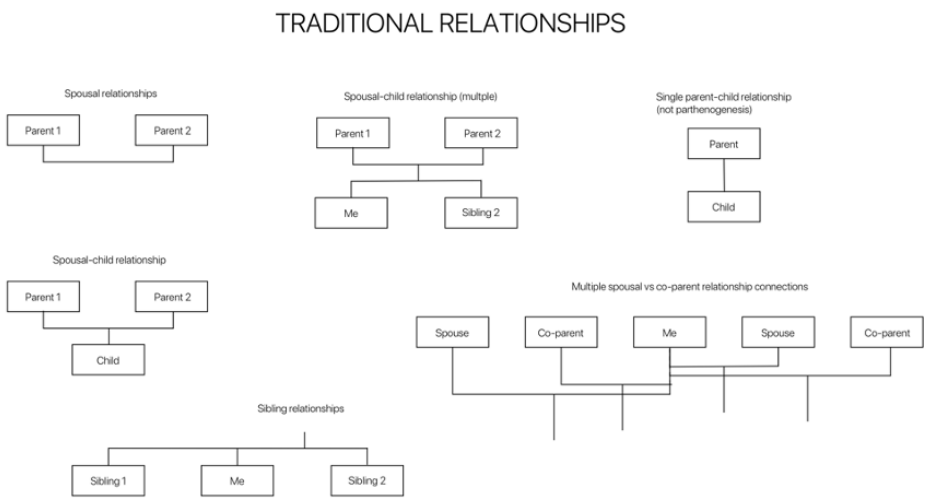

Figure 4.4: Adaptations of our Prototype 2 layout for different types of traditional connections

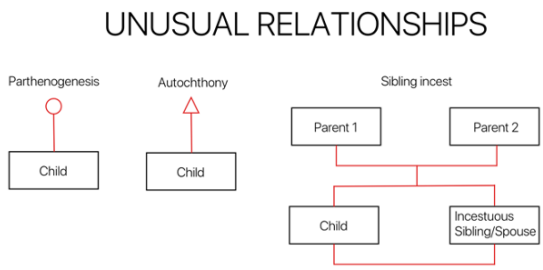

Figure 4.5: Representations of unusual relationships for Prototype 2. Icons were used to denote unusual birth, and incestuous connections were made obvious through implicit loops

(Figure 4.5). Incestuous connections between siblings and spouses were even more obvious and created a loop similar to the one in the genealogy chart of King Charles II of Spain in Section 2.3.4.

Contested traditions – "disputed relationships" prior to the first round of user interviews – were also more visually striking and distinctive once staggering effects had been added to the graph (Figure 4.6).

The implementation using HTML canvas was simple, and despite its lack of event-handling support, it was able to generate graphs to a decent quality. For entities with a small number of connections (e.g. less than ten significant others) the graph seemed readable (Figure 4.7). However with more connections – such as Zeus' 30 significant others – the graph was still unruly, even with staggered connections (Figure 4.8).

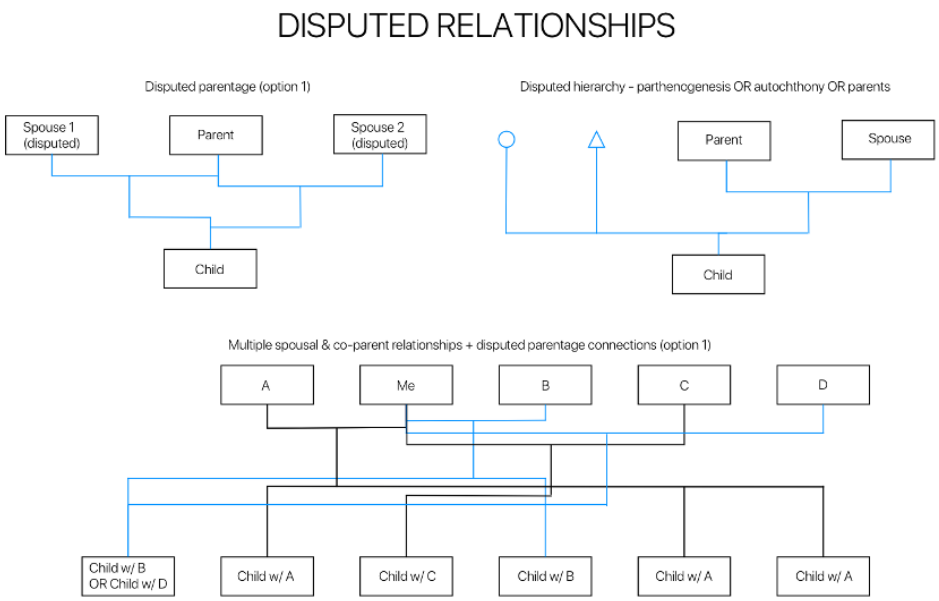

Figure 4.6: Representations of disputed relationships for Prototype 2

Given the primitive nature of this prototype, errors were acceptable, so this prototype was referenced in the first round of user interviews as a potential Greek graph layout candidate nonetheless.

4.2.3 Alternative visual layouts

Throughout our initial research into genealogical graph layouts, it was made apparent – by software such as Legacy 9 (see Section 2.5.1) – that there were many different layouts that could be used to explore genealogical information. There has been little research conducted into whether these alternative layouts are more intuitive or preferable for genealogical visualisation than pedigree charts. There is also little research supporting the idea that pedigree charts are the most preferred format for representing traditional genealogies, let alone the complexities of Greek myth.

To test these assumptions for ourselves, we developed a website filled with various graphing prototypes that are not typically associated with genealogies (see https://yayalu.github.io/greekgraphs-prototypes). Due to the time constraints, it was not possible to make all of the prototypes functional, so many were screenshots from the graph equivalent in Legacy 9, and others were filled with sample data to give the overall impression of the graph layout without being tailored to Greek myth. This fact was made clear to scholars prior to the start of the user interview and they were told not to let this factor into their overall impression of the capabilities of the graph layout.

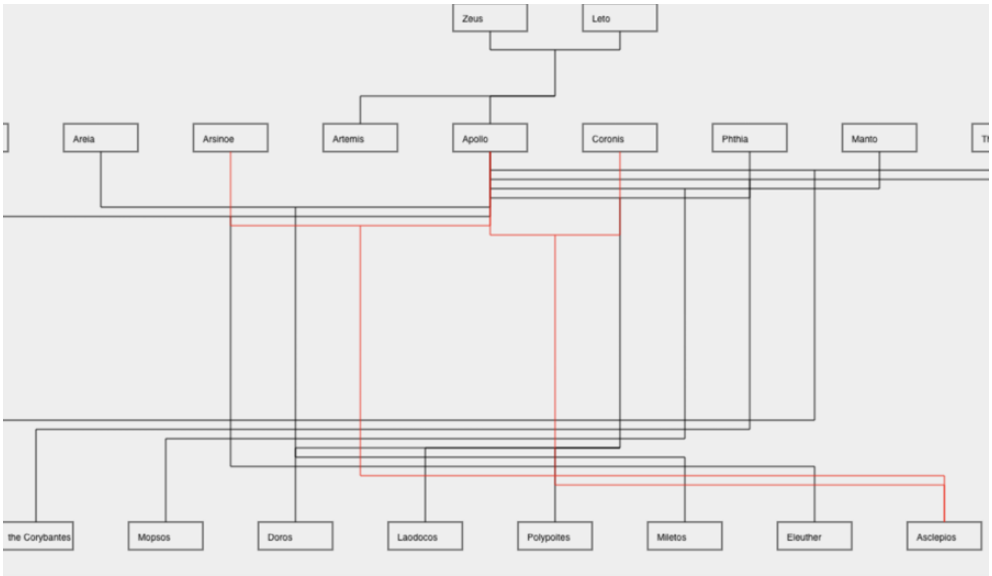

Figure 4.7: Prototype 2: The dynamically-generated graph of Apollo's genealogy, using HTML canvas

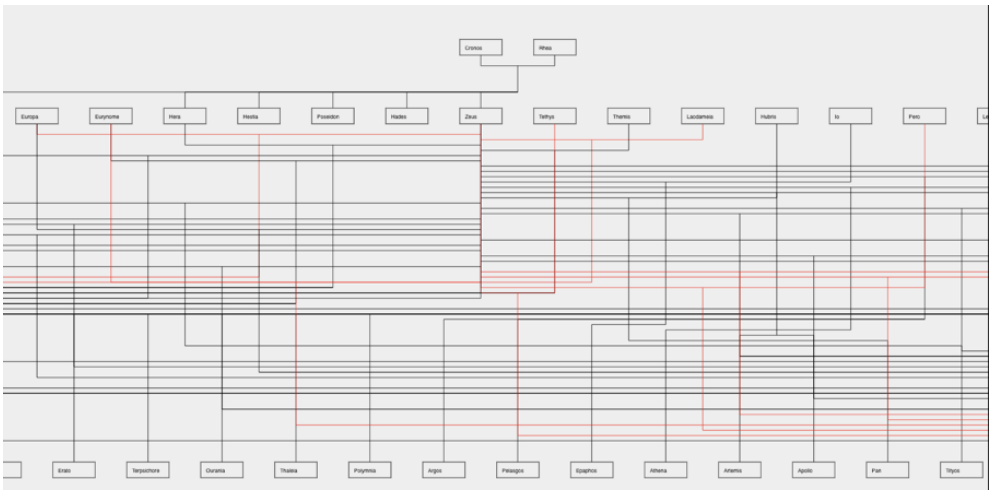

Figure 4.8: Prototype 2: The dynamically-generated graph of Zeus' genealogy, using HTML canvas. This is far less readable.

The graph layout styles chosen, fell into two categories: those commonly associated with genealogy to test genealogical intuitiveness, and the most popular graph layouts to test the familiarity factor in graph layouts. Common genealogical layouts include ancestor fans, booklets, timeline charts, and vertical & horizontal trees. Timeline chart prototypes were provided despite its incompatibility with immortal entities, to see whether the scholars saw any potential, and to pay homage to the timeline emphasis in the TimeNets paper (see Section 2.3.1). Popularized graph layouts not commonly associated with genealogy are collapsible and non-collapsible forced-directed acyclic graph structures, radial tidytrees and cluster dendrograms, and linear tidytrees and cluster dendrograms. Prototypes 1 and 2 were added to the list of visual layouts to give these prototypes context and also ensure all graph formats have an equal chance.

4.2.4 Interaction diagram

All of the above prototypes were primitive, and only had the bare layout of the graph but none of the necessary functionality. As the interactivity element is what we believe to be one of the primary benefits of this platform, we developed an interaction diagram that shows the intended list of interactions in the final product (Figure 4.9). This was to determine whether the interactivity proposed is of value to researchers, and what interactions they would prefer to see in a graph.

Like the existing digital representations of Greek genealogies – e.g. in Theoi.com and Wikipedia (see Section 2.2.2) – we wanted the nodes in the graph to be clickable and to redirect to the data page for the clicked entity.

As mentioned previously, differently-coloured lines were used to denote the different kinds of complexities. At the time of this first round of interviews, there were only two distinctive categories: contested tradition (at the time named "disputed relationships") and unusual births. Incestuous connections were grouped into the "unusual relationships" category. We decided to make these connections interactable, which would give MANTO an extra edge over competitive digital graphing systems. Clicking on these connections would pop up information cards about that connection, along with explanations of the type of connection and – if applicable – links to other examples of this connection occurring in other genealogies. This once again speaks to the project's desire to provide a generous interface, and allow for multiple avenues of navigation.

To make the unusual connections more noteworthy, we wanted to assign dedicated icons to each of the unusual births. These icons are similarly clickable and reveal the same information as clicking on the red line connection itself. The specifics of these icons were defined in the next version of this prototype (Prototype 3, Section 5.2) but we wanted to investigate the usefulness of this design choice first.

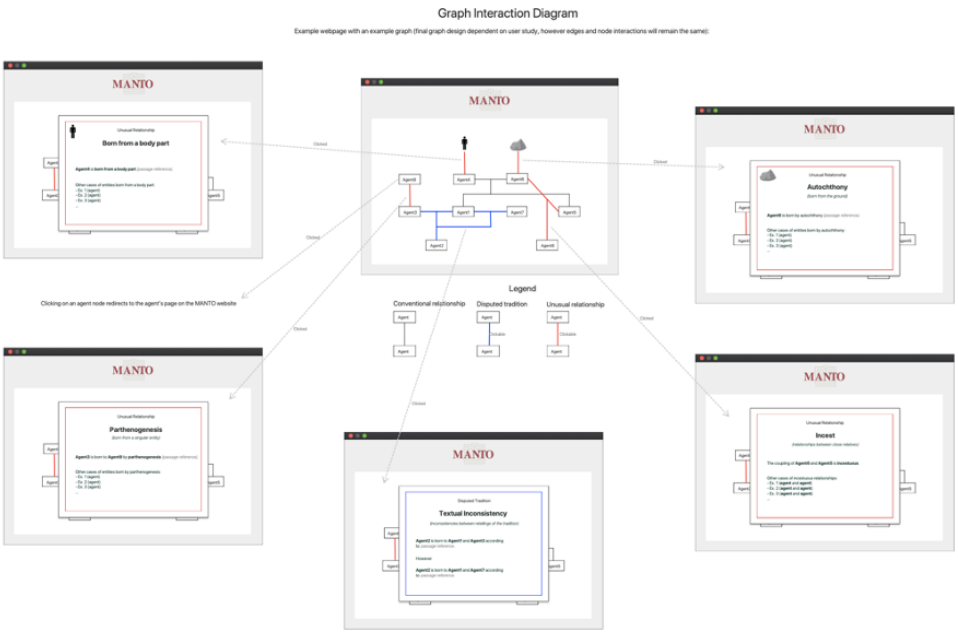

Figure 4.9: Prototype 2: A diagram of the proposed interactions that users can have with the graphs in MANTO.

4.3 User Interviews Round 1

4.3.1 Background and motivations

To determine whether the overall platform as well as its prospective components were user-friendly and of use to one of our target audiences, we conducted a preliminary set of user tests. By conducting an initial test with some primitive – and unfinalized - prototypes, we were trying to obtain an initial reaction to our proposed solutions, and also address any strong requirements from scholars early on in the development process. In other words, this round of user interviews attempted to address all three of our research questions:

1. How can we organise raw references from Greek mythology in a way that is systematic, consistent, and accessible?

2. How do we design an intuitive interface that represents complex, non-traditional genealogical data?

3. How do we provide genealogical data in a format beneficial to those invested in Greek and Latin literature?

We decided that an in-depth qualitative review was preferable to a standardized quantitative one. This was because at this stage of the project the benefits were unsubstantiated and the design choices were ambiguous, so a lot of open user exploration was required. The greater the level of insight into expectations and

desires from users with extensive knowledge of Greek mythology, the better we were able to abstract this information to produce a solution that accurately accommodated the nuances of the mythology. It was also an effort to determine whether our current approach towards addressing Greek myth visualisation, was in fact of benefit to either research or teaching as we had hoped. Consequently, due to their experience in the field, the target user base for this stage of the user interviews were scholars of Greek and Latin literature.

4.3.2 Format of the user interview

Once we received ethics approval to conduct this round of user interviews, we gathered participants from our target user base: researchers and scholars of Greek and Latin literature. Dr Greta Hawes sent out an email with expressions of interest to some of her colleagues in the field. 11 responded, all of them expressing interest in participating, and enthusiasm at the prospect of the project, which was particularly heartening given their busy schedules. The interviews were conducted over Skype as the majority of the researchers were in different time zones, such as in the UK and the US. These interviews were conducted over a two-week period, with each interview lasting anywhere from 1hr to 1.5hrs due to the interest expressed by the scholars, and the steady flow of conversation. These conversations were recorded with full consent from the researchers, and were transcribed and documented in Appendix B.

The interviews were intentionally exhaustive and exploratory, and attempted to touch on every functionality within the existing platform. This was done in order to provide ample opportunity for the users to discuss their thoughts and feelings about certain functionalities; which spoke out to them and which did not. The interview was divided into four main sections:

Exploration of the website, specifically the data cards and search functions, as well as the overall website aesthetic. We wanted to determine if the idea of a search facility, as well as the functionality of the data cards themselves, were intuitive. Most of the question prompts were about general usefulness (e.g. "did you find <X> useful in your exploration of the website") and navigational processes used to obtain the desired information. (e.g. "If you wanted to find the children of Apollo, how would you navigate through the system to find that?").

Comparisons of graph layouts in the list of prototypes. Users were asked to explore the list of prototypes, and discuss the pros and cons of each style for representing genealogical data. Evaluative questions were also asked, such as "would you like to have ancestors, descendants, or both shown in your graphs?" and "is the idea of a graph for genealogical data useful for you and why?".

The interactions proposed in the interaction diagram. Users were asked to look at the diagram in depth, and provide insights into the intuitiveness of this format of graph interactions. Examples included enquiring about the use of icons to denote unusual connections, the colours proposed for the different kinds of relationships, and the interactivity elements such as where clicking a connection opens a

corresponding information page. Benefits and disadvantages of highlighting this information we also discussed.

Overall impressions of the platform in both concept and execution. This was more of a post-exploration evaluation and closing interview, where users were asked about their overall experience with the platform. It enquired as to whether the project fills any gaps in the market for genealogical data representations for Greek myths, and asked for the user's insights. On a personal note, it discusses the circumstances of their future use of this platform, and whether they would - if they choose to use this platform again – prefer to use it for research purposes or teaching purposes.

The questions in each of these sections were used for guidance rather than strictly enforced, as the interview benefited more from a conversational style. By doing so, we encouraged a flow of ideas and opened the scholars up to new insights and recommendations for the platform. The full set of questions is listed in Appendix A.

4.4 Responses from User Interviews Round 1

Feedback from the scholars were overall extremely positive. All researchers loved the premise of the project and also wished to be contacted with progress updates. The accumulated qualitative results from the interviews and the attributions for each response is provided in Appendix B.

4.4.1 Feedback for the MANTO website, data cards and search function

Overall the impressions for the MANTO website, i.e. the data cards, search functionality and overall aesthetics, were positive. Most scholars found the design of the website to be simple, clean, intuitive and elegant.

All the researchers loved that the data cards had links to the original text through Scaife Viewer, and commented that this was a better reference system than indices in books and textbooks due to the digital aspect of this platform. However, they reaffirmed that having more than just references from Apollodorus' *Library* and *Epitome* would be more beneficial in the long term. In particular, they were interested in seeing how the MANTO system would handle conflicts between sources, not necessarily within a single reference text. This critique in particular can only be resolved by the further development of the MANTO database, which is beyond the scope of this project. However, at the time of this thesis submission more texts are being added to MANTO so these shortcomings will be addressed in future iterations of the project.

Many reported themselves "going down a rabbit hole" and "spending hours in the interface", as clicking on connections in one data card led them to continue clicking on other entity links in other data cards.

Some scholars expressed desire for more types of data in the data cards. Examples include a brief summary of the entity's background, a quote from the original text concerning the entity, visual materials such as statues or vase paintings depicting the entity, geographies, and dates that the connections occurred. Some of these (i.e.

geographical and chronological data) could be created out of the existing MANTO dataset, but it is beyond the scope of this project. Others, especially linkages to other datasets of visual and material culture, are under consideration for future versions of the product.

Some users did not like the inconsistent identifying information for entities in the database. The identifying information for most agents and collectives was originally taken from the index of Smith & Trzaskoma's translation of Apollodorus [Smith et al., 2007] – and then altered as necessary to help data collectors identify entities more quickly. As a result, the identifying information had become qualitatively inconsistent and biased. For example, Hera, who is an Olympian god, had the identifying information "Hera, Juno: wife of Zeus". Whereas Zeus, who is also an Olympian god, was referenced as "Zeus: Olympian god". This meant that an overly patriarchal perspective was explicit in this aspect of the data display. Other notable concerns were where the identifying information can be disputed or inexhaustive, for example Aphrodite had "goddess of sex and lust" as her identifying information, but she had many other roles as goddess as well.

One scholar commented that a lot of obscure entities in Greek myths have notable grandparents. However, with much of the identifying information being "X: son of Y" by default, that identifying information makes this entity less searchable. Additionally, having only immediate relations in the data cards makes the entity appear less significant to the storyworld.

Some scholars wanted instructions on the website for how to use the platform, for example what the different relationships mean, how to search using alternative names, a list of potential interactions with the diagram, and how to click between entities.

Some commented on the benefits of having an exhaustive search facility, since they knew of nowhere else that had all the entities in Greek myths in one searchable form. However there were some (understandable) concerns about the alphabetization of the search facility. This was also mentioned as an internal concern in Section 3.4.2. Some thought it tiresome and inefficient to click on a button or press the Enter key to render the search. Some wanted the search function to include filters for keywords, as well as identifying information and relationship keywords. These were all useful suggestions, however – similar to the search results alphabetization – this was a lower priority item than the development of a working graph, and thus would be more beneficial as a future work item.

4.4.2 Feedback for the graph prototypes

There were mixed reviews for the most preferred graph layout. Each format had at least one researcher preferencing it above the others, however there were still distinctive commonalities in the comments made about each of the layouts.

The most recent prototype (Prototype 2, Section 4.2.2) had the most preferences, on par with vertical and horizontal trees. According to one researcher, the format of Prototype 2 is what they would have personally advised to other people if they

were creating a genealogical chart. This gave the impression that familiarity was an important factor in acceptance, but the problem then became how to convey connections clearly and concisely. According to the scholars, the problem with Prototype 2's layout was that even with staggering, the overlapping lines made it difficult to discern the different parent-child relationships. As already discussed, this is particularly problematic with a large number of connections, such as with Zeus and his plethora of children. The most common suggestion was to add hover-effects to the diagram instead, where hovering over a connection shows all the entities and lines relevant to that connection.

In terms of the other graph layout formats (see Section 4.2.3), linear graphs and network force-directed graphs were also well-liked. One particular researcher much preferred the network force-directed graph and circular graphs to the others. The booklet and timeline charts were the least preferred overall, as they were considered less visually striking, and timelines seemed unfitting for the immortality aspects prevalent in Greek myths.

Altogether, the scholars found a use for almost every graph layout style, preferences aside. In fact, most of them expressed interest in the idea of multiple types of graph styles representing the same data, over a single graph. The reasoning was that different users have different interpretations and methods for approaching data, so variety is beneficial for insight.

The scholars preferred having the option of both ancestors and descendants shown in the graph. This is because the more information about the entity's genealogy is shown, the better the user is able to obtain context for the genealogies or understand the significance of those relationships. However only some scholars wanted both ancestry and descendants to be shown on the same graph, unless both ancestry and descendant data was "straight-forward".

Some further suggestions were made for improvements to the graph. These are modifications that could be useful for future embellishments of the project but are not a high priority at the current stage of development. Examples include showing more than one generation at a time (or allowing the ability to toggle the number of generations shown), collapsible nodes to ease screenshotting and printing, and JPEG-export capability.

4.4.3 Feedback for the interaction diagram

All of the scholars loved the interactions proposed in the diagram. They loved that each node was clickable and that clicking on it redirected them to the page for that clicked entity. This, according to several researchers, provides a huge advantage over static representations of genealogical data. They liked the idea of information pages popping up as a result of clicking the complex connections, as well as its "other places of" feature as an alternative navigational tool. They also loved the use of icons to distinguish the different unusual relationship types.

In terms of aesthetics, they loved the use of the coloured lines to mark contested relationships. This according to them, revealed the complexities of the system, and

in turn demonstrated the inherent complexities of mythical data, forcing the user to think about the nuances of the connection rather than nonchalantly accept it as the truth. However some thought the idea of clicking said lines to be unintuitive, and recommended that a hover effect be added to the lines – e.g. a thickening of the lines – and that a legend be added to the graph for clarity.

The addition of unusual relationship lines was deemed useful in drawing attention to the juxtaposition of what is commonly occurring in Greek myth, yet is unusual based on modern perceptions of relationships. There was, however, some debate between the scholars about what is truly "unusual". According to almost all the scholars, unusual relationships are the norm in Greek mythology and not the exception, and expressed concern that the graph could become overly complex as a result. Many did not believe "incest" to be an unusual relationship, especially since graphs of entities near the start of creation are based entirely on incest due to lack of alternatives. As such, the idea of unusual relationships and incestuous connections would need to be defined and scoped so as not to overwhelm the graph with red lines.

Some inquired as to the hierarchy of unusual versus contested representations in the graph, as there are many cases of unusual relationships which are also contested.

One big concern from scholars was the use of the word "textual inconsistency" and "disputed tradition". They commented that this title is misleading, and made it seem as though there was an issue in the manuscript as opposed to denoting a contestation between different authors' retelling of a story. Additionally, in Greek mythology there are often multiple valid but simultaneously conflicting retellings of the same story, but "textual inconsistency" implies only one is the correct one.

4.4.4 Overall feedback for the system

Overall, the feedback for the MANTO platform was overwhelmingly positive. Many mentioned that books can not cope with Greek mythology because of the linear nature of conventional narrative, and that it is good that someone is using the flexibility and interactivity of the digital realm to do this. They commented that MANTO would be reached for, far more than other reference text formats – such as books - with practice.

All scholars believed that the visualisation aspect of the genealogies makes the information clearer and easier to interpret than if someone were to describe the connection and write it out. They noted that once the number of relationships increase due to the addition of more reference texts, the genealogy list will become more complex and difficult to read so a graphical representation of the same data would be useful to clarify that. Many said that having graphs already available at the drop of a hat means time saved trying to create similar graphs using other rudimentary software, for example Microsoft PowerPoint.

Some even compared the current system to Wikipedia, saying that Wikipedia is a good alternative source for Greek mythology data. They commented that Wikipedia would have an advantage in that it contains more text citations and would have more

complete references for the more famous entities. However, they believe the MANTO system is far more efficient to look through than the large and overwhelming chunks of data available on Wikipedia.

Half of the researchers preferred using data cards to explore the system, while the others expressed more interest in using the graphical interface. This consolidates our existing perspective that there is a need to accommodate for multiple types of users.

The scholars expressed more interest in using this system as a teaching tool rather than a research tool. If it was for research purposes, the MANTO system provides more efficient clarification on genealogy than indexes in a book, however overall it would be used more as a casual reference rather than serious research or for major insights in Greek myth. On the other hand, they expressed interest in using this platform as a teacher educating students about Greek myth. Some even expressed enthusiasm at the prospect of putting MANTO in their syllabus, and loved that they could obtain a quick and easy genealogical graph for use in their lecture slides or tutorials. They also mentioned that MANTO would be hugely beneficial for students, as they could use it as their own reference tool for learning about Greek myths. The unintimidating nature of the website means that they can use it where normal reference texts would be overwhelming, and can be used as a clarification if students get confused about a genealogy. The simplicity of the navigation process, and the explicit highlighting of unusual connections would challenge their perception of Greek myths, and make the process of finding out more about mythology fun.

Based on all of this feedback, it seems that the platform is well-received, and there is a clear gap in the market for this kind of system. Scholars felt that the way in which certain connections were emphasized could help make users more comfortable about what might be slightly uncomfortable material (such as unconventional relationship types).

4.5 Summary

In this chapter, we provided context for the design and development of the first set of genealogical graph prototypes for MANTO. We conducted several interviews with scholars of Greek myth to determine their impression of the prototypes, the proposed interactions within the graphs, and the website overall. It was clear from the results that the scholars saw immense potential in the platform, and they offered some suggestions for improvements. Our responses to these suggestions are in the following chapter.

Chapter 5

Graph Design Phase 2

In this chapter we generate a second set of prototypes based on the feedback from the user interviews in Section 4.3, providing a basis for a second round of user interviews. In Section 5.1 we address the feedback from the first round of user interviews, and describe the subsequent modifications to the data cards, graph layout and the originally-proposed interactions. Section 5.2 explains the design considerations for representing complexities such as contested tradition, unusual births and incestuous relationships in a graph, and their subsequent development. Section 5.3 then explains the process for the second round of user interviews, and Section 5.4 discusses the results. Section 5.5 then summarises this chapter.

5.1 Updates Based on Feedback from User Interviews Round 1

5.1.1 Modifications to the data cards

Some modifications were made to the underlying data as a result of the discussions from the user interviews. For example, all inconsistent identifying information was replaced with more consistent representations. For example, "Hera, Juno: wife of Zeus" became "Hera, Juno: Olympian god". This was also to address any misconceptions about patriarchy in the Greek mythic storyworld.

The grandparent attribute in the previous sections was added as a response to the feedback from one of the scholars. Grandparent relations were added but grandchildren were not, due to the iterative complexity that occurs with grandchildren, particularly if – in the case of Zeus – there are already too many children to display in a data card in an effective manner. Grandparents were not, however, added to the graphs as well since for now we want to generate graphs with maximally depth 1 from the focus node.

A "How to use" button was added to the platform. Clicking on this button opens a modal popup with information about the different kinds of connections, and instructions for the website (Figure 5.1).

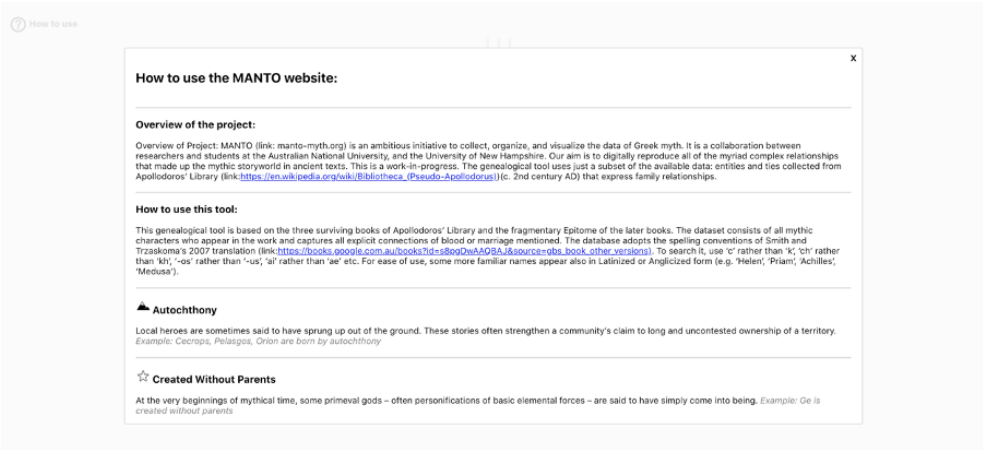

Figure 5.1: The "How to use" modal popup on the MANTO website

5.1.2 Modifications to the genealogical graph

With the project's time constraints, it was not possible to develop multiple varieties of functional graphs that visualise the same data. We recognised the benefits of having multiple formats as a form of insight but deemed a fully functional development of one form of graph layout to be preferential to multiple semi-functional graphs. We – along with many of the scholars we interviewed – agreed that the alternative layouts presented could visualise genealogies, but they would be better suited to visualising other kinds of relationships in Greek myths. For example, the force-directed collapsible graphs could be a better choice for showing the concentrations of the storylines for an event, based on ties in MANTO. A timeline chart could also be more impactful as a timeline of events in an epic. This is an interesting potential future endeavour, however not plausible at this point in the project. As such, we decided to implement the most-preferred graph format for the purposes of a genealogical graph - Prototype 2 - but also to redesign the graph format for greater clarity in connections.

Both ancestors and descendants were added to the graph, in response to the desire expressed for both. In the future it is worth considering a view toggle function for showing ancestors, descendants, or both so the users can adjust the views accordingly.

5.1.3 Modifications to interactions from the interaction diagram

Due to positive feedback, the nodes in the graph were made clickable and automatically redirected to the clicked entity's page. Distinctive colours were used for different categories of relationships (traditional, contested, unusual, incestuous), and each contested/unusual/incestuous relationship – when clicked – displayed an information page with links to similar cases.

Since unusual relationships can be considered the norm in Greek mythology,

combining all cases of unusual birth circumstances and incest into a generic "unusual relationships" category could be overwhelming and derivative. Customized icons were considered by the scholars to be an extra form of visual stimulation for the graph, and make the unusual connections distinctive enough to be impactful.

Due to the concern that the nature of "incest" is common in the Greek mythic storyworld, we needed to distinguish between different types of common connections, without overwhelming the graph with unusual connections (red lines). To address this, incestuous connections were abstracted to a different set of coloured lines (green). This is a logical distinction, because incest can be common and naturally occurring, but other kinds of unusual relationships identified in Greek myths (e.g. autochthony and parthenogenesis) do not naturally occur. By abstracting incestuous connections away from the set of unusual connections, we are also rescoping what we determine to be an "unusual connection", as births such as parthenogenesis and autochthony are distinctive even in the context of the Greek mythic storyworld. We also limited the idea of incest to a generation difference of maximally two, which means also separating intergenerational incest from sibling-spousal incest. This is further explained in the following sections.

The idea of clickable connections was deemed unintuitive, so we added weighted hover effects to the lines as per the recommendations from the users. In other words, all the connections would be a uniform width, and only when the connection is hovered over would it change weighting to emphasize the connected entities. This was in place of an alternative suggestion, where we could use different types of lines to distinguish between different relationships (dashed for unusual, dotted for contested, etc), as we thought this would be visually overstimulating and more confusing to learn than coloured connections.

The phrases "textual inconsistency" and "disputed relationships" were modified to "contested tradition". This gives a greater impression that the connection is contested, but not that one version of the story is more inherently valid than another.

In terms of the visual hierarchy between unusual and contested relationships, we decided that contested is the highest-level connection, unusual relationships can be contested, but the nature of contestation is not unusual. Furthermore, unusual relationships are more interesting on a lower-level and for information discovery, and contestation is considered more useful from a research perspective. To emphasize this hierarchy, we kept the combined contested and unusual connection as contested on the higher level, and only when hovering over it do we show the specifics of its unusual nature.

Very few researchers had suggestions for improvements to the layout of the information cards on the graph, just that they were useful. As such, we moved the information cards to above the graph rather than as the modal popup format indicated in the diagram. This was intentional, as modal popups obscure the content underneath when they are open, and from discussions with the scholars they seemed to enjoy referring back and forth quickly between the information and the graph.

5.2 Prototype 3

It was clear that the more customized graph (Prototype 2, Section 4.2.2) was the most preferred graph layout of all the graph prototypes. The interactivity element was also deemed crucial to the user's positive experience with the platform.

React-Konva is a KonvaJS framework modified for use with React components that achieves a happy medium between the layout customizability of HTML canvas and the interactivity potential of D3.js. More information including the discussion and analysis of this framework can be found in Section 2.6.4.

5.2.1 Traditional genealogical chart format

This third prototype takes inspiration from the most recent prototype – Prototype 2 (Section 4.2.2) – due to its popularity. However it also takes into account the concerns regarding clarity and readability expressed by the scholars during the first round of user interviews. As mentioned, weight hover effects were added to each of the connections, along with highlighting the connection's associated entity nodes to emphasize the entity's involvement in the connection. This also meant that the initially-proposed staggered layout is unnecessary, due to the complexity of the output when dealing with entities with many connections.

Each graph retains the initial preference for showing only one generation. This is purely for the sake of simplicity in this still relatively primitive rendition of the graph. Depth is denoted in the frontend as a numerical difference in hierarchy from the centre node – namely, parent depth is "-1", main entity depth along with its siblings and significant others is "0", and children depth is "+1". This is not as impactful in the early stages of this project, however it will help in the future with the recursive display of more generations once we add a function to set the number of generations shown in the graph.

Once these minor modifications were implemented, we designed the individual unusual, incestuous and contested line connections and icons, and aimed to find the most intuitive connection layout for each.

5.2.2 Contested tradition

Once we renamed "disputed relationship" and "textual inconsistency" to "contested tradition", we discovered there are actually three distinct types of contested relationships with respect to the main entity: contested parentage, contested unusual relationships, and contested lineage.

5.2.2.1 Contested parentage

Contested parentage is where a parent, or both parents, of the main entity are contested. For example, Asclepios is the child of Arsinoe and Apollo according to one source, whereas he is the child of Coronis and Apollo in another (Figure 5.2) [Apollodorus, p. 3.10.3]. There were several attempts to design this connection, to

Figure 5.2: Contested parentage as shown in the MANTO website data cards, using Asclepios, god of healing as another example (ID: 8187834)

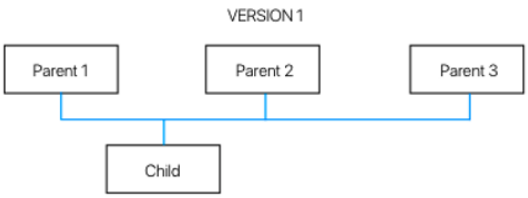

Figure 5.3: Prototype 3, Version 1: All parents in the same connected line, gives the impression that this exists in the same timeline

ensure the format is intuitive, but remains true to the intention of the source content.

Version 1: The first design had all three parents in the same connection, with a singular blue line between them. This was simplistic, however it gave the incorrect impression that all three parents were the parents of the child in the same timeline, i.e. that the child had three parents as opposed to two parents where one of the parents is contested (Figure 5.3).

Version 2: The second design had two distinct parent connections leading to the same child node. This made the contestation more explicit, as it highlighted the node that remained consistent in this contestation (i.e. Parent 2) (Figure 5.4). This idea is great in theory, however the graph can become incredibly unruly when there are many permutations of lineage, and all parents are contested. An example is the contested parentage in Asopos (Figure 3.5), where there are three alternatives for Mother, and three alternatives for Father.

Version 3: A suggestion from Dr. Greta Hawes was to have a nested tab structure for contested traditions (Figure 5.5). This was to show that each of these alternatives were equally valid, but also provided the opportunity to focus on the alternative that is most widely recognised, i.e. the entity that has the most sources backing

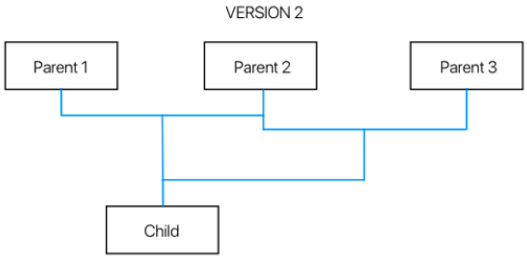

Figure 5.4: Prototype 3, Version 2: Staggered contested connections are an effective representation format for a small number of parentage permutations

its connection. This primary alternative was the default connection rendered in the graph, but the user could click on the alternative parent name listed, and the graph would re-render with this clicked entity in place of the primary alternative. An additional benefit of this system would have been to reveal how the ancestry tree would have changed as a result of the change of parent.

Again, this is a good idea in theory, however with an increasing number of alternatives (referencing again, the example of Asopos, see Figure 3.5) this would be difficult to implement. The text would be too small and unreadable, or it would take up too much additional space to stack all the alternative nodes on top of each other.

Version 4: We reverted back to the simpler versions – in this case, Version 1 – as it had the greatest impact without unnecessary extra development effort. We then attempted to address the issues in Version 1 by applying a weighted hover effect to the connection and adding the word "OR" in the middle point between the nodes upon hover (Figure 5.6). By doing so, we hoped to show that the relationships were contested but each alternative was equally valid. This was again, an effective solution for a smaller set of alternatives, but with a greater amount of contested parentage the nodes were too far apart for a middle "OR" to be effective.

Version 5: This final version was an adaptation of Version 4, where instead of adding "OR" between the nodes, all contested entities had an "OR" attribute appear on the top right corner of the node (Figure 5.7). This solution saves space, and also encourages people to click on the connection itself for further clarification, since the information page that pops up describes the specifics of the contestation. The effectiveness of this final design will be explored in the second round of user interviews.

5.2.2.2 Contested parentage information page

For every unusual, contested and incestuous connection and their respective subcategories, there is a dedicated information page (Figure 5.8). For contested parentage, there is a brief explanation of the type of contest, as well as the specifics of the particular contestation clicked, with their respective supporting references to Scaife Viewer.

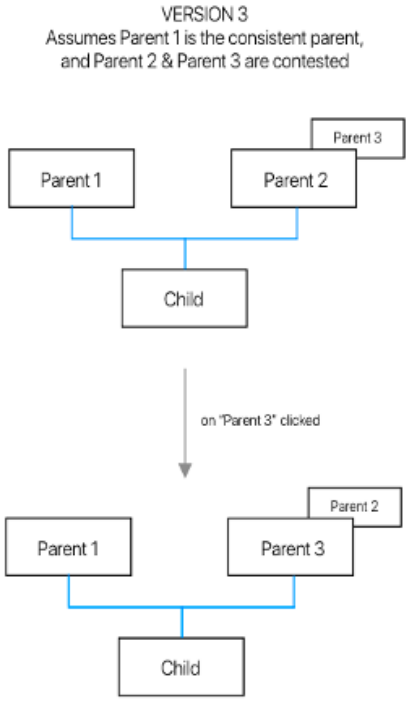

Figure 5.5: Prototype 3, Version 3: A nested contested parentage structure. This is difficult to implement but has benefits for exploring the flow-on effects of alternative ancestors.

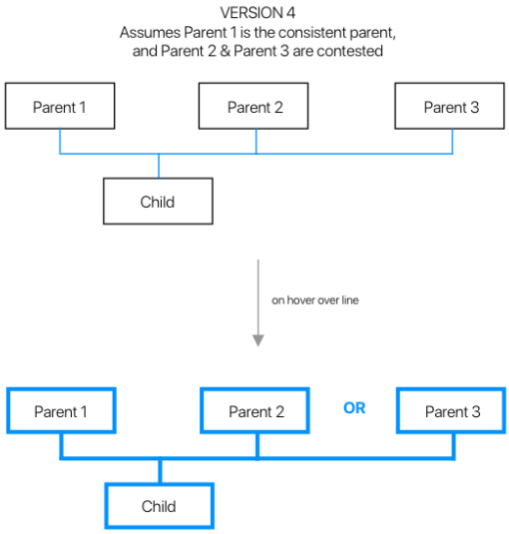

Figure 5.6: Prototype 3, Version 4: Adding "OR" between nodes, useful for a small number of permutations only

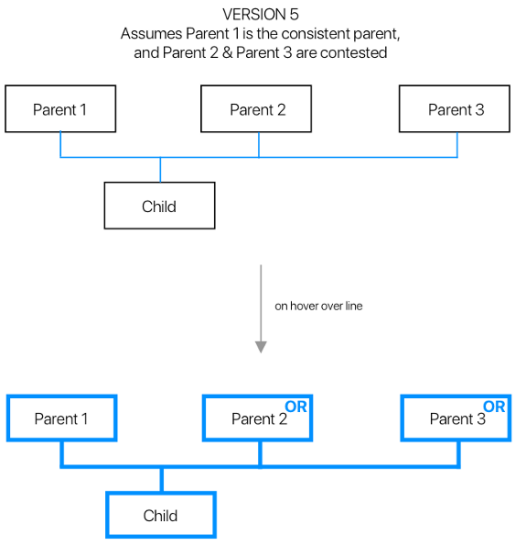

Figure 5.7: Prototype 3, Version 5: Adding "OR" inside of the contested nodes. This is clear, concise, indicates the existence of alternatives, and is also simple to implement.

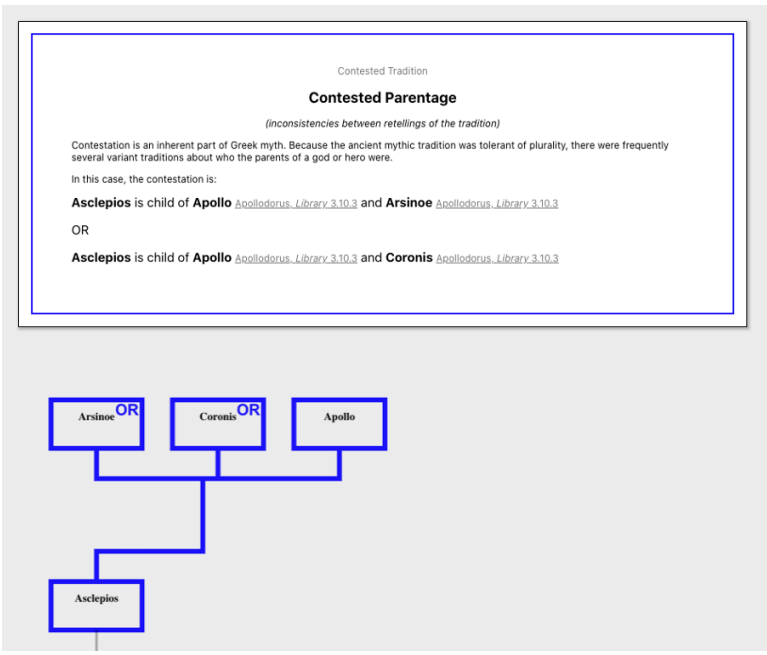

Figure 5.8: The information page for "contested parentage", using Asclepios, god of healing as an example (ID: 8187834)

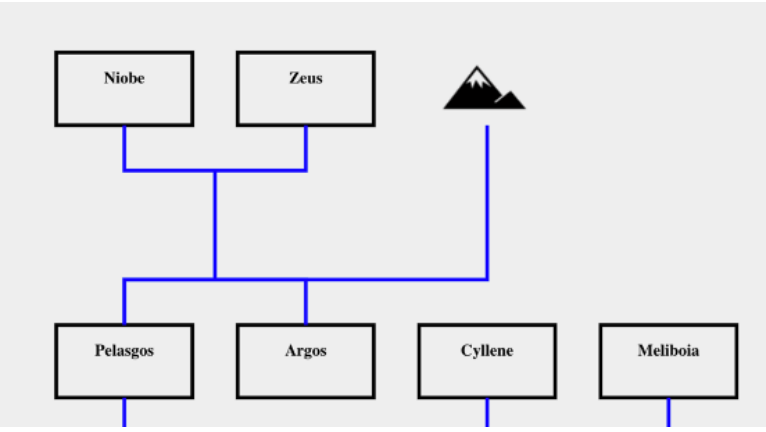

Figure 5.9: A contested unusual graphical representation when the connection is untouched, using the contested autochthony of Pelasgos as an example (ID: 8189143)

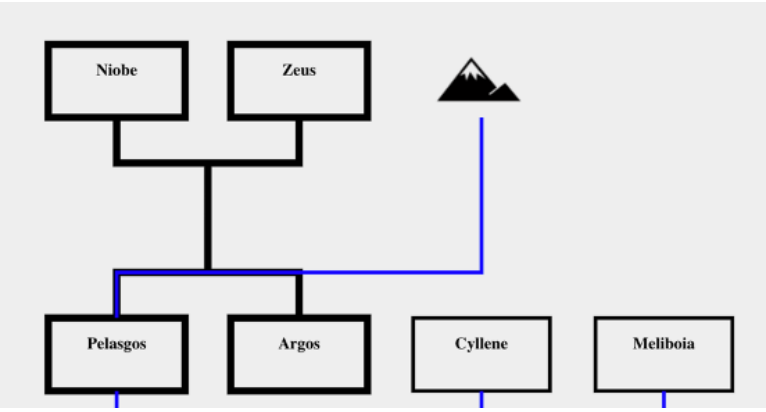

Figure 5.10: A contested unusual graphical representation when the traditional part of the connection (i.e. not unusual, not contested, and not incestuous) is hovered over, using the contested autochthony of Pelasgos as an example (ID: 8189143)

5.2.2.3 Contested unusual births

There are many cases of unusual relationships that are also contested (see Section 2.1.2.6). To address this issue - as explained in the user interview feedback (see Section 5.1) - the contestation is the highest-level view in the graph (Figure 5.9), and the unusual aspect of the relationship is only available upon hover (Figure 5.11). In other words, the set of connections are shown as contested (blue) by default, but hovering over them reveals the traditional part of the connection (black) and the unusual part of the connection (red).

Unlike the other contested tradition types, when clicked this connection only shows the information page for the unusual relationship, not information about its contest. This is because the dispute here should be obvious, and the primarily interesting aspect about this connection is the unusual relationship.

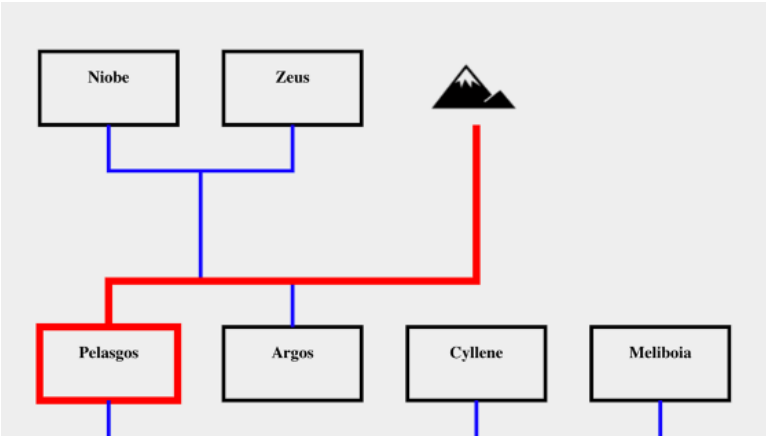

Figure 5.11: A contested unusual graphical representation when the unusual part of the connection is hovered over, using the contested autochthony of Pelasgos as an example (ID: 8189143)

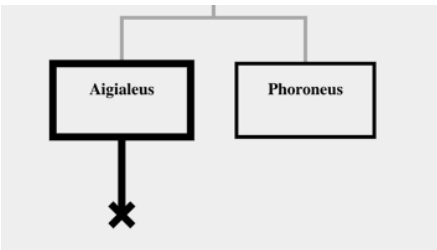

Figure 5.12: The graphical representation of "dies without children", using the example of Aigialeus, son of Inachos, who has no children (ID: 8182075)

5.2.2.4 Contested lineage

There is often dispute about whether an entity has children. As mentioned in previous sections, this is denoted by the tie "has no children". As the lineage for the entity ends at this point, a terminal point (a cross) is the best way to display this connection (Figure 5.12).

When this relationship is contested, it is possible for the entity to either have children, or no children according to different versions of the mythology. As such, the terminal point is contested, as well as the child that exists in the alternative version. This is represented by an "OR" next to the terminal point, as well as the top right corner of the child that is contested (Figure 5.13). The information card that pops up when this connection is clicked, details similar information to the contested parentage information card, where an explanation of the contestation is given, along with the specific parts of the connection that is contested (Figure 5.13).

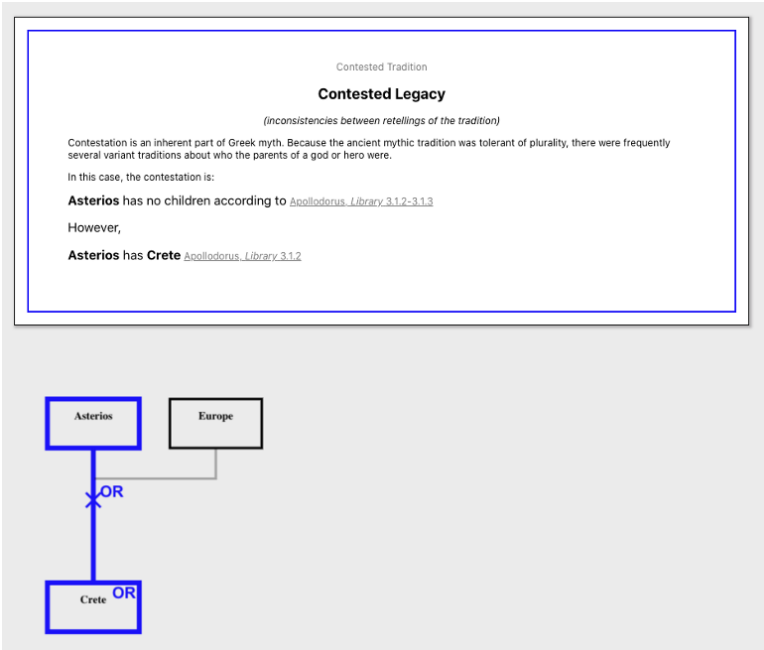

Figure 5.13: A contested "dies without children" graphical representation when the contested connection is hovered over, using Asterios, king of Crete, as an example (ID: 8187843)

5.2.3 Unusual births

As all of the scholars loved the use of icons to denote the different kinds of unusual relationships, each of unusual circumstances had to be tailored to reflect the nuances of the source text. For all of the following unusual birth scenarios, the information card that pops up when the connection is clicked, contains a brief explanation of the type of unusual birth, the entities involved in the connection, the references to the original passage, as well as a list of other entities in Greek myth with the same unusual connection (if applicable).

5.2.3.1 Autochthony

Autochthony, as explained in Section 3.4.3.5 is where an entity is born from the ground. In some circumstances, the autochthonous birth can be associated with a place or a landmark, however the MANTO data subset used for this project does not yet reflect this.

There were three suggestions for the autochthony icon. Firstly, a rock or mountain, due to the entity being born from the earth. Secondly, a person rising from the earth. Thirdly, a snake, as according to Theoi.com [Atsma, 2019c], many creatures born from the earth take on a snake-like appearance. The latter was deemed too esoteric and unnecessarily complex for those new to Greek myths. We placed this icon above the entity – where parent connections usually occurred – to

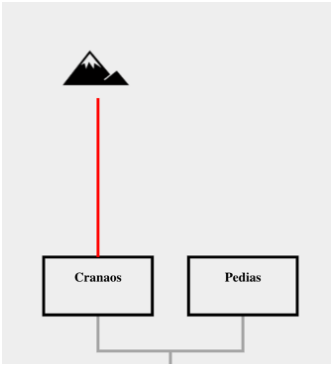

Figure 5.14: MANTO website's graphical representation of autochthony using Cranaos, early king of Athens, as an example (ID: 8188080)

emphasize the idea of birth from the ground (Figure 5.14).

5.2.3.2 Born from an object or body part

Most occurrences of "born from an object" in the interface give the immediate visual impression that it is a contested tradition. This is intentional even if the birth circumstance is not explicitly contested because the contest is not due to conflicted retellings; rather, it can be argued that the entity is both born from the object, and born from the entity the object came from. In the example of Athena's parentage - it is argued that Athena is both the daughter of Metis and Zeus, and born from the Head of Zeus (refer to Section 3.4.3.5).

To visualise this implicit contest, we used the contested and unusual hierarchy we established in our response to the first round of user interviews; we make the high-level view a contested connection (blue), and only reveal its unusual aspect (red) when the user hovers over the connection itself (Figure 5.17). In displaying this relationship in such a way, we can emphasize that the entity has a normal mother and father connection as well as being born from an object, but that the connections are not explicitly contested and only have conflicted representations.

The object that the entity is born from is added to the list of parent nodes, but it is greyed out, dotted, and clicking the node has no effect (Figure 5.16). This is to demonstrate that this is a symbolic node, and not an entity searchable in the system, i.e. it has no corresponding entity page or data cards.

The icon chosen was a cracked egg, playing homage to the story of Helen of Troy's birth from an egg [Euripides and Allan, 2008, pp. 16-21 257-259]. Here, the icon was placed in the centre of the line connecting the parent object to the child node, unlike in autochthonous births. This is because the parents themselves are a significant part of the Greek mythic universe, and an integral part of the unusual connection, therefore it must be highlighted.

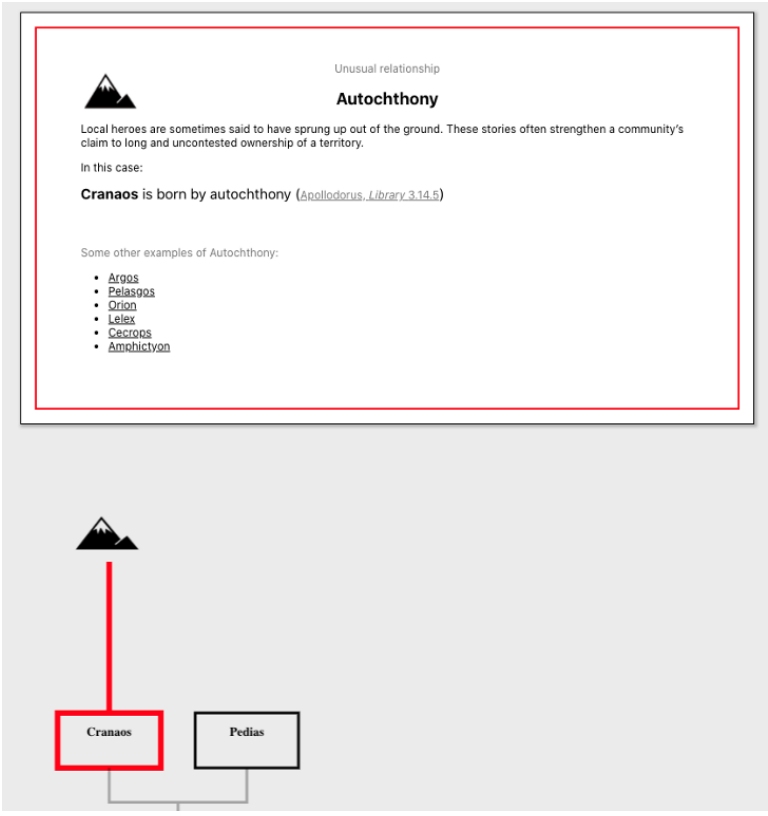

Figure 5.15: MANTO website's info page popup for autochthony when the unusual connection is clicked, using Cranaos, early king of Athens, as an example (ID: 8188080)

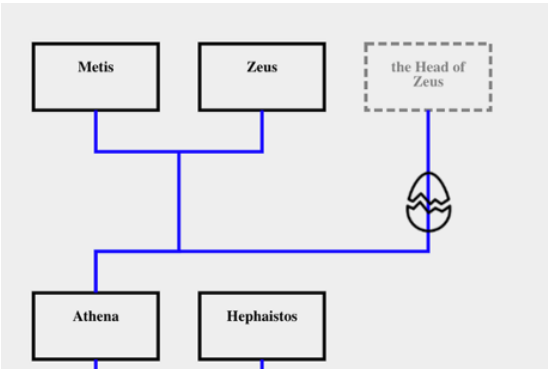

Figure 5.16: MANTO website's graphical representation of contested "born from an object" using Athena, Olympian god as an example (ID: 8187870)

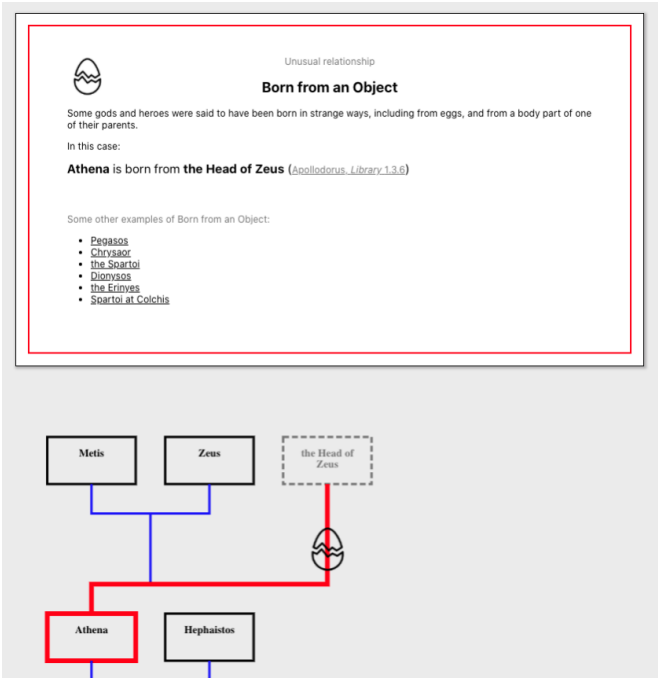

Figure 5.17: MANTO website's info page popup for "born from an object" when the unusual connection is clicked, using Athena, Olympian god, as an example (ID: 8187870)

5.2.3.3 Created by an agent

This unusual birth appears like a traditional parent-child connection with a singular parent. However, this connection remains unusual because the creation process is non-biological. A well-known example of "created by an agent" is the creation of Pandora by Hephaestus, the blacksmith god. As such, the icon is chosen to be a hammer (Figure 5.18).

5.2.3.4 Creation without parents

This relationship occurs primarily with primordial beings. The entities in this connection have no parents, but it was necessary to distinguish these unusual representations from entities where the parents exist but are unknown. In other words, we could keep the entities created without parents standalone nodes, but we want to emphasize their primordial nature. As such, we use a star icon to denote the entity being born at the start of the universe (Figure 5.19).

5.2.3.5 Parthenogenesis

There is only one case of parthenogenesis in the ties – the relationship between Hera and Hephaestus (refer to Sections 2.1.1, 2.1.2.5 and 2.1.2.6) - and it is contested. Being born from a singular entity could, in theory, have a similar visual representation to

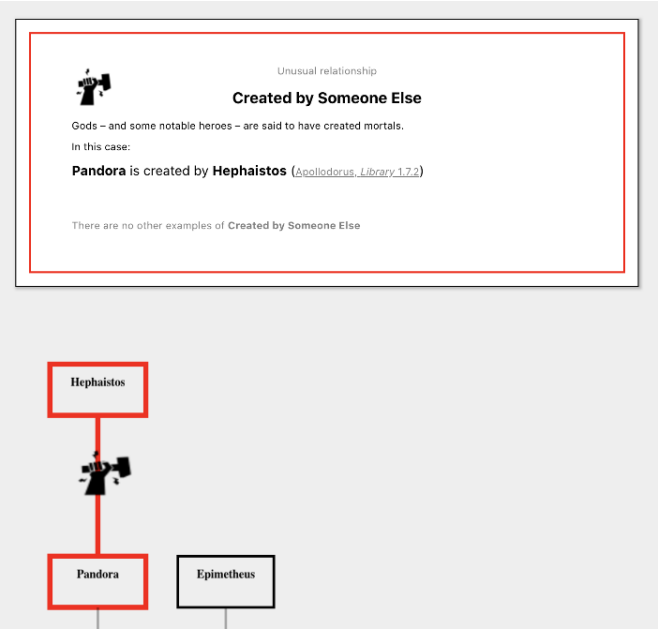

Figure 5.18: MANTO website's info page popup for "created by an agent" when the unusual connection is clicked, using Pandora, first mortal woman, as an example (ID: 8189114)

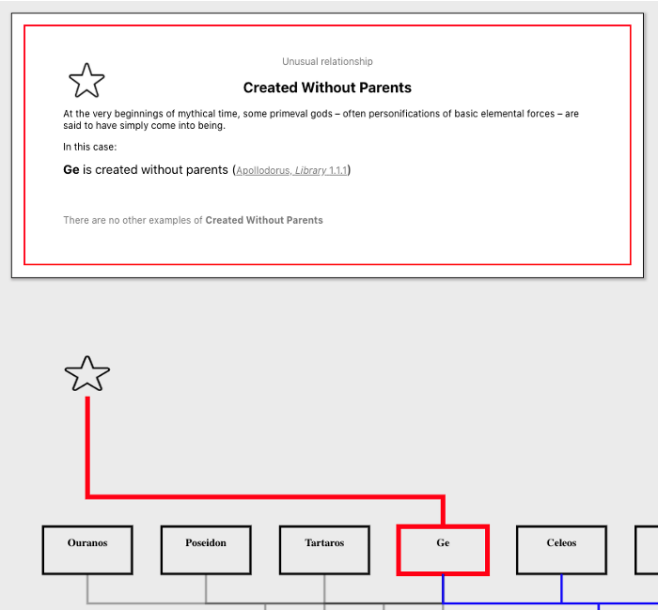

Figure 5.19: MANTO website's info page popup for "created without parents" when the unusual connection is clicked, using Ge, personification of Earth, as an example (ID: 8188388)

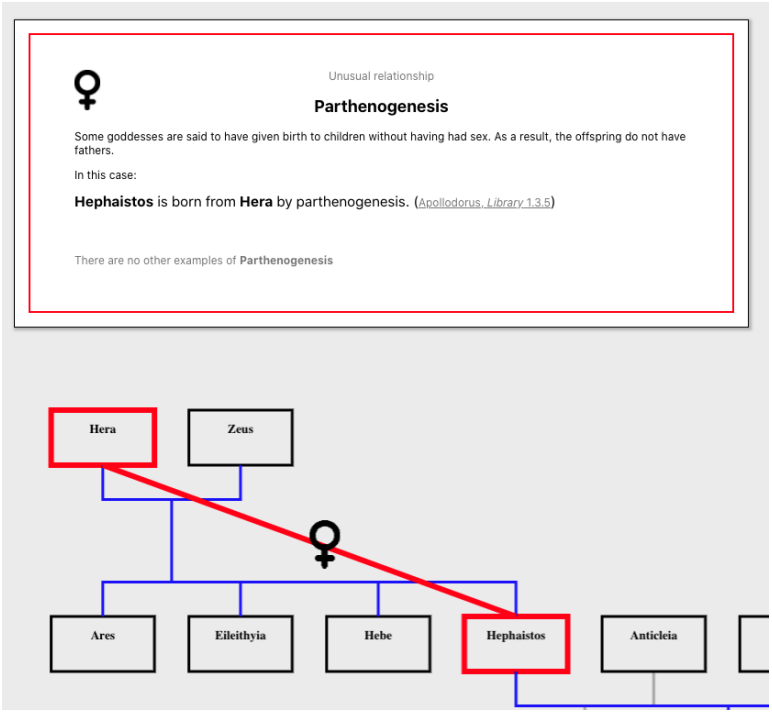

Figure 5.20: MANTO website's info page popup for parthenogenesis when the unusual connection is clicked, using Hephaestus, Olympian god, as an example (ID: 8188476)

autochthony or "created by an agent". However, a fundamental flaw in this strategy is that – like the relation "born from an object" – the two alternative versions of the story are not entirely distinct.

For example, even if the contestation is for whether the mother gave birth through parthenogenesis or through a partner, the mother herself is still involved and uncontested. The graphical representation must therefore show that the versions are alternatives, but that the mother in both connections remains the same. We chose the female symbol (♀) to represent parthenogenesis, as it is always a female that gives birth through parthenogenesis in Greek myth.

The problem with having a line drawn from mother to child in the traditional u-shaped format, is that the pre-existence of the mother would result in an overlap of the line with the existing mother-father-child connection. Instead, to emphasize the difference of this parthenogenesis connection, a line is drawn directly from the mother to the child by parthenogenesis, forgoing all predefined graph layout formats (Figure 5.20).

5.2.4 Incestuous relationships

Based on the feedback from the first round of user interviews (refer to Section 4.4), incestuous connections were identified as a separate category distinct from unusual

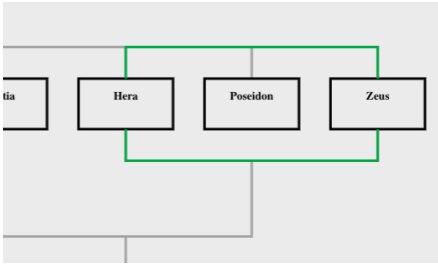

Figure 5.21: A graphical representation of sibling-spousal incest when the connection is untouched, using the relationship between Zeus and Hera as an example (ID: 8188390)

relationships. Here we distinguish between two types of incestuous relationships - relationships of generational difference 0 (i.e. sibling-spousal) and generational difference 1 (i.e. inter-generational). For the first iteration of the prototype, the idea of incest was limited to one generational difference.

The information cards for these relationships explain the type of incest, as well as other examples of incest (Figure 5.22 and 5.23).

5.2.4.1 Sibling-spousal (same-generational) incest

To represent sibling-spousal relationships, we can take inspiration from the diagram of King Charles II of Spain (Section 2.3.4). The loops that these relationships generate make the incestuous aspect of the connection more intuitive. The u-shaped nature of the connection makes it obvious that the two entities are siblings (top line) and also spouses or co-parents (bottom line) (Figure 5.21).

5.2.4.2 Intergenerational incest

We recognised that in many incestuous relationships, the incest stretched over multiple generations. This was particularly apparent when – like the duplicated incest examples in the genealogical representations researched in Sections 2.2 and 2.5 – some entity nodes were repeated at different depths. As previously discussed in Section 2.1.3, this particular type of incestuous relationship is commonplace in Greek myth as some of the entities are immortal, and thus can interact with several generations of mortals.

The propagational impact of this type of incestuous connection means that any attempts to generate a loop like in the sibling-spousal incest example would result in a messy graph. For example, suppose Entity X has 10 children, then marries one of their children Y, and with them give birth to more children. Which entities are part of the incestuous connection? Child Y? The children of child Y? The Entity X themselves? Additionally, which version of Entity X is the one that should be referenced in the incestuous loop – the original X that had 10 children as their primary connection, or the X that co-parents with Y?

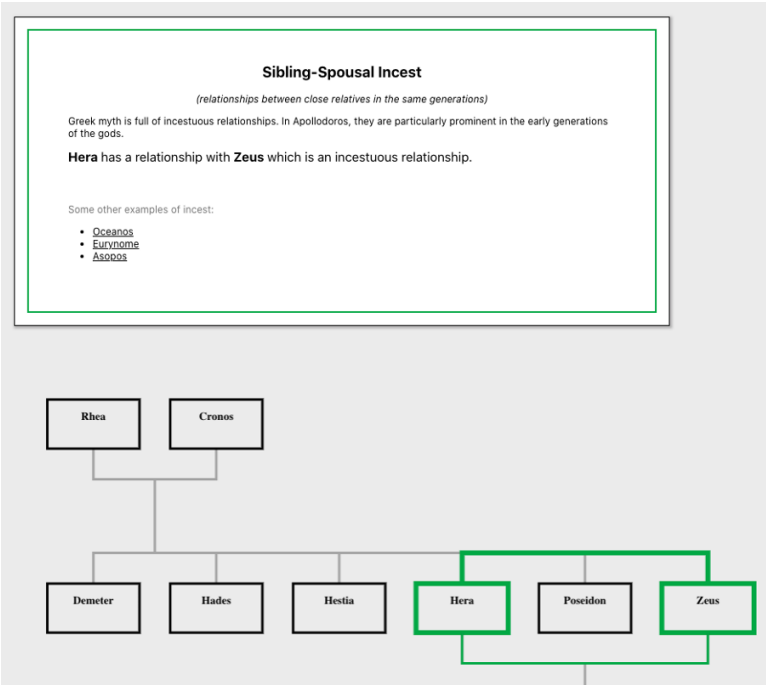

Figure 5.22: MANTO website's info page popup for sibling-spousal incest when the connection is clicked, using the relationship between Zeus and Hera as an example (ID: 8188390)

Acknowledging that there would be an overwhelming number of green lines needed to connect all entities affected by this inter-generational incest, and that more inter-generational incest occurs towards the start of the Greek mythic universe, it is clear that simplicity is preferable over comprehensiveness. Rather than attempt to draw a loop-like structure like in sibling-spousal incest, it is much simpler to draw a singular green line between inter-generational entity duplicates. This attempts to grab the attention of the user with a green line, without overwhelming the graph with green lines as would happen with loops. The idea is that by only using the green lines to link duplicated entities in inter-generational incest, users can look at the other lines in the graph and infer that an incestuous connection has occurred. If the representation is still unintuitive, the information pertinent to the connection is made clear when the connection is clicked, and the information card appears.

An example of an incestuous connection is Euronyme (Figure 5.23). In this figure, Eurynome almost appears as her own mother, which is an immediate indication that some form of intergenerational incest has occurred. In this particular case, Eurynome gives birth to Asopos either with Zeus, Poseidon or Ouranos. But Ouranos is also her father so this creates an inconsistency in the representation of significant others and children.

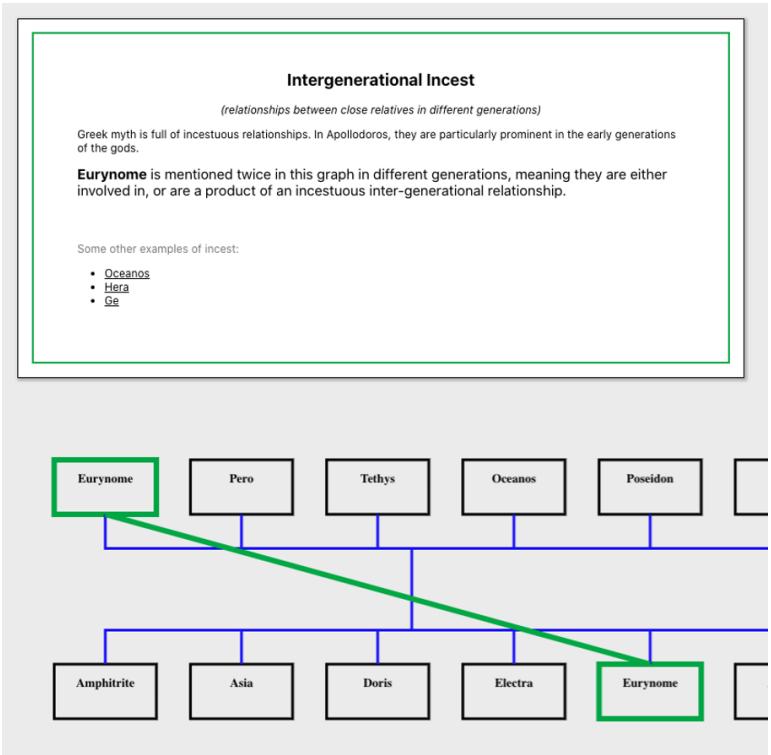

Figure 5.23: MANTO website's info page popup for inter-generational incest when the connection is clicked, using Eurynome, mother of Charites, as an example (from the entity page of Asopos, river god of Sicyon) (ID: 8187838)

5.3 User Interviews Round 2

To determine the effectiveness of Prototype 3 in addressing the main research questions, we conducted a second round of user interviews.

5.3.1 Background and motivations

Recall that our three research questions are:

1. How can we organise raw references from Greek mythology in a way that is systematic, consistent, and accessible?

2. How do we design an intuitive interface that represents complex, non-traditional genealogical data?

3. How do we provide genealogical data in a format beneficial to those invested in Greek and Latin literature?

Compared to Prototypes 1 and 2, this updated version focused more on the intricacies of the graph's design. In particular, it focused more on the intuitiveness of each of the individual connections, rather than its overall use as an explorative or conceptual tool. In order to obtain further insights into the usefulness or intuitiveness of this updated platform, we designed a second round of user interviews.

The first round of interviews provided valid insights into the desires of scholars, and we discovered that the interface was able to provide most of those capabilities at a higher level. Given that the majority of the interface remained unchanged, explicit repetitions of those qualitative questions were not essential. The aim of this second round was to quickly and easily determine whether we had addressed the original critiques of this system in a meaningful way. However, we still valued any opportunity for in-depth insight into the benefits or disadvantages of the system. As a result, we chose to format the user interviews as a combination of quantitative and qualitative questions, with the emphasis on exploration over strict question-answering or enforced navigational approaches.

Based on the responses from the first round of user interviews, there was a greater emphasis in the second round on use of the system as a teaching or reference tool, rather than for academic research purposes. Of particular interest was the system's ability to act as a supplementary tool for students learning about Greek myths. To verify this statement, and also to determine whether the updates to the graph made it more useful as a research tool, the target user base became teachers and researchers in classics or ancient history, and students studying classics or ancient history. Input from members of the general public interested in Greek mythology were also encouraged to see if the interface can assist those wishing to explore the nuances of Greek myths. In doing so, we were able to determine whether the updated prototype contributes to the research questions proposed.

5.3.2 Format of the user interview

Once we received ethics approval for this second round of user tests, we hosted it on the ANU Qualtrics server. The questionnaire can be found here: https://anu.au1.qualtrics.com/jfe/form/SV_ahFqCsvZOjVAy9f. It was divided into four sections, and every question was optional to give users the choice to opt-out of answering a question unless they felt strongly enough about it to offer insights. An online questionnaire was chosen as opposed to another set of in-depth qualitative interviews, as the focus was on a larger variety and a greater number of participants. The questions used for the questionnaire is in Appendix C.

We primarily wanted an audience of students and teachers studying ancient Greek and Latin literature. We sent follow-up email links to the first round of participants and others previously involved with MANTO, and circulated information about the questionnaire to students in a first year ANU Classics course on Greek myth. The link was also posted to the MANTO Facebook page and blog for extra exposure.

The first part had users enter their personal details, such as their ANU university ID, name and qualifications. In particular, we asked if they were researchers or students of Greek myth, and examples of sources they used when they conducted research in the field to provide context for their comparisons.

The second part led users to the link for the MANTO website. We encouraged users to explore the system for themselves and find their own method for navigating the platform before diving into the questionnaire. By doing so, their impressions of the website were arguably more authentic – i.e. they weren't forced by the structure of the questions to conform to any specific navigational method – and were more able to pinpoint the effectiveness or noticeability of certain elements in the interface. This method provided useful insights into the platform's capability as a generous interface.

The third part was primarily a set of quantitative multiple-choice questions, however there was the option under each question of providing more insights if the users chose. This section was designed to provide insight into the user's experience with navigating the website and address the first two research questions. The first half of the questions reflected on the users' website navigational preferences (for example, which part of the interface they interacted with the most: graph, data cards, both or neither), and how intuitive they found the website, data cards and graph functionalities. The second half inquired about the intuitiveness of the representations of unusual relationships, contested tradition and incestuous connections in the graphs, as this was the primary update to the system since the first round of interviews. These questions also contained corresponding links to entities in the website with said traits. For example, "Navigate to <link>Ge, Gaia: personification of Earth</link>. Does the representation of *created without parents* make sense to you?"

The last part had purely qualitative questions, which were about the user's overall experience with the platform, and was designed to address the last two research

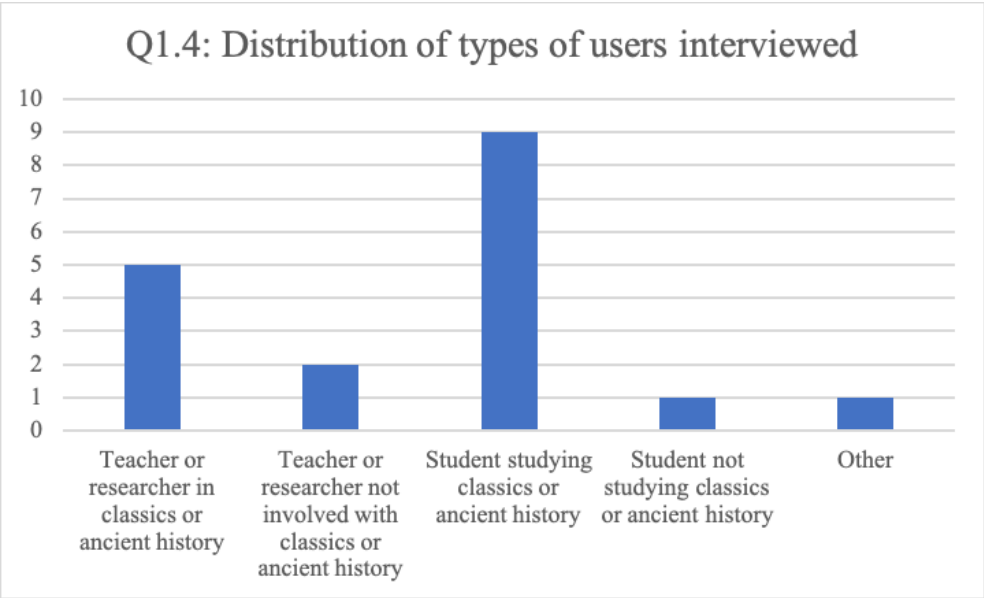

Figure 5.24: The distribution of user types interviewed for round 2

questions in particular. We asked the user how their interactions with the platform compared to how they usually explored Greek myth, if there was any feature they missed, any new insight they had about Greek myths, and whether they would use the platform again in the future.

5.4 Results from User Interviews Round 2

The questionnaire was live for three weeks, and we received 18 separate responses. The quantified results and visualisations of the responses, as well as the individual qualitative feedback from users can be found in Appendix D.

We wanted to determine how users responded to the updated prototype in general, and how the backgrounds of different user groups contributed to their experience with the platform.

5.4.1 Responses to part 1 - personal details

Out of the 18 separate responses, 5 were from teachers or researchers in classics or ancient history, and 9 were students studying classics or ancient history, including PhD students and those who had tutored Classics in past courses. In other words, a majority of the users were interested in Greek myth for academic learning or teaching, or for other academic pursuits such as research. The remainder were interested members of the general public, or students or teachers not involved in the above fields (Figure 5.24).

In terms of reference materials, students of Greek myth used the greatest variety. Their sources ranged from “commentaries”, “dictionaries”, “textbooks”, “Google

searches", to ancient texts such as *Odyssey* and *Iliad* and online resources such as *Theoi.com* and *Perseus*. The researchers and teachers of Greek myth were more generalistic, preferring use of their own knowledge base to recall Greek myths, and Wikipedia to check their references. Some also reported using textbooks such as *The Myths of Greece and Rome* by H.A. Gueber, and online resources such as *Perseus* and *Topostext* for additional reference. The remaining users – general members of the public, and teachers or students with no background in Greek myths – used general references such as the "internet", "local library" and "YouTube channels" to explore Greek myth. These results show that there are a variety of resources being used to explore Greek myth. See Appendix D, Q1.8.

5.4.2 Responses to part 3 - exploration of the website

Overall, users had an equal preference for the data cards and the graphs as their primary navigational tool. Some students and teachers found the data cards "clearer" and "more to-the-point" than the graphs. Others thought "the graphs to be of more immediate interest to explore" and "that they are the form with which we're used to thinking about familial relationships". They thought the data cards were "busy" and the graphs made the "visual aspect easier to process". The division was primarily function-based, and several users recognised the usefulness of both components in the interface as a navigational tool. For example, A teacher noted that the "cards were more useful to get to the sources. So, I would use the graph first to explore, then use the cards to get / check the information". This was great insight for us, as it demonstrated that we were able to address the needs of different user types in the interface, whether they were a visual, kinaesthetic or textual user. See Appendix D, Q3.2.

In terms of the graph layout format (designed in response to the first round of user interviews), the response averaged at "intuitive". In particular, "the graphs are a familiar representation of familial relationships. The tree structure works well" according to one teacher, and the "lines are clear and unjumbled". Those who did find the graph layout unintuitive commented primarily on the "confusing intersecting lines" as opposed to the hierarchical layout of the graph itself. For example, one researcher said, "the overlap of the lines between different sets of parents makes it hard to tease out which set has which child", however, this issue was "mostly solved through the darkening of a specific line when hovering over it". In other words, the issue is manageable, but we may need to conduct even more research into the design of a non-intersecting graphical layout, or one that creates less confusion (D Q3.3)

Half of the users found clicking the lines to be intuitive as there was "information on each page of the feature, both legends, and the text above the graphs" and "the lines are highlighted when you hover over them", but it "took a little while" to understand they were clickable. However the other half commented the opposite, that it "wasn't clearly indicated in the legend, nor is it highlighted when you hover over it" (D Q3.4). One user even reported that they did not see the graph at all

because they accessed the website on their iPad. This suggests there are some issues with rendering on different platforms, so more research needs to be conducted into this.

Only half of the users found the different colours for the lines intuitive. A researcher was "not enamoured about the colour selection" and wanted "green, amber and red in descending order", where amber is for contested connection (D Q3.4). The reason for this was not clear, however colour theory may be a point for discussion in later prototype iterations.

Respondents reported particular confusion with the graphical representation of contested tradition. One mentioned that the "OR" representation in the data cards was obvious for contested births, but less so in the graph; that if they hadn't seen the data cards first they would not have noticed that the two parents were contested. Some thought the number of contested connections was overwhelming. For example, one user said "I searched up Lycaon and was looking at his 50 children who are all marked as contested by blue lines when it is only one child, Callisto, that is contested". In other words, they would have preferred it if a connection wasn't shown as blue "just because one of their siblings or parents is contested".

There were also noticeable inconsistencies in the representation of contested tradition in the website overall. A user noted that in the entity page for Athena, her Metis-Zeus connection is contested, but on Metis' page, Athena's relationship to Metis is not contested. This was an intentional omission, as the contested birth of Athena is tied closely with the genealogy of Athena, however it is arguably less integral to the genealogy of Metis and Zeus. In other words, the contested nature of Athena's birth is essentially at two degrees of separation from Metis and Zeus, and as mentioned in Section 4.2.1, the focus for this stage of the prototype was a maximum of one degree of separation. A future goal is to expand the graph to more generations per graph, which would therefore reveal Athena's contested birth in Metis' page, however this goal should have been made clearer in the user interview.

A majority of the users loved the icons, but wanted them to be colour-coded and respond to hover effects in a manner similar to their relationship type. There was also some controversy about the interactivity of the icons ("a cursor on the icon would help", and colour-coded). The feedback for the representation of autochthony (D Q3.8), contested autochthony (D Q3.9), parthenogenesis (D Q3.10), born from an object (D Q3.11), created by someone else (D Q3.13), dies without children (D Q3.14), was overwhelmingly positive. Most other comments were purely aesthetic, such as alternative icon suggestions for "born from an object" (whether the Head of Zeus can be classified as an object) (D Q3.11) and whether "created without parents" needs an icon at all. However users "appreciated that [these are] difficult icons" to represent appropriately as everyone has a different aesthetic preference.

The feedback for the representation for incest – a newly established connection category based on the first round of user interviews – was informative. There was an overwhelmingly positive response to the graph's representation of sibling-spousal incest (D Q3.15), however users thought the green line above the connection to be superfluous. They made it clear that "the incestuous relationship would still be very

clear if they were only connected from below". On the other hand, the response to the intuitiveness of inter-generational incest was mixed, with the choices split evenly between "No", "Somewhat" and "Yes" (D Q3.16). The feedback was not particularly informative, however, as respondents commented on "confusing graph lines" and "not immediately understand[ing] how these lines are working" but did not give any suggestions. This is another feature worth re-investigating in the future.

Three-quarters of the users found the information popups to be at least somewhat useful. Users loved that the pages explained "alternative parenting possibilities" and expressed that they "were easy to understand and solidified understanding of the relationships". A particular user claimed that "linkages are very important and a key reason for the digital project" and "couldn't get enough" of these additional information pages. One user commented that this was a useful feature, however they were noticeably absent for some relationship types – true as we actively did not provide information pages for the traditional relationships - so this may require clarification (or implementation) in further iterations of the interface.

The "How-to-use" page - another new feature in response to the feedback from the first round of interviews - had mixed reviews as well (D Q3.17). The feedback was that it either didn't help with the initial exploration of the website – i.e. they chose not to use it – or they didn't notice its existence. Those who discovered this feature found it intuitive, but reported that they did not interact with it until the question was asked in the questionnaire. This indicates that this feature either needs to be in a more noticeable location, requires more useful instructions, or is not needed after all.

5.4.3 Responses to part 4 - general feedback and suggestions for improvements

In this part of the questionnaire, users were faced with a set of qualitative questions about their overall experience with the platform. Again, all these questions were optional and an overview of these results can be found below (or by referring to Appendix D.3).

Compared to how the users normally explored Greek myth, researchers and students had similar opinions about the benefits of the platform. The researchers appreciated that the data cards were "pulled from expertly collated data and are easy to read" and students thought they "gave basic information in a visual format in a quick and efficient way that other resources are not capable of". Both groups appreciated the links to the original sources; one researcher said they "liked the ability to see relationships in overview, then explore particular relations / individuals and get to the source(s)" and a student reported that "the links to Apollodorus made interaction with primary resources much easier and very smooth". Users appreciated the ability to click between entity pages, as "linking each entity to others helped [them] learn quickly about different relationships". One compared our website's contested tradition representation to existing references, saying that it showed "contested information much better than any other resources

[they] use now". In terms of overall platform aesthetic, one user "liked the clarity of the platform overall, there was no excess text or media anywhere on the page, which helped focus [their] attention." Based on these results, it is clear that users do benefit from using this platform, and that there are distinct advantages to using the website over other reference materials.

There were some aspects that users found comparatively worse than, or missed from their existing resources (D Q4.3). A classics student that used "primary texts, secondary literature, commentaries and dictionaries" as their resource for Greek myth, commented that the MANTO website "does not provide variations, or a history of representation. For example, variations on Herakles, when first attested in surviving texts.". This is an understandable complaint for someone who uses a large variety of resources for Greek myth. A researcher who primarily used *The Myths of Greece and Rome* by H.A. Guerber as a reference mentioned that the platform is "good for understanding relationships, but wouldn't replace storytelling, which [they] believe is the most engaging way to explore myth", which is also an understandable comment given the book's narrative format.

The rest of the recommendations were aesthetic. One suggestion was for the card and the graph to be shown on the same screen – without needing to scroll - and for the legend to be "top right or somewhere which is clear but not dominating". In a similar calibre, users wanted the graphs to dynamically resize according to the screen, so they could use it for "screenshotting". Another common issue was with the search function, in particular the entities showing up in alphabetical order and not order of relevance (an issue we discussed in the user round 1 feedback), or suggestions for additional search filters (e.g. search by author, or between authors).

Both the researchers and the students thought the platform would be even more interesting once more sources are added. One commented that visualising "the distinction between cataloguers (like Apollodoros, who attempt a mythical overview) and narrators (like Homer or Sophocles, who provide particular versions of myth)" could be interesting, and another wanted "versions from different authors" rather than just Apollodorus. As mentioned previously, this is a feature that is currently in progress by the MANTO team.

When asked whether the users had any new insights about Greek myth while using this data, a majority of the researchers said no (D Q4.4). Few of them gave reasonings for this response, however given that – based on similar responses from researchers in the first round – these researchers of Greek myth have spent many years cultivating their knowledge in the field, finding new information is unlikely. On the other hand, one student said "yes! Quite a few connections I don't think I ever fully conceptualized before seeing them side by side in the graphs" which is interesting as their background was "reading numerous books on Mythology since childhood and am taking a Classical Mythology class in June". This suggests that this website is more of a reference tool for those with extensive experience in Greek myths, but is an advantageous learning tool for those with limited background in the field.

When asked whether they would want to use this website again in the future, researchers had a variety of responses, but they were similar to the results from user tests round 1. Two researchers said they would use it as a tool for "easy visualisation of characters and where the contested materials are", and "to check relations and especially to find the primary source citations." One likened it to a "kind of primary source mytho-pedia". Another two researchers said they would use it primarily for teaching, such as a "reference/resource for [their] students" and "perhaps an assignment in a mythology class". Those who tutored in Greek myth mentioned they would "definitely recommend it to students, and would perhaps use screen shots to put on hand outs and slides if more generations could fit on the screen at once." The students reported they would "use it as a source", as a "reference for origins and relationships between mythical entities". One said they would use it as a "researching tool for a project or paper", or as clarification for "something that [they were] reading in Greek myth". Even members of the general public found the platform fascinating and would reuse it, reporting that from now on they would use the platform "whenever asked about Greek god genealogy" and that "the clickable reference links to the original source of the represented relationship, is an enormously handy and time-saving feature."

Overall, the feedback provided for the system was exceedingly positive, with several suggestions for improvements. Our responses to this feedback will be discussed in Section 6.1. All-in-all, the results reveal that a majority of users were thoroughly impressed by the project, and "excited" about its future prospects. Summarised by one user, this has been "great progress on a project that features the ugly messiness of Greek myth!".

5.5 Summary

In this chapter, we outlined the changes we adopted based on the suggestions from the first round of user interviews. We then explained the development of a second round of prototypes (Prototype 3) and explored how it highlighted – rather than ignored – the complexities prevalent in Greek mythic genealogies. Lastly, we conducted a second round of user interviews and explored the intuitiveness of this new graph layout. We collated all the feedback from these tests and drew conclusions from the data, which will be outlined in the next chapter.

Chapter 6

Project Limitations and Future Work

In this chapter, we explore MANTO's potential and assess our existing work. In Section 6.1 we respond to the suggestions from the second round of user interviews (Section 5.3) and postulate modifications for future iterations of the platform. In Section 6.2 we explore other avenues of future work for MANTO. Section 6.3 addresses the limitations of our current implementation, and Section 6.4 concludes this chapter.

6.1 Prospective Modifications to MANTO based on User Interviews Round 2

Based on the feedback from the second round of user interviews, there are a few further areas of research required and some potential modifications to the MANTO interface.

More research needs to be conducted into the best way to display genealogical connections without an overwhelming number of intersecting lines. Several users commented on the confusing line intersections when there are a large number of connections, but that they were addressed by the "darkening of a specific line when hovering over it". However it would be beneficial to conduct further research into graph layout algorithms, possibility finding a middle ground between the staggered layout of Prototype 2 (Section 4.2.2) and the hovered intersecting lines of Prototype 3 (Section 5.2). It is also worth investigating edge minimisation algorithms, however given the number of genealogical connections of certain entities (e.g. Zeus), avoiding intersection altogether could be impossible.

Some interactive elements of the interface need to be more intuitive. For example, users only noticed the clickability of the coloured lines when faced with instructions on the page, indicating that the layout by itself is not intuitive. In a similar calibre, the "How to use" function was either not used, or not noticed. Some users didn't like that the legend was in the middle of the page, and would have preferred it to be placed in a less intrusive location. Other aesthetic suggestions were for different icon types and different colours for the connections. As very few of these suggestions

had accompanying reasons and were just statements, these aesthetics changes would benefit from further research, perhaps a third round of user tests.

Since the lines representing contested tradition were considered overwhelming, it is worth investigating alternative layouts. Recall that in Section 5.2.2.1 there were five different prototypes designed for contested tradition, so it is worth investigating if any of the other versions (in particular, Version 3) would make the contest more distinct. Alternatively, we can design a more nuanced connection that only highlights the contest for those directly affected (i.e. the entities in question, but not other entities indirectly affected by the contest such siblings). Referring back to the example given by the user – Athena's mother Metis is shown as contested but the graph for Metis does not show that Athena is contested – we can also endeavour to improve the consistency of contested tradition representation.

Significantly more research needs to be conducted into making the inter-generational incest representation more intuitive, but due to the lack of in-depth feedback on this, it is hard to determine how best to improve this feature.

Lastly, to improve consistency, it is worth adding clickability and information pages to the traditional relationships as well. In doing so, we hope to generate less confusion over which aspects of the graph are interactable.

6.2 Other Future Work

Based on our current prototype and feedback from both rounds of user interviews, there are several other recommendations for future prototypes.

Firstly, by adding more reference texts by other authors into the platform, we can develop a greater appreciation for how our system handles contested tradition. When multiple texts are entered, the contestation will be made clearer, and the strengths of the connections can be quantified. In other words, if a connection has e.g. 5 supporting references but its alternative has only 3, then the connection with 5 can be considered a stronger connection and this could be reflected in the graph. In the future, data from adaptations of Greek mythology could also be added, to determine how the entities changed from their early Greek representation to their Romanized equivalent.

Currently the only available attribute for "significant others" in the data cards is spousal. The only other representation for a significant other is when they are co-parents of a child. This makes sense in the context of a genealogy chart, as a mistress is not genealogically attached to an entity, however this means that a lot of notable mistresses or partnerships without children in Greek mythology - such as the relationship between Hades and Persephone [Atsma, 2019d], and Heracles' many male sexual partners [Plutarch and Goodwin, 1878] - are not mentioned in the MANTO website. The best way to display this information should be further explored in future iterations of the project, and research should be conducted into whether these types of relationships – untethered by children or marriage – "belong" in a genealogy chart in the first instance.

We can also improve the search function so that it no longer orders all search results alphabetically; rather, it will search by matching name, then identifying information. Including filters for different kinds of relationships in the search field (e.g. all children born by parthenogenesis, all entities with two contested fathers, all entities who die without children) could simplify the search facility further, and again provide more methods of navigation in the system.

All graphs in the current version only show one generational distance from the main node. This in the future – as mentioned in the first round of user interviews – could benefit from an input that allows the user to specify their desired number of generations and have the graph render this accordingly. This would allow users to get a better overview of the whole tradition, rather than one-generational snippets of genealogical data.

Some users expressed the desire to have collapsible hierarchies, for example collapsing all parts of the graph that the user deems irrelevant. This could be a useful layout technique to incorporate in the website as it would be helpful for large overview graphs based on entity type (e.g. immortals, or monsters) in Greek myth. In other words, it would provide the ability to generate higher-level graphs like the ones in Theoi.com, or be useful in visualising a large number of generations in one graph without overwhelming it with connections. This would also be beneficial for teachers of Greek myth who want to focus on visualising particular parts of the tradition.

Given the digital nature of the platform and the desire to make it publicly-accessible, the website would benefit from dynamic resizability of the graph and multi-platform support. Currently it is only compatible with desktop internet browsers, as the graphs do not show in other platforms such as tablets and mobile devices. Once even more ties and entities are added to the MANTO database, there is talk of making MANTO data available and queryable through services such as SparQL, which would make the data from MANTO more publicly-accessible.

Currently the data for the MANTO website requires a manual export from the NodeGoat database, followed by a manual conversion to JSON format, which is then parsed to a relationships.json format that can be used for the genealogies. This then needs to be manually uploaded to the webpage. This creates delays with new reference texts showing up in the database, so future iterations of the website could be synchronised with updates in MANTO NodeGoat, with automatic exports and conversions to reflect updates to the database in real-time.

Lastly, the purpose of the current MANTO is to show genealogical connections, whereas the MANTO database itself has more non-genealogical connections than genealogical. In other words, the platform is a comprehensive list of all genealogical information inside MANTO, but it does not exploit the full capabilities of the MANTO ontology. There is no platform that extracts the other types of connections from MANTO and makes it publicly-accessible. This is a potential future iteration of the platform; to generate a MANTO database that takes a list of adventures (e.g. Odysseus' journey, and Heracles' labours) from Greek myth and exports these

events into a timeline chart to show the progression of the adventure over time.

6.3 Overall Project Limitations

This project produced the first graph platform that could create dynamic family trees for a mythic tradition in ways that satisfied even the experts in the field. It resolved numerous unique problems in creative ways, and in doing so provides a prototype for further visualisations of the fuller MANTO data.

This project included two rounds of user testing, which identified several points of concern, and led to numerous specific improvements of the platform. The most important and higher-level criticisms of the project put forward by respondents have involved aspects which are beyond its scope, as previously discussed in Sections 4.4 and 5.1, and even in 6.1. Examples of said criticisms are adding more reference texts, exploring contestation between different authors' retellings, and using the fuller MANTO data set to show geographical, temporal and visual materials. Although many of these features could have been implemented – especially since more texts have been added to the MANTO database at the time of this thesis' submission – these expectations were unrealistic for a project at this stage of infancy. Instead, we wanted to explore the best baseline representation of complex genealogies in a manner befitting to those invested in Greek and Latin literature. As such, we intentionally restricted the data to a small set of carefully selected texts (e.g. Apollodorus' *Library* and *Epitome*) that also gave a very broad overview of the tradition of mythic genealogies. These texts also contained examples of all of the main instances of 'unusual' births we were seeking to visualise without providing so much data that would overwhelm a project in such an early stage of development. The choice to limit the MANTO data to genealogical ties was necessary because of the particular challenges that these relationships posed, and it spoke to our desire to generate an accurate – as opposed to overwhelming – representation of Greek myth that is closely aligned to the source material.

In other words, the recommendations provided above are useful indicators for the future, but not for this stage of the project. If anything, these limitations play homage to the vastness of the topic itself, and the never-ending need for further work.

6.4 Summary

In this chapter we explored potential avenues of future work for MANTO. We addressed the suggestions from the second round of user interviews and proposed some modifications to future iterations of the system. We also recognised the platform's limitations, but acknowledged that the system we currently have is sufficient for this stage of the project's development.

Chapter 7

Conclusion

In this chapter, we conclude this thesis. Section 7.1 evaluates our work and discusses whether it has achieved the goals established at the start of this project. Section 7.2 summarises the points covered in this thesis and briefly acknowledges the potential for a bigger scope of influence.

7.1 Evaluation of Our Contribution

Greek mythology is inherently complex; rife with contestation, incest and unusual relationships. No attempts to visually represent this information have satisfactorily accommodated these complexities. Even attempts at displaying these relationships in the digital realm do not adequately reflect the dynamic nature of these relationships.

It is clear from the results of the user interviews (Sections 4.4 and 5.4) that there is a need for a system that can systematically, consistently, and intuitively display these complex genealogies in a manner true to the ancient texts. At the commencement of this project, we firmly believed that by creating a bespoke and interactive graph layout along with a searchable publicly-accessible interface and tailored data cards for each entity in Greek myth, we would take the first steps towards addressing these needs. Hence, we generated three distinct research questions that would define our project success, and we evaluate our contributions now:

How can we organise raw references from Greek mythology in a way that is systematic, consistent, and accessible? The creation of the MANTO ontology prior to this project was an attempt to systematically organise the raw references of Greek myth into a database of concrete connections between entities in the storyworld. In the process of this project, we optimised the ontology and guided its development into a computationally-digestible database, focussing on achieving consistency in relationship representation. Once this was achieved and these guidelines were enforced in subsequent additions to the database, the generation of a public-facing website ensured the genealogical connections within this data were accessible and represented consistently in each entity's page. In other words, this research question was applied, and referenced consistently throughout the project.

How do we design an intuitive interface that represents complex, non-traditional genealogical data? The website designed for this platform contains a searchable list of all entities in the Greek mythic storyworld found in Apollodorus' *Library* and *Epitome*, and also has a dedicated page for every entity with corresponding data cards and a genealogical graph. The design of the data cards and graphs highlight the unusual, contested and incestuous relationships prevalent in Greek myth, and successfully did so according to a majority of the users interviewed. By having multiple interactive components and navigational options – such as tailored URLs, a search function, genealogical links in each data card, clickable graph nodes, clickable connections, and links in various relationships' information pages – the interface encourages the user to explore the website to their liking. As such, the interface is generous [Whitelaw, 2012] and represents complex, non-traditional genealogical data in an intuitive manner. This statement is further supported by the positive feedback from the two rounds of user tests, in particular referencing the users who consistently went "down a rabbit hole" when using this system – an implicit sign of an intuitive interface.

How do we provide genealogical data in a format beneficial to those invested in Greek and Latin literature? Based on the user interviews, scholars – researchers of Greek myth – were enthusiastic about the prospect of a digitized and comprehensive source for genealogical information. Researchers benefited from the interface's consistent references to the original text, and expressed that having multiple ancient text citations could make MANTO supersede even textbooks as a reference guide. Students, teachers and researchers of Greek myth found use for the website as a reference tool, but researchers found the website to be more beneficial as a teaching resource, with some even suggesting putting it in their teaching syllabus for future semesters.

All in all, despite the project still being in its infancy, based on the results from the user interviews it was able to satisfactorily address most – if not all – of the above research questions. Based on this information, we deem the project to be a success, but there is still much that can be done to improve the platform.

7.2 Summary

In this project, we generated a data-visualisation platform for the inherently-complex family structures of entities in the Greek mythic storyworld, viewable at https://yayalu.github.io/greekgraphs.

Chapter 1 introduced the project and its motivations.

Chapter 2 investigated related works, such as existing representations of Greek mythical genealogies, papers on genealogy visualisation techniques, genealogical data structures and open-source graphing frameworks. In the process we revealed

the inherent bias towards traditional relationships in existing genealogical software.

Chapter 3 explored the MANTO ontology developed by Dr Greta Hawes and Prof. R. Scott Smith, as well as how the ontology was shaped according to the parameters of this project. It also delved into the development process of our publicly-accessible digital platform (with data cards and a search facility) that navigates these genealogies.

Chapter 4 described the development process undertaken for the first few interactive graph prototypes, as well as the content and inspiration behind the first round of user interviews.

Chapter 5 responded to the interview feedback, and described the design considerations for an updated prototype. It then provided the content and inspiration behind a second round of user interviews.

Chapter 6 responded to the feedback from the second round of user interviews. It then discussed other potential areas for future work, and expressed the limitations of the current prototype.

Finally, in Chapter 7, we evaluated our contributions and concluded our project.

Though the project is still in its infancy, the overwhelmingly positive feedback from reviewers and its ability to satisfactorily address the three research questions proposed at the commencement of this project, indicate it has been a resounding success.

However, this project is more than just a useful tool for understanding and exploring the Greek mythic tradition. It acknowledged the many and various ways in which gods and heroes are born, and the many alternative definitions of parent-child relationships, which – in doing so - highlighted the inherent gaps in our usual conceptions of family dynamics. We exist in a world in which artificial insemination, adoption, polyamory, and blended families are facts of life, and in which cloning and genetic modification are on the horizon. Conventional family trees are too narrowly constrained by linear, hierarchical conceptions to display such complexity, and this project also suggests new ways to address these challenges.

Bibliography

AncestryDNA, 2020. Ancestrydna: The world's largest online consumer dna database. https://www.ancestry.com/dna/. (cited on page 2)

Apollodorus. *The library*. Harvard Univ. Press. (cited on pages 1, 6, 7, 8, 46, and 68)

Atsma, A. J., 2019a. Theoi greek mythology - exploring mythology in classical literature art. https://www.theoi.com/. (cited on page 12)

Atsma, A. J., 2019b. Theoi greek mythology - exploring mythology in classical literature art. https://www.theoi.com/Tree.html. (cited on page 12)

Atsma, A. J., 2019c. Theoi greek mythology - exploring mythology in classical literature art. https://www.theoi.com/Heros/Kekrops.html. (cited on page 75)

Atsma, A. J., 2019d. Theoi greek mythology - exploring mythology in classical literature art. https://www.theoi.com/Khthonios/HaidesPersephone1.html. (cited on page 94)

Bezerianos, A.; Dragicevic, P.; Fekete, J.-D.; Bae, J.; and Watson, B., 2010. Geneaquilts: A system for exploring large genealogies. *IEEE Transactions on Visualization and Computer Graphics*, 16, 6 (2010), 1073–1081. doi:10.1109/tvcg.2010.159. (cited on pages xv and 17)

Bremmer, J., 1986. *Interpretations of Greek Mythology*. Barnes Noble Books. (cited on pages 2, 5, and 6)

Buxton, R., 1996. *Imaginary Greeece*. Cambridge University Press. (cited on page 6)

Caldwell, R., 1993. *The origin of the gods*. Oxford University Press. (cited on page 1)

D3.js, 2020. https://D3.js.org/. (cited on page 25)

Dobbs, D., 2020. The risks and rewards of royal incest. *National Geographic*, (2020). https://www.nationalgeographic.com/magazine/2010/09/tut-dna-dobbs/. (cited on page 18)

Euripides and Allan, W., 2008. *Euripides' Helen*. Cambridge University Press. (cited on pages 1 and 76)

Evans, B., 1991. *Dictionary of Mythology*. Laurel. (cited on page 1)

FamilySearch.org, 2020a. https://www.familysearch.org/developers/docs/guides/FamilyTree-data-objects. (cited on pages xv and 20)

FamilySearch.org, 2020b. https://www.familysearch.org/developers/docs/guides/gedcom. (cited on page 19)

Fischer, P.; Sauer, A.; Vogrincic, C.; and Weisweiler, S., 2010. The ancestor effect: Thinking about our genetic origin enhances intellectual performance. *European Journal of Social Psychology*, 41, 1 (2010), 11–16. doi:10.1002/ejsp.778. (cited on page 1)

Gantz, T., 1996. *Early Greek myth*. Johns Hopkins University Press. (cited on page ix)

GEDCOM-X, 2020. http://www.gedcomx.org/About.html. (cited on page 19)

Harten, B., 2020. Gedcom and formal standards organizations. (cited on page 19)

Hawes, G. and Smith, S. R., 2020. Documentation. https://www.manto-myth.org/documentation. (cited on pages 29, 30, and 39)

Henry, T. R. and Hudson, S. E., 1991. Interactive graph layout. *Proceedings of the 4th annual ACM symposium on User interface software and technology - UIST '91*, (1991). doi:10.1145/120782.120788. (cited on page 18)

Hesiod. *Theogony*. Harvard Univ. Press. (cited on pages 1 and 7)

Holtcamp, W., 2009. Lone parents: Parthenogenesis in sharks. *BioScience*, 59, 7 (2009), 546–550. doi:10.1525/bio.2009.59.7.3. (cited on page 7)

Holten, D., 2006. Hierarchical edge bundles: Visualization of adjacency relations in hierarchical data. *IEEE Transactions on Visualization and Computer Graphics*, 12, 5 (2006), 741–748. doi:10.1109/tvcg.2006.147. (cited on page 18)

Hott, J. R.; Martin, W. N.; and Flake, K., 2018. Visualization of complex familial and social structures. *Electronic Imaging*, 2018, 1 (2018), 314–1–314–9. doi:10.2352/issn.2470-1173.2018.01.vda-314. (cited on pages xv, 14, 15, and 16)

Jose de Carli, G. and Campos Pereira, T., 2017. On human parthenogenesis. *Medical Hypotheses*, 106 (2017), 57–60. doi:10.1016/j.mehy.2017.07.008. (cited on page 7)

Kalia, K., 2020. *Graphviz Example: Family Trees*. https://graphviz.org/Gallery/directed/kennedyanc.html. (cited on pages xv, 26, and 27)

Khan, R., 2020. Inbreeding and the downfall of the spanish hapsburgs. *Discover Magazine*, (2020). https://www.discovermagazine.com/the-sciences/inbreeding-and-the-downfall-of-the-spanish-hapsburgs. (cited on pages xv, 18, and 19)

Kim, N.; Card, S.; and Heer, J., 2010. Tracing genealogical data with timenets. 241–248. doi:10.1145/1842993.1843035. (cited on pages xv and 14)

Legacy9, 2020a. https://legacyfamilytree.com/. (cited on page 21)

Legacy9, 2020b. https://legacyfamilytree.com/DeluxeEdition.asp. (cited on page 21)

ludios, 2004. Greek gods family tree. https://ludios.org/greekgods/. (cited on pages xv and 10)

lutzroeder, 2020a. https://github.com/dagrejs/dagre. (cited on page 26)

lutzroeder, 2020b. https://github.com/dagrejs/dagre-d3. (cited on page 26)

Mcleod, S., 2018. Oedipus complex. https://www.simplypsychology.org/simplypsychology.org-Psychosexual-Stages.pdf. (cited on page 1)

misterblanket, 2020. https://github.com/mister-blanket/gedcom-d3. (cited on page 26)

Noyce, D., 2017. Mormon genealogy library unveils a fun new way to discover your roots. *The Salt Lake Tribune*, (2017). https://www.sltrib.com/news/mormon/2017/03/02/mormon-genealogy-library-unveils-a-fun-new-way-to-discover-your-roots/. (cited on page 23)

Plutarch and Goodwin, W. W., 1878. *Plutarch's Morals*. Little, Brown, and Co. (cited on page 94)

RootsMagic, 2020. https://www.rootsmagic.com/RootsMagic/Features.aspx. (cited on page 23)

Sailors, C. L., 2007. The function of mythology and religion in ancient greek society. *Electronic Theses and Dissertations*, , 59 (2007). https://dc.etsu.edu/etd/2110. (cited on page 1)

Smith, R. S.; Trzaskoma, S.; and Hyginus, C. J., 2007. *Apollodorus' Library and Hyginus' Fabulae*. Hackett Pub. (cited on pages ix, xv, 11, and 60)

Syamili, C. and Rekha, R., 2018. Developing an ontology for greek mythology. *The Electronic Library*, 36, 1 (2018), 119–132. doi:10.1108/el-02-2017-0030. (cited on pages 10, 11, and 12)

Vijverberg, K.; Ozias-Akins, P.; and Schranz, M. E., 2019. Identifying and engineering genes for parthenogenesis in plants. *Frontiers in Plant Science*, 10 (2019). doi:10.3389/fpls.2019.00128. (cited on page 7)

Whitelaw, M., 2012. Towards generous interfaces for archival collections. *Comma*, 2012, 2 (2012), 123–132. doi:10.3828/comma.2012.2.13. (cited on pages 2, 37, and 98)

Wikipedia, 2020a. Aphrodite. https://en.wikipedia.org/wiki/Aphrodite. (cited on pages xv and 13)

Wikipedia, 2020b. Family tree of the greek gods. https://en.wikipedia.org/wiki/Family_tree_of_the_Greek_gods. (cited on page 9)

Appendix A - Questions for User Interviews Round 1

As mentioned in Section 4.3, these questions were used as guidance only, and were not strictly adhered to. By adopting a conversational style, we were able to encourage exploration and insight. Note that all of these website links and diagrams were provided to the users via email prior to the interview, to allow extra opportunity for insight.

A.1 Part 1: Exploration of the Website

- Did you have any notes for the website while you were exploring it for yourself prior to this interview?
- If I were to ask you to find the father of Apollo and its location in the original text, how would you find this information?
- Is the data card system useful for you? Is the link to the original text useful?
- Did this data card system make sense to you?
- Would you use this system? If so, when? If not, why not?

A.2 Part 2: Exploration of Graph Prototypes

We asked the participant to navigate through the graph prototypes website (https://yayalu.github.io/greekgraphs-prototypes) and discuss their impressions of each of the layouts in terms of benefits, disadvantages, aesthetic appeal, and applicability for Greek myth genealogies. The following were the graph types investigated:

- Force-directed non-hierarchical graph
- Force-directed collapsible graph
- Radial tidytree

- Radial cluster dendrogram
- Semicircular ancestor fan
- Quarter ancestor fan
- Booklet of descendants
- Narrative booklet
- Timeline chart
- Linear tidytree
- Linear cluster dendrogram
- Hierarchical directed acyclic graph (Prototype 1)
- Horizontal pedigree chart
- Vertical pedigree chart
- Vertical staggered pedigree chart (Prototype 2)

We also enquired about the following aspects:

- Which style do you prefer? Why do you gravitate towards that style?
- Do you prefer having ancestors, descendants, or both in the graphs?
- Is it useful to have a graphical interface for genealogical data?

A.3 Part 3: Interaction Diagram

- Did you have any notes for the diagram while you were exploring it for yourself prior to this interview?
- Looking at the diagram, is it clear what the difference between disputed, unusual and traditional relationships are?
- Are these distinctions between types of relationships in the graph useful for you?
- Would you use these distinctions? If so, what for, if not, why not?
- Is there anything particularly unclear about these diagrams?
- Is there anything missing from this diagram?
- Is there anything you want more of or want a greater emphasis on?
- What do you think are the benefits or disadvantages of highlighting these kinds of interactions (if any)?

A.4 Part 4: Post-Exploration Questionnaire

- Prior to this interview, what were your expectations for the platform? (i.e. based on information provided in the expressions of interest email from Dr Greta Hawes)
- Did the platform meet these expectations? Why/why not?
- What is the most appealing feature of this platform for you?
- Was there anything unappealing or restrictive about it?
- Do you wish there was something else or something different that it could do?
- Did looking through this platform give you any new insights into Greek mythology?
- Is the idea of addressing complexities (e.g. unusual relationships – incest and autochthony – and disputed tradition) of interest to you?
- What do you think are the benefits or disadvantages of addressing these kinds of complexities?
- What do you think are the true complexities of the Greek mythos?
- What other complexities might there be that we could address in the future?
- Are there any other things you would want to discuss about the project?

Appendix B - Interview Insights from User Interviews Round 1

All users consented to having their full names attributed in the interview responses

B.1 Scholars Interviewed

- Dr Emily Pillinger = **EP**
- Dr Gabriel (Gabby) Bodard = **GB**
- Dr Emma Aston = **EA**
- Prof. Joel Christensen = **JC**
- Prof. Emma Stafford = **ES**
- Ari Toumpas = **AT**
- Prof. Lee E Patterson = **LEP**
- Prof. Scott Smith = **SS**
- Rebecca Rusk = **RR**

B.2 MANTO Website (Search Function, Data Cards and Homepage)

B.2.1 Good

- Want to see all cases where a specific person is referenced (EP)
- Use this platform to find out more about a specific entity they have not come across before (EP)
- Nice that there is a link to the text in the Scaife Viewer (GB, AT, LEP, SS)

- Link to the original locations makes this much more useful than Timothy Gantz's book (AT)
- Moving between family members through linked names in the data cards (JC, SS)
- Clean, intuitive interface. Simple elegance. (JC, AT, LEP, SS)
- I can't think of another drop-down menu where you can go and find all of these entities – unique and ambitious! (JC)
- The ease of looking up any greek myth character and getting this contextual information (ES)
- Everything I would need to get the whole story about a particular entity is here.
- The separation of children with other parents to show several potential mothers (SS)
- Having the MANTO ID is important because it will be LOD at some point (SS)

B.2.2 Bad

- Only Apollodorus is used as a source (EP, JC)
- There are only the source references for the mother and father, no one else. (SS)
- Is there a better way to describe specific people? e.g. identifying Hera as "wife of Zeus" instead of an independent entity with goddess powers of her own. People could question this way to describe women in particular (EP)
- The top identifier line is potentially debatable, e.g. Aphrodite is listed as the goddess of sex and lust – that's a very colourful description of her! It's a bit reductive – she's also marriage and reproduction (ES)
- Meanwhile, Apollo is just listed as "Olympian god" – why not the same descriptiveness for Aphrodite? (ES)
- A bit thrown off by the dotted lines in the children part (GB)
- "Suitor of Penelope" is an identifier but not in the data cards (GB)
- Unintuitive that I can't choose the entity in the search bar and it will go to straight to the entity (GB)
- What about people with dyslexia? (ES)
- Suppose someone didn't have an important genealogical connection there? E.g. their main purpose is to kill people. They wouldn't be listed in the search. (AT)
- The search is alphabetical, so sometimes what you want doesn't actually come up (RR)

B.2.3 Recommendations

Filecards

- Add a quote from the original text inside the data card. Will determine what the author originally said. (EP)
- I'm opposed to the idea of a brief summary because it means picking one specific story about the entity instead of the user making that decision for themselves. But if you wanted to, add only a sentence. (AT)
- Brief description of each entity at the top of the data card (GB)
- Add grandchildren to the data cards, since grandparents are useful for heroes where their grandparents are gods. (GB)
- Specify a more well-known identifier/relationship for the entity that's not an immediate relationship, especially if that defines that person e.g. "Descendant of Apollo" rather than "Son of <an obscure entity>" (GB) A prosopography (SS)
- Include visual material, such as visual depictions of the mythologies – wall paintings and antiguities (EA)
- Inconsistencies in spelling conventions in the text – go Latin or Greek? Makes it difficult to find items (EA, LEP, RR)
  - Cronos vs Cronus vs Kronos
  - Asklepios vs Asclepios
- Genealogical collectives could be useful, but if you could just make the sons listed under their collective father despite them being a collective would also be useful (AT)
- Why is "Olympian God" not a collective in the database? (AT)
- If there are multiple children, have them in long columns as opposed to in a list. Would be easier to scroll down (SS)

Search function

- We should be emphasizing keywords and filter via keywords. So identifying information and relationship labels, but more specific experiential keywords.
  - E.g. "rock" for Andromeda, "prophet" for Tiresias. (EP)
  - E.g. List of all women chained to rocks. List of all women died by X. (EP)
  - E.g. All people who don't have mothers (GB)
  - E.g. Cases of autochthony, all cases of people born from a body part (GB, JC, RR)

  - E.g. Anyone who is a grandfather (GB)
  - E.g. Women-only graphs / matrial-lineal relationships (JC)
  - E.g. all sources from author X and Y but not author Z (LEP)

- Defamiliarise ourselves with the typical ways we tell stories.
  - E.g. the catalogue of women on the Odyssey (JC)

- Have a consistent level of identification in the search field (aka. Aphrodite should also be "Olympian god") but then have a more thorough description of the character at the top of the data card, "often known as god of X, Y and associated with <Z>"

- More tailored and prioritized search function, e.g. have the name be the main search result as opposed to alphabetically (RR)

Homepage

- Instructions on the first page on how to use the platform, e.g. how to click between entities, search with alternative names, interact with the diagram, different types of diagrams available (EA, ES)

- Add a disclaimer about what sources have been added to the database so the user knows what to search (EA)

B.3 Graph Prototypes

B.3.1 Force-directed non-hierarchical graph layout

- Like the graphs with the main node as centre focus (EP)

- Want to have a sense of going back and forth in time, this can't do that. (EP)

- Not a fan of network graphs, never found them hugely useful. (GB)

- Not insight-giving or user-friendly, and reshaping can be misleading (EA, LEP, RR)

- There is potential here – I've seen a few presentations on using ancient networks and graph visualisations to show concentration of network and influence (JC, SS)

- Don't immediately understand what the relationships are (ES, AT, LEP)

B.3.2 Force-directed collapsible graph layout

- A really smart idea (EP, ES, LEP)
- More clear and dynamic than the non-collapsible version (EA)
- Don't see the utility of this (JC)
- I like the ability to shut off a certain individual or branch of a genealogy (AT)

B.3.3 Radial tidytree and dendrogram

- Not sure what this is about (EP, ES, AT)
- It makes a decision about the data for us (AT)
- This is somewhat limited, not sure how far out / how many generations you can take this (LEP)
- Siblings and relationships are on the same level, which is a problem (EP, EA, AT)
- Tidytree keeps everything at the same level visually – not as bad (GB)
- Don't think they'll be good at teaching because they're not the typical way we look at genealogies (JC)
- Look nice and are a change from the traditional layout (ES)
- Hard to understand the degrees of separation here. (AT)
- Works for one author, not sure how it will work for multiple authors. (SS)
- Spaced out, I appreciated the aesthetics and the names, connections not as dense as other types. (RR)
- For gods – less so for the mortals – the radial graph is more straight-forward. (RR)

B.3.4 Ancestor fan

- I don't like them as much, but as a reference point it's very clear and helpful (EP)
- Nice and intuitive, but names repeat quite a lot (GB)
- As someone not familiar with the degree of incest and repetition in greek myth, it might initially require an explanation. But since I do have that background, it seems fairly self-evident. (ES)

- Repeated names could be beneficial if you count up the number of times the name occurs. Get a sense of how embedded they are in the genealogy. (EA, SS)
- Fascinating how broad it goes (JC)
- Clear and immediately spoke to me. (ES)
- A cool and appealing looking image to print out and put in a handout (AT)
- More dense text-wise and intimidating as an initial approach. Radial graph is friendlier to look at (RR)

B.3.5 Booklet

- So much information it's almost like the original texts (EP)
- Filecards fulfil the same purpose as the booklet (AT)
- Desire for more visualisations
  - The visualisations are the fun part of this project, this has none of it (EP)
  - Booklet is useful but not a visualisation format (GB)
  - Traditional but not as much fun (ES)
- I like the use of keywords in the booklet, e.g. "this is an incestuous relationship" (EP)
- "This couple did not marry" is irrelevant information (ES, AT)
- A good research tool for students (JC)
- It offers a clean, organised, highlight of all the relationships – the bold helps refer to other things within it. It's really great, I would have this on my desktop (SS)
- This looks like hard work (to read)! (ES)

B.3.6 Timeline chart

- Mythical events are hard to conceptualise (EP)
- Different people have different ideas of chronology (LEP)
- Not easy to see how this would apply in greek myth (ES)
- Don't have the date data for this (GB)
- Very useful, something we could possibly adapt to greek myth (JC, SS)
- Could be useful if instead of years it was events ('mythical time markers') on the x-axis (AT)

B.3.7 Linear tidytree and cluster dendrogram

- Probably the most useful because people are used to genealogical charts (JC)
- Slight preference for dendrogram, because they keep everyone in order (ES)
- Same problem as radial graph (AT)

B.3.8 Hierarchical directed acyclic graph (DAG) (Prototype 1)

- I quite like this (EP)
- Indicates the types of connections without necessarily being on the same level (EA)
- Beautiful and clearly laid out (JC)
- Don't like "sibling", "child", "other parents" outside of the circles, I'd be in danger of not spotting it. (ES)
- Messier version of the current prototype (AT)
- I don't like the arrows in terms of aesthetic (LEP)
- Interesting to look at (SS)

B.3.9 Horizontal and vertical genealogical tree

- Not that different from the kind of things people can draw for themselves. Very clear, not very memorable (EP)
- What we expect to see from a family tree. Vertical tree is especially messy. (GB)
- This one spoke out to me because it's so familiar. (EA)
- Can't see any reason not to have these charts – classic, usable, especially the vertical one (JC, LEP)
- Potentials for duplication here (LEP)
- Complicated because Nyx keeps coming back into the picture / repetition, but I like this. (SS)

B.3.10 Staggered hierarchical graph (Prototype 2)

- Lines overlapping creates issues
  - It's not clear who the parents of each child are due to lines overlapping (EP, AT, SS)

  - The number of lines that cross make it really odd. If we were able to move nodes into separate sections to remove crossing of lines that would be good (GB)
  - Would be easier to read if we could toggle on/off the figures I'm seeing. (AT)
  - You need prior knowledge of the tradition to understand this. (SS)

- Can't see any reason not to have these charts – same reason as vertical/horizontal tree (JC)
- I think this is how I would first think if I was advising people to create a chart / what I would come up with (ES)
- Fairly immediately comprehensible, just n0t as pretty as the linear tidytrees and dendrograms aesthetically. (ES)

B.3.11 Recommendations

- For the ancestor fans, hyperlink each name, and when clicked show the information from the booklets (EP).
- For the ancestor fans, go down generation by generation to ensure with big graphs the writing doesn't get too small (LEP)
- For the current prototype, if the lines are less squared and follow a curved line it could be easier to read overlaps. (EP, ES)
- For the radial graphs, if this graph were linked to larger / other circles, and you could zoom out and in, I suppose there is value. E.g. click on a name in a circle, zoom into a whole new circle.
- If we cursor-hover over the line, the line is highlighted and the connection is made clear – emphasizes the interactive elements of the graph. (EP, SS)
- Provide the option to export the booklet as a PDF from the webpage – as long as it's not the main graph tool used. (GB)
- Want to have the booklet as an addition to the graphs, but not the main visualisation format (SS)
- Vertical trees can be really messy – if we were drawing them by hand we could move that node to a different empty space but can't do that easily in an algorithm (GB).
- Make different types of graphs available, because different people have different ways of interpreting/approaching data. Variety is good. By visualising things differently, you're able to understand things differently (EA, JC, SS)

- Make graphs exportable to JPEG format (JC)
- Be able to download / screenshot a particular part of the graph (AT)
- If I want to screenshot it and send it to students, I would want to collapse a part of the tree and only send them what I need. E.g. collapse certain branches, individuals and variants. (AT)
- Making the incestuous relationship under the connection itself, but only direct incest, not first-cousins etc because that'll be too difficult and complex (AT)
- Add the MANTO ID to the graph nodes to show that two entities are the same.
- The more connections that can be seen, the better (AT, SS)
- Look at http://www.sixdegreesoffrancisbacon.com/?ids=10000473&min_confidence=60&type=network, which visualises the 6 degrees of Francis Bacon. Might help with understanding how to code graphs. (SS)

B.3.12 Most preferred graph style

- Current prototype (EP, AT)
- Vertical and horizontal trees (GB, AT)
- Linear tidytree and dendrogram (ES)
- Any of the linear graphs (LEP)
- Network force-directed graph (SS)
- Circular tidy-tree and dendrogram (SS)
- DAG (SS)
- Radial graph (RR)

B.3.13 Ancestors, descendants or both

- Both because want to know as much as possible about each entity's relationships to understand the significance of those relationships. (EP, EA, ES, AT, LEP)
- Both, but not necessarily in the same graph (GB, SS)
- Generate either ancestors, descendants or both depending on the graphing parameters we specify (JC)
- Ancestors or descendants, but not both in the one graph – so many connections, want to separate them so the graph is still straight-forward. (RR)

B.4. Interaction Diagram

B.4.1 Good

- I like that by clicking on the node you're directed to the graph for that entity where the clicked entity is now the centre! (EP, GB, AT, LEP, RR)
- Coloured lines to mark disputed tradition and unusual relationships (EP, GB, AT)
- Revealing the complexities, demonstrating how complex this data is (EP, RR)
- Forces the user to think rather than nonchalantly accept it as the truth (RR)
- Unusual relationships are useful to draw attention to what is commonly occurring in greek myth (GA).
- The idea of "dispute" has a small scope so it doesn't have to deal with the overwhelming number of types of disputed connections (GB)
- Clickability of elements provides an advantage over text (EA)
- I like the icons – autochthony and parthenogenesis! (EA, ES, AT, RR)
- Having "other places of" is useful (ES, AT)
- The descriptions are clear. (LEP)

B.4.2 Bad

- Accessibility issues – red and blue are not as bad as red and green, but some people still wouldn't be able to see it (GB)
- Unusual relationships are the norm in greek mythology, not the exception. Could become complex and there could be dispute about what is truly unusual. (GB, EA, JC, ES, RR)
- Not clear what the hierarchy between unusual and disputed relationships are. What if the relationship was disputed and unusual? (GB, LEP, RR)
- Clickable lines might be hard to notice / unintuitive. (JC)
- "Textual inconsistency" and "Disputed tradition" titles debatable
  - Use "multi-form / variable" instead of :textual inconsistency". Because textual inconsistency implies one answer is the correct one, whereas in greek myth there are multiple valid options. (JC)
  - "Textual inconsistency" is misleading – it sounds like there is an issue in the manuscript (AT)
  - "Inconsistency in tradition" instead of "textual inconsistency" (SS)

- "Unusual relationships" examples are disputable (GB, SS)
- There's a danger that with highlighting these aspects, you're discouraging people from looking at other parts of greek myth (ES)
- What if someone adds text later that means it becomes disputed, but the user previously saw it was convention so they don't bother re-checking the website. So they keep assuming it's conventional when it's not (RR)
- A user should be able to draw conclusions about incestuous relationships in the graph for themselves – should be intuitive from the graph (AT, SS)

B.4.3 Recommendations

- Accessibility fixes: instead of colours for accessibility, maybe weighted lines or dashes instead. Or possibly label the links in addition to colours. The legend is very important for this. (GB)
- Emphasize the information box, because otherwise no idea what the nodes and links mean. (GB)
- Make the interactive lines thicker (JC)
- Add more information about the individual characters in the graph e.g. X is god of Y, Y is associated with <Z> (ES)
- Check if there is ever a primary disputed relationship (aka. one correct understanding of the genealogy and the rest are secondary disputes). (RR)

B.5 General Insights

B.5.1 Overall opinions of the system

- There is nothing in the system that deals with if two people are the same person (GB)
- Books can't cope with greek myth because of the linear nature of conventional narrative. It's good that someone is using the flexibility / interactivity of the web to do this (EA, AT)
- The preferred graph type is going to depend on personal preference and what information people will want to get out of it / context specific (EP, EA, AT)
- The visualisation that you get with a graph makes the info easier to see than if you were to describe and write it out. (ES)
- Adding genealogical connections/entities from other texts/sources/authors will be more helpful (EP, EA, JC, ES, AT, LEP, SS, RR)

  - Do we have any plans for adding multiple users to help add more sources? (JC)
  - What about the family relationships in Homer heroes? They often don't come from the text; rather, some marginal note in the script that some other author chooses to expand on. (AT)
  - Possibly adding Strabo as a source (LEP)
  - How do we make it explicitly obvious what variants are from which author? (LEP)

- Other source links
  - Consider also using the Perseus website to access texts (EA)
  - Check out Theoi.com as it's a competitor website (EA, JC)
  - Check out Suda at https://www.cs.uky.edu/ raphael/sol/sol-html/. (JC)
  - Oxford Classical Dictionary (RR)
  - A few referenced Wikipedia as a good alternative source for greek mythology data. (GB, JC)
    * Wikipedia would have more texts and be more complete references for the more famous entities. (GB)
    * However this is more efficient to sift through than the large chunks of data from Wikipedia. (GB)
    * Wikipedia would be a good medium (JC)
    * User Wikipedia links for mythical figures, because the links seem to have pretty high quality information with lots of variance (JC)

- Once the number of relationships increase, the list will become more complex and difficult to read, and the graph will be useful to visualise the information (GB)

- Would spend hours looking through the system, i.e. down the rabbit hole (GB, EA, ES, LEP, RR)

- MANTO will be reached for more than the other reference formats (books) with practice/habit. (EA, ES, AT)

- However if you start getting into fragmented and debated text, it will be much harder so books would maintain their primacy over MANTO here (EA)

- The most appealing feature is that I don't have to go through powerpoint and draw shapes etc. to make these images myself (AT)

B.5.2 Higher-level recommendations

- Draw a distinction between divine and mortal characters, or characters of elements e.g. nymphs (EP)
- Have different colours for Olympian gods, demigods, nymphs and mortals to give a sense of the cosmic dimension of the mythology (EP)
  - Could also use different icons
  - Could add colours to the legend at the top
  - Could mark on the node rather than the connection itself.
  - Could be identified by the colour of the text
- Adding geographical data and date data
  - Giving geographical location of some of these entities. "Are there any mythological families in icily?" (EP) "These are genealogies from Thebes" (JC, LEP)
  - See how entities travelled the world, as these stories are about travel as well as fixed dynasties (EP)
  - Would want geography (GB)
  - Offer a heatmap of people from that region of ancient greece
  - Highlight regional variatioin, used in disputed relationships – "there's two different versions of the story, one seems associated with a certain location ore than the other". Could be offputting at the early stages of a prototype though to show that level of complexity. (ES)
  - Consider what MythMap is currently doing (LEP)
  - All cases of autochthony should have a geographical location attached as it ties them to that specific location (SS)
- Adding date data
  - Would want dates (GB)
  - Dates might help with multiple disputed lineages (RR)
  - Add in dates for when Apollodorus said X information, e.g. a rough date of the composition of the text you're using. Or the first date the text was written. People are interested in change (RR)
- Adding astronomical data and constellations (LEP)
- Adding influences from other mythological cultures / how those different representations in other types of cultures draw parallels / crossovers (RR)

- Clarify what the different types of family relationships mean and the significance of those – what expectations do you have of a brother and sister? The human expectation is not that you will marry them, but it is for the gods. (RR)
- Request for us to release the MANTO data in LOD through SparQL for public use, so that anyone can query the database externally. (GB)
- We have to make it clear that a lot of what is happening in greek mythology is rape and sexual violence. We don't want to gloss over that, so maybe have a disclaimer page mentioning that this is the case. (JC)
- What about different types of incest, e.g. Type 1 with Adonis where the incest is a significant part of the story, or e.g. Type 2 where brothers and sister marry because it's the beginning of time and people haven't existed yet. It seems difficult / unnecessary to group them into the one. (AT)
- I want the user to have the freedom to click buttons and arrange things to tell a specific story for their own purpose. (AT)
- Have large genealogies and small genealogies – get the small and big picture of the genealogy (AT)

B.5.3 Usefulness and applications

- Usefulness as a research tool
  - To get clarity on something when you don't have time to look it up in a book (EP)
  - Not so much for researching myth (GB)
  - MANTO would be a good baseline and casual reference, rather than serious research (EA)
  - For reference rather than use it for it major insights (EA)
  - I would use it as a teacher rather than for research (LEP)
  - I would use it for both teaching and research (AT)
- Usefulness as a teaching tool for university students
  - For a student where reading the text could be overwhelming (EP, ES)
  - A clarifying tool if students get confused (EP)
  - Students are allergic to complexity, but the fact that this is so easily clicked through, would help address that (ES)
  - Would put this tool in my syllabus (EP)
  - Highlighting "weird stuff happened here" for students makes it pretty fun (GB, ES)

  - Make <the user> feel comfortable about what might be slightly uncomfortable material (ES)
  - My undergraduates would get a lot of benefit out of this website (EA, AT)
  - Less frightening than looking at a book (EA)
  - Can create a quick and easy genealogical graph to use in teaching (JC)
  - Allow students to navigate between platforms and links without having to search through Google. (JC)

- Usefulness for the general public
  - Useful for them to see at a glance the whole story of the genealogy. (GB)
  - Looking up individual characters and whether they're related (ES)

B.6 Summary

1. All scholars said that having more textual references per relationship would significantly increase their interest in using the system, however most expressed concern that it could not be done – "too complex"

2. Only some scholars saw merit in using the system for their own research – if they forget the name of an entity they can quickly search it up. But most found their research to be too esoteric to be used with the website.

3. All scholars saw the website as being more beneficial for teaching – both as a tool to screenshot for lecture slides, and a link to give to students for their own assignments – than for their own research.

4. A majority of scholars noted the fact that unusual relationships in greek mythology are the norm and not the exception, therefore the number of unusual connections in the graph could become overwhelming

5. Scholars consistently wanted the option of multiple graphs available, or expressed interest in having graphs generated according to their preferences. However a majority of the scholars preferred the linear hierarchical styles.

6. All scholars wanted both ancestors and descendants to be shown on the graph, but one suggested both options be available but on separate graphs.

7. Some scholars liked that the graphs showed them something new, others thought that graphs were interpreting the data for the user as opposed to the user interpreting it for themselves. Some preferred the safety of the traditional genealogical layout forms (trees) whereas others liked the increased scope of other kinds of graphs (ancestor fans and network graphs)

8. All scholars wanted a filter to be added to the search function (see above for more details)

9. Most scholars wanted a brief description about the character in each of the data cards, such as geographical location, information about their conquests, and images of the entity.

10. All scholars wanted clearer identifying information for each entity, whether it be the version of the name (Latin or Greek), more consistent description between entities (e.g. Aphrodite vs Apollo descriptors), more generic descriptors (e.g. Descendant of X as opposed to only direct relative identifiers, or a phrase associated with their story that's more identifiable).

11. All scholars found the website data card system and search functions very easy to navigate, but some would have appreciated an introduction page that explains how to use the system.

12. Every scholar was passionate and enthused about the project, and wanted information on deadlines, output dates. All wanted to be kept updated about the project's progress.

Appendix C - Questions for User Interviews Round 2

C.1 Part 1: Personal Details

Q1.1 This questionnaire serves as the user evaluation for Yaya Lu's 2019-2020 Honours Thesis, titled "Analysis and Visualisation of Complex Familial Relationships in Greek Mythology". Your user evaluation will assist with future iterations of the interface.

The information sheet for this project is here. By continuing with this user evaluation, you as the participant are consenting to have your information recorded according to the specifications in the information sheet. This user evaluation should take between 10-20 minutes depending on the depth of the answers you provide. ** Please note **At this stage the website only displays appropriately on laptops and desktop computers, not on mobile phones or tablets. This is something we will develop in the future but for the moment please consider switching to a laptop or desktop computer to fill in this questionnaire.

Q1.2 ANU Uni ID (or type "NA" if you do not have a Uni ID)

Q1.3 Email, if you would like to be sent an overview of the results of the survey in the future:

Q1.4 Are you a:

- Student studying classics or ancient history
- Teacher or researcher in classics or ancient history
- Student not studying classics or ancient history
- Teacher or researcher not involved with classics or ancient history
- Other: <text input field>

Q1.5 Full name (or pseudonym if preferred

Q1.6 Would you like to be identified in the final research publication in any of the following ways?

- Full name
- Pseudonym
- No attribution

Q1.7 What is your background in terms of expertise/knowledge of Greek mythology?

Q1.8 What do you currently use to explore ancient Greek mythic traditions?

C.2 Part 2: Exploration of the website

Q2.1 Please head to the website: https://yayalu.github.io/greekgraphs and play around with it. Once you are satisfied, head to the next page.

C.3 Part 3: General Interface Exploration Questions

Q3.1 Please answer these questions in as much detail as you like. The more answers you provide and the more in-depth, the more feedback I will be able to work with for my project. All questions are optional, so please leave the question blank if you decide not to answer it. There are no negative consequences if you choose not to answer a question; all other answers you provide will still be recorded.

Q3.2 Which part of the interface did you interact with the most?

- Data cards (the text box with relationship information above the graphs)
- Graphs
- Data cards and graphs in equal amount, or in combination
- Neither formats appealed to me
- Please explain your reasoning: <text input field>

Q3.3 How intuitive do you find the layout of the relationships in the graph (e.g. parent-child, spousal and sibling)?

- Highly intuitive
- Intuitive

- Average
- Unintuitive
- Highly unintuitive
- Please explain your reasoning: <text input field>

Q3.4 Was it obvious that the coloured lines in the graph are clickable?

- Yes
- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.5 Was it obvious that the icons were clickable?

- Yes
- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.6 Is the significance of the different coloured lines easy to understand?

- Yes
- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.7 Were the information popups for the different relationships (contested and unusual) useful? These can be accessed by clicking the icons or the coloured lines.

- Yes
- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.8 Navigate to Cecrops: first king of Athens. Does the representation of *autochthony* make sense to you?

- Yes

- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.9 Navigate to Pelasgos, Pelasgus: eponym of the Pelasgians. Is it obvious that the *autochthony* aspect is contested?

- Yes
- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.10 Navigate to Hephaistos, Vulcan: Olympian god. Does the representation of *parthenogenesis* make sense to you?

- Yes
- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.11 Navigate to Athena, Minerva: Olympian goddess. Does the representation of *born from an object* make sense to you?

- Yes
- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.12 Navigate to Ge, Gaia: personification of Earth. Does the representation of *creation without parents* make sense to you?

- Yes
- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.13 Navigate to Pandora: first mortal woman. Does the representation of *created by someone else* make sense to you?

- Yes

- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.14 Navigate to Aigialeus: son of Inachos. Does the representation of *dies without children* make sense to you?

- Yes
- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.15 Navigate to Hera, Juno: Olympian goddess. Does the representation of *spousal-sibling incest* make sense to you?

- Yes
- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.16 Navigate to Eurynome: Oceanid, mother of Charites. Do the representations of *inter-generational incest* in Oceanos and Asopos make sense to you?

- Yes
- Somewhat
- No
- Please explain your reasoning: <text input field>

Q3.17 Was the "How to use" on the top left of the screen helpful in your exploration of the website?

- Yes
- Somewhat
- No
- Please explain your reasoning: <text input field>

C.4 Part 4: Qualitative Evaluation of the Website

Q4.1 Now that you've provided some insights, please answer these feedback questions in as much detail as you like. The more answers you provide and the more in-depth, the more feedback I will be able to work with for my project. All questions are optional, so please leave the question blank if you decide not to answer it. There are no negative consequences if you choose not to answer a question; all other answers you provide will still be recorded.

Q4.2 Compared to how you normally explore Greek myth, how would you rate your interactions with this platform?

Q4.3 Was there anything that was comparatively worse, or was there a feature that you missed?

Q4.4 Did you discover anything new about Greek myth while using this website?

Q4.5 If you have never explored genealogies in Greek myth before, what did you like or not like about the website, and what are some general improvements you'd like to see?

Q4.6 Under what circumstances would you use this website in the future?

Q4.7 Do you have any other comments?

Appendix D - Responses to User Interviews Round 2

D.1 Part 1: Personal Details (Quantitative Results)

- **None:** The user explicitly states that they use no research materials for Greek myths
- **General Sources – Books:** Books used were unspecified, e.g. "local library" and "books"
- **General Sources – Digital:** Generic website references, e.g. "internet", "Google", "Wikipedia" and 'YouTube".
- **Educational Sources:** "Classics textbooks", and "historical texts"
- **Academic Sources – Research Sources:** Primary source texts, literature, reference works and commentaries
- **Academic Sources – Digital Resources:** Greek mythology-specific online resources with direct references to the source text, e.g. Theoi.com, Topostext, Perseus Scaife Viewer

D.2 Part 3: General Interface Exploration Questions

Each question in this part of the questionnaire has a number of possible options, as well as a corresponding text field where the user can enter their reasoning for their answer.

Q3.2 responses

Here is the reasoning alongside the answers (if provided):

Graphs:

- "Graphs are beautiful in their detail and interactivity"

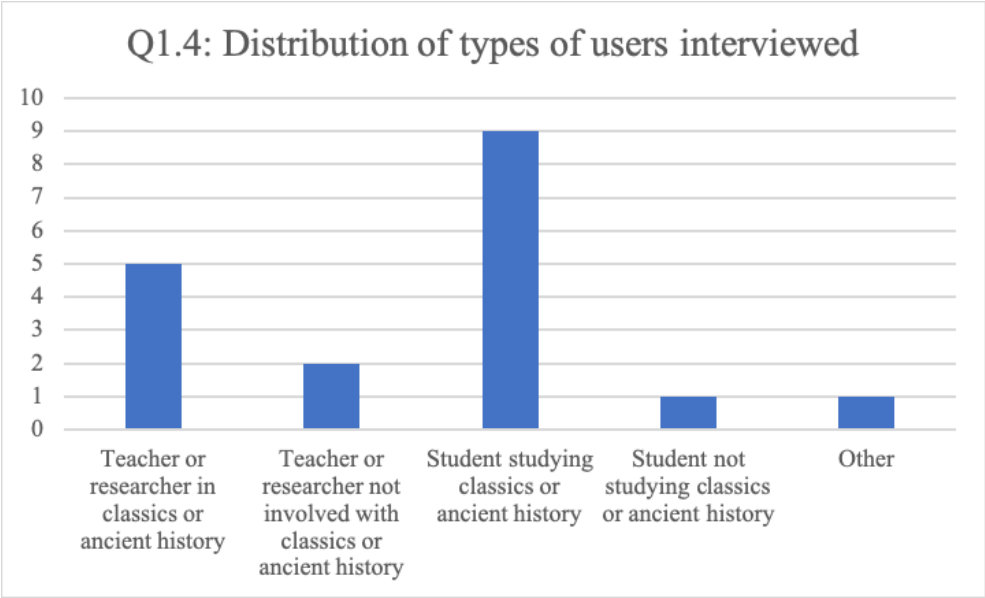

Figure 1: Results of question 1.4

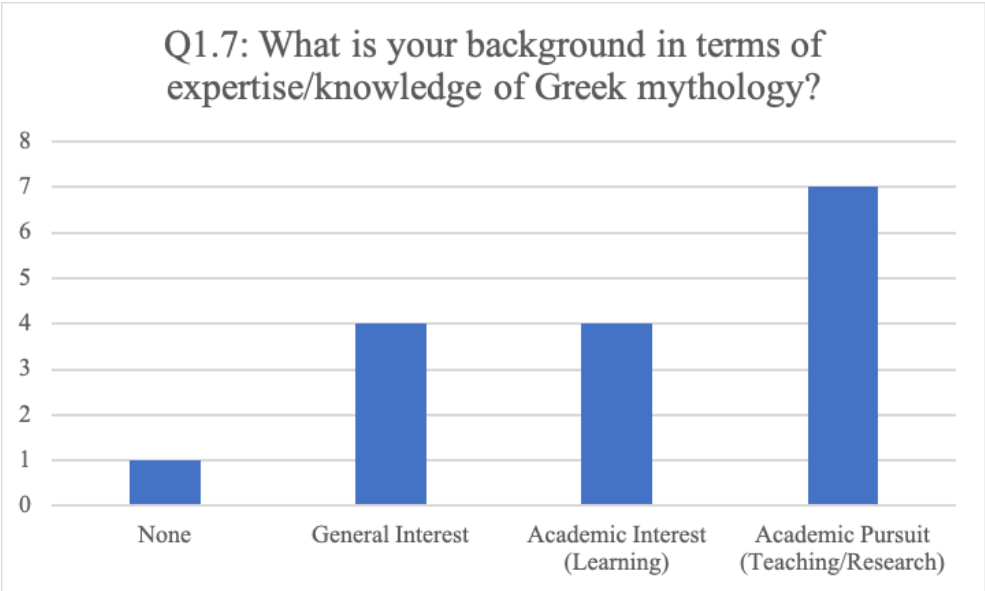

Figure 2: Results of question 1.7

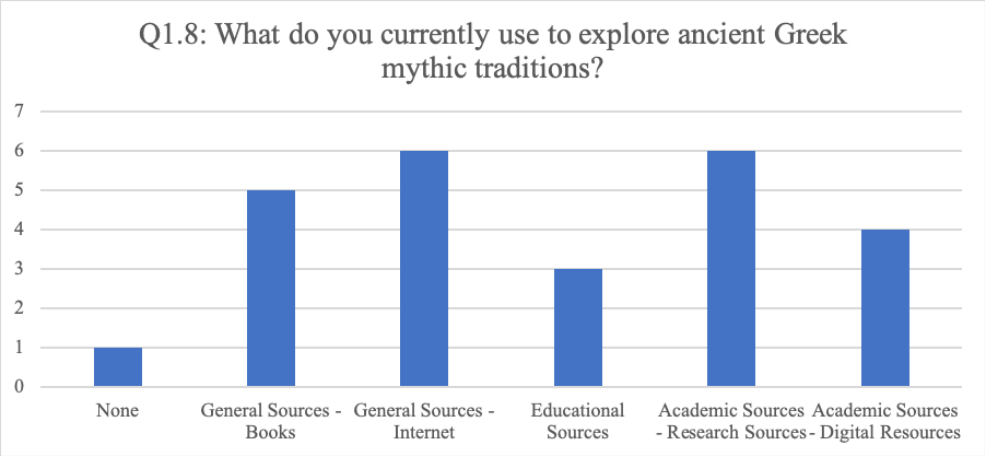

Figure 3: Results of question 1.8

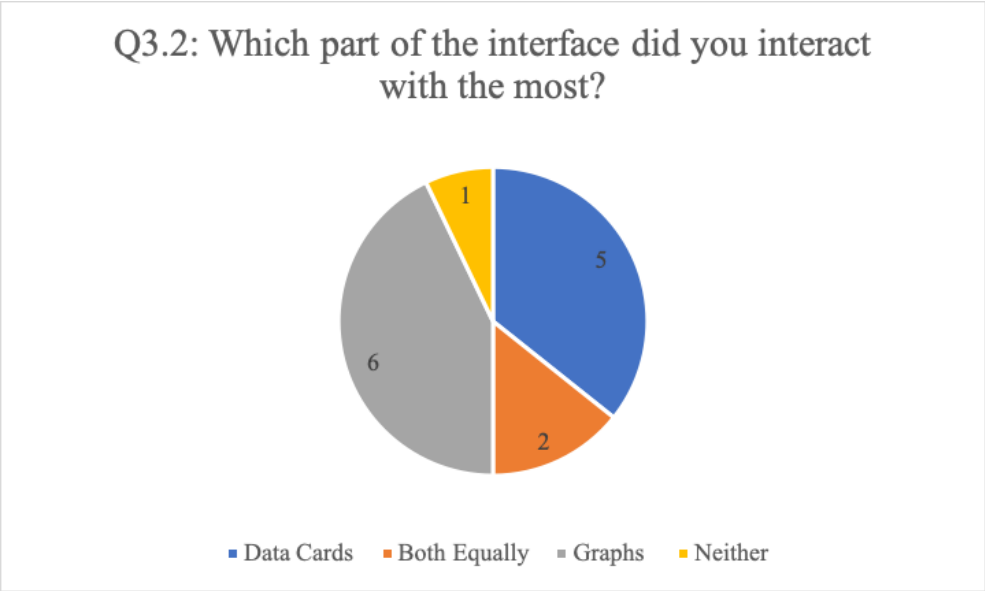

Figure 4: Collated quantitative responses to question 3.2

- "Ability to click and see contested data is very appealing"
- "I liked the layout of the graphs much more."
- "Visual aspect easier to process"
- "Graphs are useful to quickly see a visual connection"
- "As an abstract visualisation, I found the graphs of more immediate interest to explore. They're also the form with which we're used to thinking about familial relationships (tree diagrams)."
- "A bit hard to use"
- "Graph is not very precise or unambiguous (e.g. Minos' offspring)"
- "Turning to the graph, I found that the information there was abridged or not as clear"

Data cards:

- "Seemed busy"
- "I found the Data Cards clearer and more to-the-point than the graphs"
- "I found the Data Cards just as quick plus it is faster to click on another entity to see their page."
- "The cards were more useful to get to the sources"
- "The data cards contained the information I generally was interested in viewing."
- "For example, the data card will give grandparents (when applicable), but not list them in the graph."
- "The citations for the information in the data cards are GREAT"
- "Using an iPad. Was I missing something, like graph?"

Both in equal measure:

- "I would use the graph first to explore, then use the cards to get / check the information."

Neither: no reasoning given.

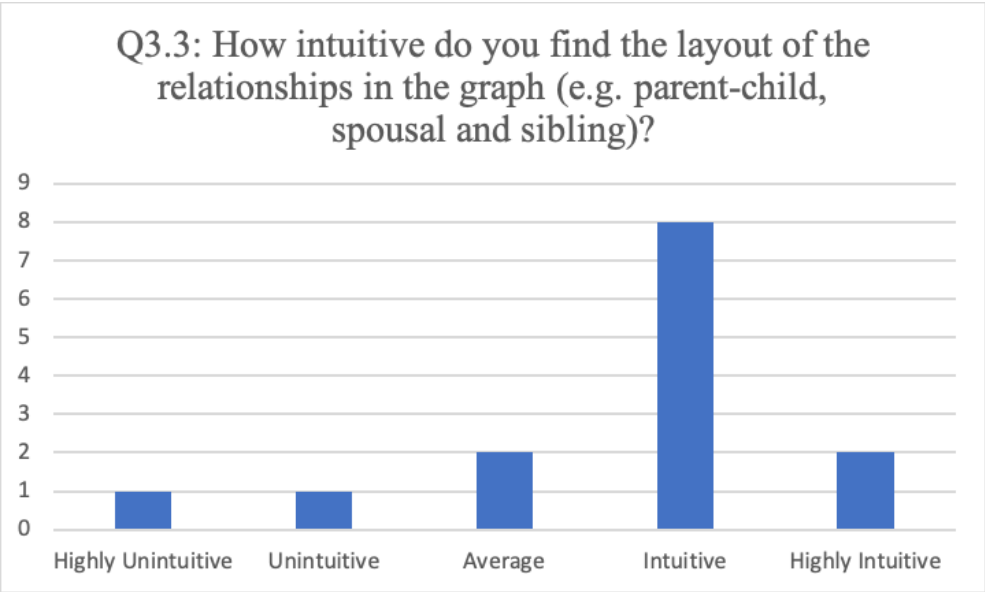

Figure 5: Collated quantitative responses to question 3.3

Q3.3 responses

Here is the reasoning alongside the answers (if provided):

"Highly-unintuitive" or "Unintuitive":

- "In cases of multiple children, the overlap of the lines between different sets of parents makes it hard to tease out which set has which child."
- "Ambiguous relationship branches."

"Average": no reasoning given.

"Intuitive" or "Highly-intuitive":

- Once I found I could click on the actual blue (etc.) line for extra detail, I found the interface remarkably easy to use, and full of information. I am a Chartered Engineer - I think in pictures.
- "Can be a little confusing with the intersecting lines, however this is mostly solved through the darkening of a specific line when hovering over it."
- "The lines are clear and un-jumbled, it looks as any family tree would."
- "As I've said, the graphs are a familiar representation of familial relationships. The tree structure works well."

Suggestions:

- "I would have found them more easily navigable if their size adjusted automatically to the size of the browser window, so I could see the entire tree all at once."

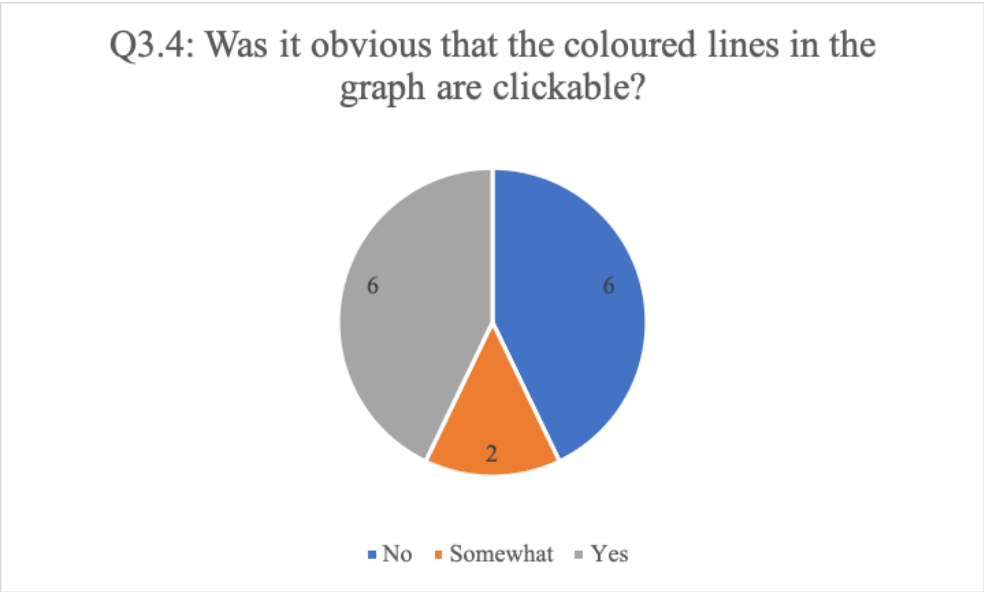

Figure 6: Collated quantitative responses to question 3.4

- "Then I can imagine clicking on any node / edge and bringing to the fore (front and centre, as it were) that particular figure / relationship."
- "I would put highly intuitive, but I think a different colour box around non-siblings (i.e. partners) on the same row would be helpful."

Q3.4 responses

Here is the reasoning alongside the answers (if provided):

No:

- "I am not used to this degree of sophistication in a diagram of this type - so I was not initially looking for, or expecting, a clickable diagram element. When I found the elements were clickable - they were obvious(!)"
- "It took a moment to realize that you have to hover over specific lines to highlight a relationship vs. hovering over the a name. I know this interface makes sense for someone like Zeus, whose name would prompt all the lines to highlight, but less sense for some of his wives/partners/children, whose lines were sometimes obscured by other lines."

Somewhat:

- "A cursor on the line in the legend would reinforce this."
- "The graph legend made it clear but if one grazed over it or didn't read it at all they would not be super obvious, perhaps a bolder line would make this more obvious from the get-go?"

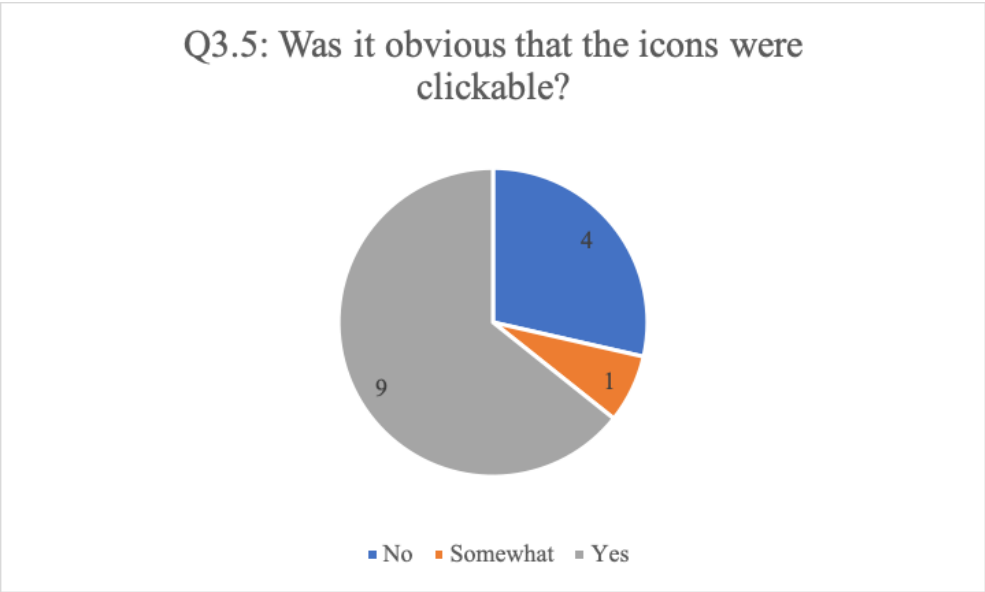

Figure 7: Collated quantitative responses to question 3.5

Yes:

- "I read the directions."
- "Information on each page of the feature, both legend and the text above the graphs"
- "You tell us. Also the lines are highlighted when you hover over them. However, is it possible to click on edge to highlight one relationship, rather than all the edges of one particular node? This wasn't clear. Helen is a good example. I get that her relationships are confusing.... But can't I highlight" Clytemnestra's relationships without highlighting the whole graph?

Q3.5 responses

Here is the reasoning alongside the answers (if provided):

No:

- "This wasn't clearly indicated in the legend; nor does is it highlighted when you hover over it."

Somewhat:

- "The directions do in fact say you can click, but for some reason, it did take my brain a little while to get there. That being said, the legend is *super* clear. I love the icons!"

Yes:

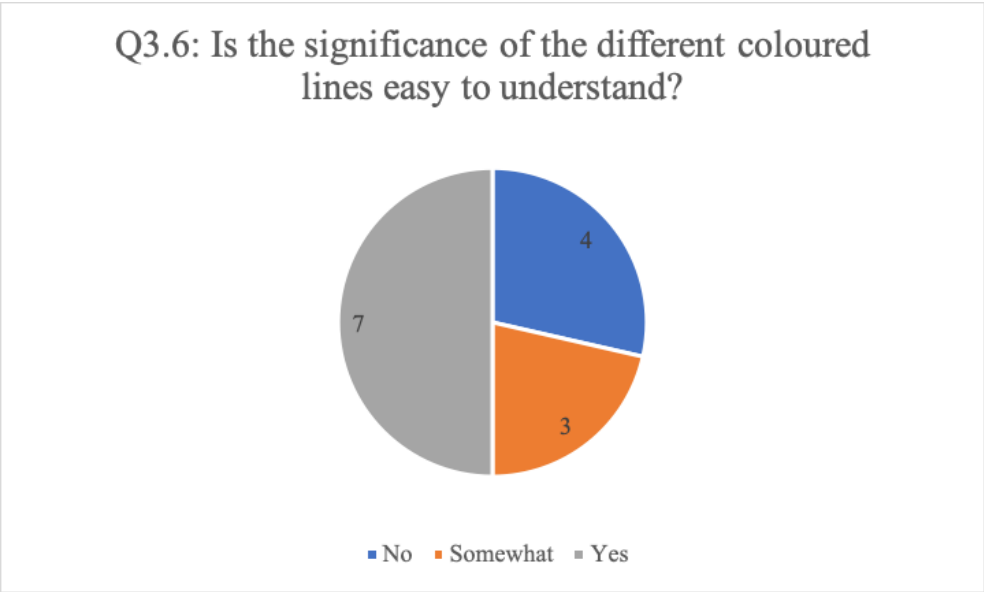

Figure 8: Collated quantitative responses to question 3.6

- "A colour other than black might highlight this message e.g. blue"
- "Same as for the coloured lines, text detailing the feature."

Q3.6 responses

Here is the reasoning alongside the answers (if provided):

No:

- "The colours used are a bit confusing. Black tends to be for text (no links). I would find the well-known hierarchy of green, amber, and red in descending order more intuitive and logical."
- "Didn't even think about that being significant, to be honest."
- "Not the clearest way of representing complicated or variant relationships."

Somewhat:

- "My one issue is that it seems lines connecting to multiple children of the same parent(s) can't be more than one color at the same moment. Particularly, I searched up Lycaon and was looking at his 50 children who are all marked as contested by blue lines when it is only one child, Callisto, that is contested. A similar issue occurs while looking at Lycaon's father Pelasgos's page: Lycaon's mother is contested between Cyllen and Meliboia, but that his father is Pelasgos is not contested, but all three parts of the branch are marked in blue. I do see on Pelasgos' family tree if I hover the mouse over his line it turns from blue to red showing that there is a contested version where he is autochthonous, so

perhaps something similar to that could occur in parts of one branch of siblings to show the a black line connecting to an uncontested parent at the same time as a blue line connecting to the other contested parents. I did find something like this affect on certain family trees, such as that of Hephaistos, where it is contested whether he is the son of Zeus and Hera or only Hera, but all of his siblings who are only given as the children of Zeus and Hera are marked in blue. The blue does change to black when you hover the mouse on this line and clicking it does not summon an info pop up. additionally, it seems that also on Hephaistos' page, the lines connecting to his two sons, Periphetes and Erichthonios, do show one as uncontested in gray and the other as contested in blue, but this seems to be only because the two sons never have the same mother. The information pop ups do often clarify these issues, but the visual of non-contested connections being shown in blue just because one of their siblings or parents is contested could be misleading. Another useful feature on this that comes to mind is a toggle that would let me freeze what color a line is instead of having it change only when my mouse is on it. If I'm taking a screen shot of this page to use in teaching I may want only certain contested versions to be shown, such as freezing Hephaistos' "line as red if I am teaching a specific text that only records his birth as parthenogenesis."

- "Yes, but sometimes the choice of default line color is not the same in all places. For example, when you lookup Athena, all the connecting lines are blue by default, (hovering over her head-birth or Metis-Zeus will turn the appropriate color). When you look up Metis, her relationship with Athena is black by default, and shows nothing of the alternative."

Yes:

- "When discovered - yes. These are really very nicely implemented in showing relationships that are an impossible headache to much genealogical software."
- "Categories are intuitive"
- "Clear, though I'm not enamoured of the colour selection :)"

Q3.7 responses

Here is the reasoning alongside the answers (if provided):

No: no reasoning given.

Somewhat:

- "Useful, however absent for some of the relationships"

Yes:

- "Legends vary. The included facility for explaining "alternative" parenting possibilities seemed to me to be well done - very clear."

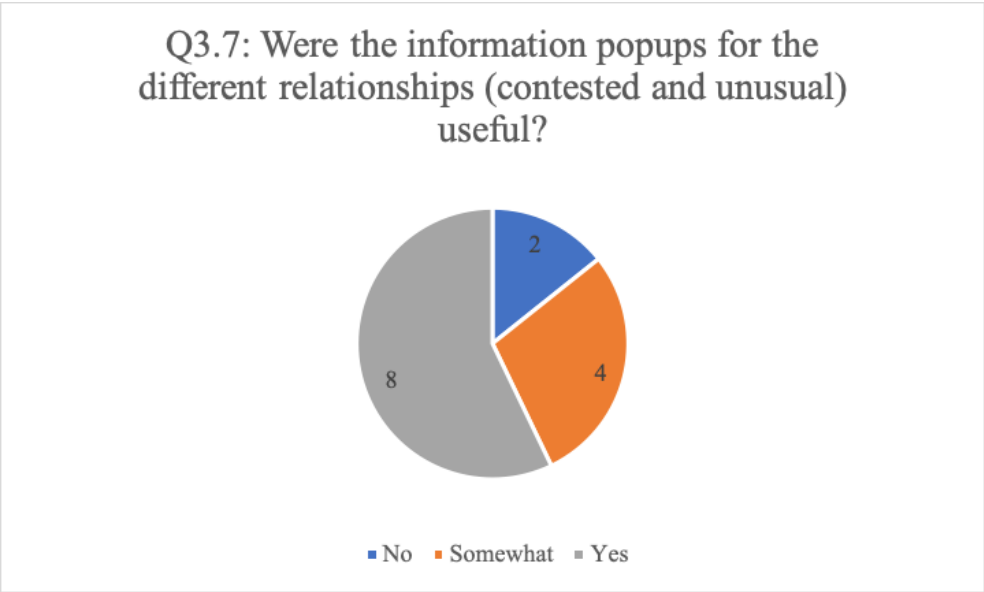

Figure 9: Collated quantitative responses to question 3.7

- "Can't have enough of these as the linkages are very important and a key reason for the digital project."
- "I liked this aspect, it was easy to understand and really solidified my understanding of the relationships."
- "Yes. It brought to the fore the relevant information."

Q3.8 responses

Here is the reasoning alongside the answers (if provided):

Somewhat:

- "Would be useful to have a clearer definition for autochthony"
- "Yes in the graph, no in the ID card."

Yes:

- "But a cursor on the icon would help. Also, in the legend 'graphs and icons' is referred to. Then an instruction to 'click on the node'. Instead of introducing another term, why not repeat icon?"
- "The graphic of the mountain and the line were very clear."

Q3.9 responses

Here is the reasoning alongside the answers (if provided):

Somewhat:

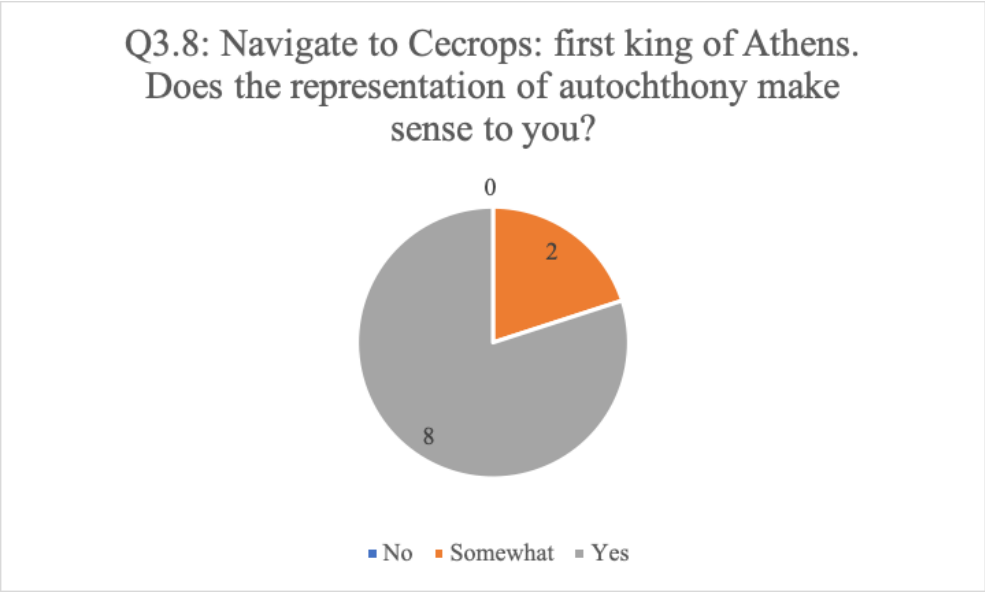

Figure 10: Collated quantitative responses to question 3.8

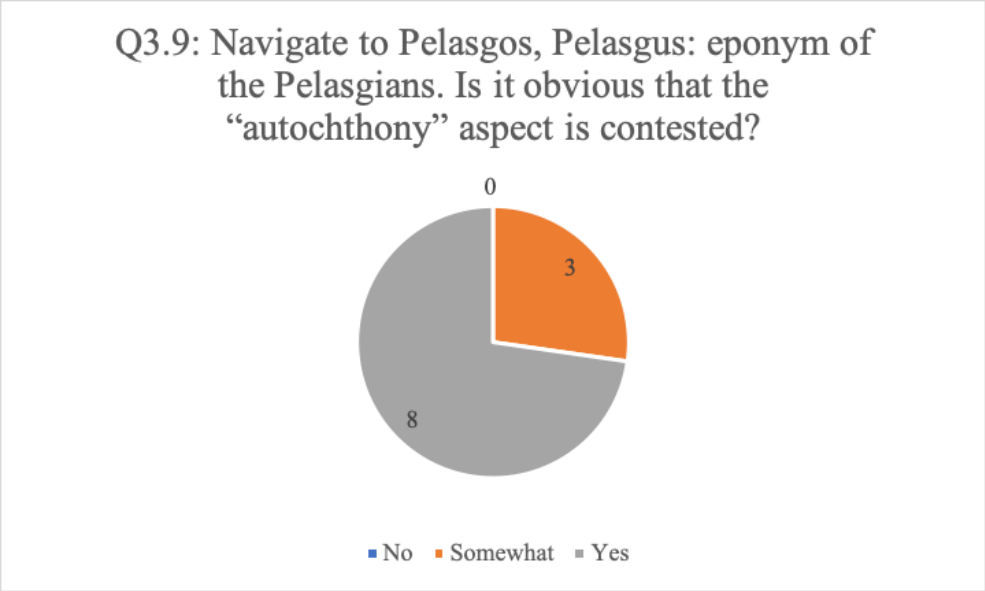

Figure 11: Collated quantitative responses to question 3.9

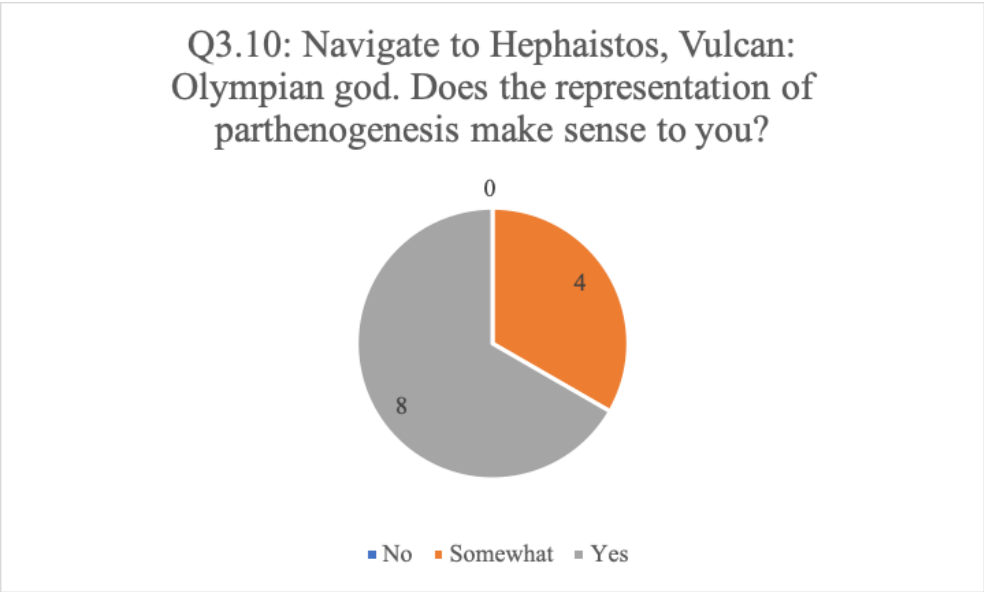

Figure 12: Collated quantitative responses to question 3.10

- "Is it possible for the icon in question to be colour-coded as well. For contested, I'd favour amber, not blue."
- "In the Text Box where it says "OR" the contested births are obvious, but less so on the graph. If I hadn't read the Text Box first it might have taken me a minute to realize that the two different lineages depicted in the graph were two possible situations rather than the same."

Yes:

- "Yes - after I took off my "standard genealogy tree" goggles and realised there was a third "parent" possibility shown. Initially I only "saw" the two-parent relationship I was anticipating! Expectation bias!!!"
- "Has both the coloured line and a prompted box to detail such."
- "He could either be the child of Zeus and Niobe, or he could have come from no parents"
- "One branch indicates autochthony, another his relation to his parents. Although, having said that, only the autochthony relationship is highlighted from the pelasgos edge."

Q3.10 responses

Here is the reasoning alongside the answers (if provided):

Somewhat:

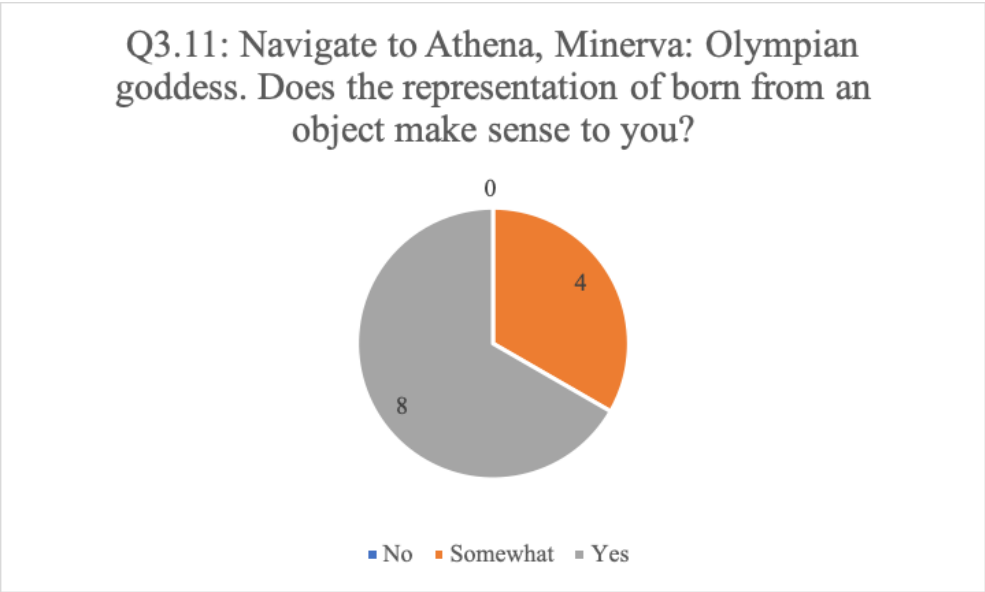

Figure 13: Collated quantitative responses to question 3.11

- "Wow! Not initially obvious to me. But when I understood what the diagram meant, I could not think of a better way to indicate this very unusual disputed relationship."
- "Is it possible for the icon in question to be colour-coded as well. For contested, I'd favour amber, not blue."
- "The line crossing the other familial relationship lines is obnoxious. The symbol is not very well-chosen."
- "The fact that Hephaistos is still linked (with a horizontal line) to the other non-parthenogenesis born children is a bit confusing. If Hephaistos had been separate from them the diagonal line from Hera would make more sense. The current graph seems like Zeus is still connected to Hephaistos as his father."

Yes:

- "Clear explanation"
- "He was not born through intercourse and by Hera alone"
- "The legend makes it clear. It wasn't immediately obvious that you could click on the icon in the graph though. (As I noted above.)"

Q3.11 responses

Here is the reasoning alongside the answers (if provided):

Somewhat:

- "The icon isn't particularly intuitive. The bottom half of the existing egg icon with a simplified head & shoulders of an emerging god might be. . Appreciate that this is a difficult icon."

- "Is Zeus' head really an object? It seems a bit clunky to phrase it this way. I'm struggling to think of someone who is born from something that is a literal objects that aren't captured in other ways. Maybe the Spartoi, born from the sowing of the dragon's teeth, but this can easily labelled as Autochthony (side comment: none of the Spartoi are labelled as Autochthony on their pages, they just don't have parents). Perhaps this issue of gods being born from Zeus's body part could be shown throw contested lines, ie Metis is the contested mother of Athena, but Zeus is the uncontested father. A similar case for Dionsysos being born from Zeus's thigh, but then again, in the Apollodorus section on this, Zeus simply saves the unborn child and semele is still considered the mother. Another example labelled as born from an object is Chrysaor and Pegasos. the object recorded here is Medousa's head and then their parents as Medousa and Poseidon are shown as contested in blue, but these two things are not contested. The Apollodorus passage says that they are the children of Medousa and Poseidon, but only born when she is decapitated. While this instance could just be a cataloging issue, I do not think the born from an object category is useful and can be misleading."

- "The representation (egg graphic) makes sense, but the inclusion of Metis and Zeus again makes it seem like there were two different births; one from Metis X Zeus and another from the Head of Zeus."

- "It's a bit odd calling a head an object, thought I get the point. I'd also have liked the connection to Zeus highlighted, rather than treat his head as something different. (It's more like an alpha Zeus after all, since it's only him who's involved in her creation.)"

Yes:

- "The symbol is delightfully appropriate for this unusual entry into the world! :-)"

- "Clear explanation from the legend, and prompted box. Also useful that the object is in a greyed and dashed box to further separate it from being a person"

Q3.12 responses

Here is the reasoning alongside the answers (if provided):

No: no reasoning given.

Somewhat:

- "Something representing a spark might be. A flash of lightning?"

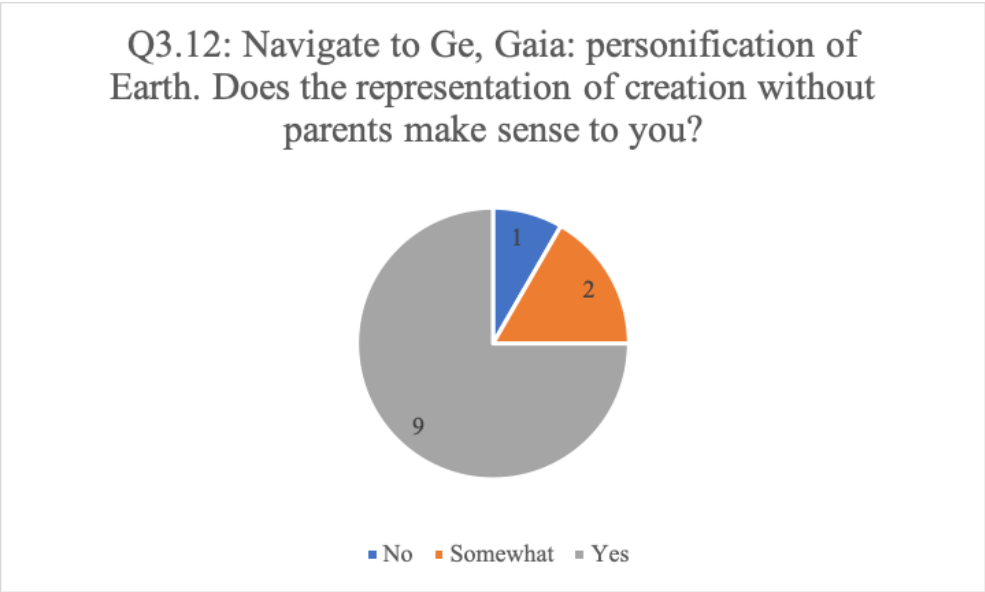

Figure 14: Collated quantitative responses to question 3.12

- "If they simply come into being, would it be better not to have them coming from anything? (I see a star icon and I think: they come from the stars.)"

Yes:

- "The symbol of a star (one of the oldest objects in the Universe) would seem very appropriate for this presumably pre-existing entity."
- "If this is the only one, do we need this item?"
- "Clear explanation. may be useful to have somewhere/something that clarifies the difference between autochthony and creation without parents."

Q3.13 responses

Here is the reasoning alongside the answers (if provided):

Somewhat:

- "I like the icon. It's almost a hammer and sickle. However, the pop up info box is a bit confusing. It reads: Gods – and some notable heroes – are said to have created mortals. Then it provides the specific case with reference. Then it reads: There are no other examples of Created by Someone Else. So, not "some" then?"

Yes:

- "Created and not by sex conveyed well with hand creating. What does the grey line stand for? Not yet entered."
- "Clear explanation"

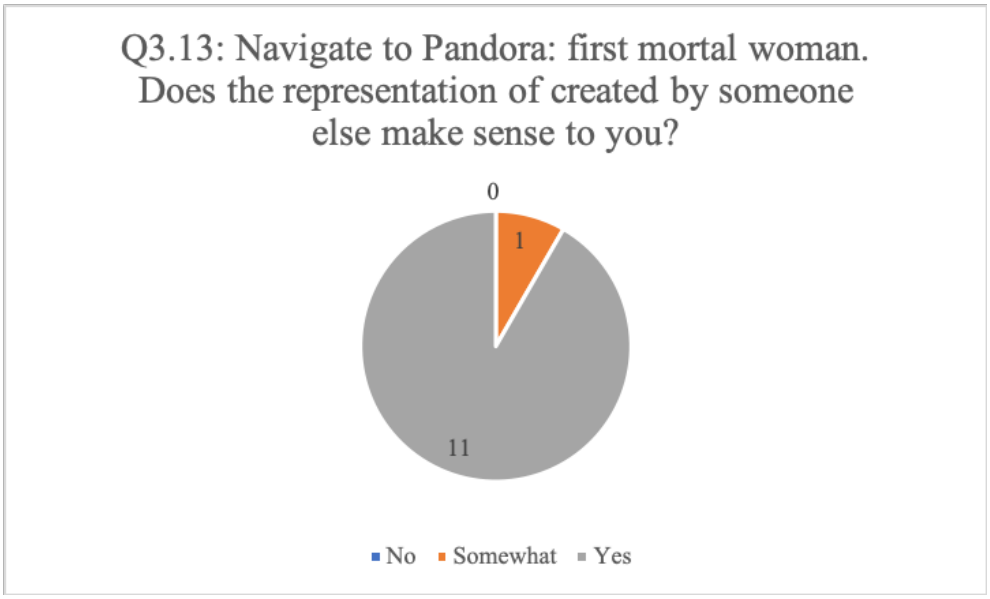

Figure 15: Collated quantitative responses to question 3.13

Q3.14 responses

Here is the reasoning alongside the answers (if provided):

Somewhat:

- "That's perhaps the least intuitive. At first I took it to mean that the line ends or something. The legend is nice."
- "The icon makes it clear. But then I wonder what the difference is between a figure who has this icon and one who simply has no edge coming from it, in this case his brother Phoroneus? Does he also die without issue? If not, where is his issue? Is the point that we don't have the evidence either way? Perhaps that ought to be conveyed somehow. I also expected to get an info box by clicking on the icon (as what happened with the other cases)."

Yes:

- "An alternative could be the small black "tombstone" square used to indicate the end of articles in many magazines. However the meaning of the "X" symbol's use is quite clear when the Legend has been consulted."
- "Familiar genealogical lines. The x marks an end clearly"
- "Clear symbolism"

Q3.15 responses

Here is the reasoning alongside the answers (if provided):

Somewhat:

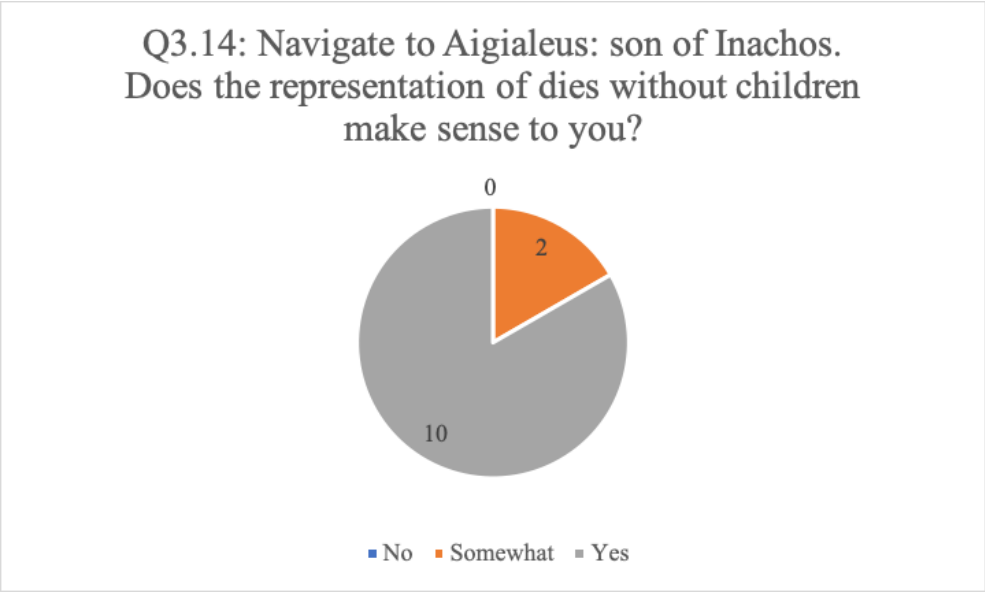

Figure 16: Collated quantitative responses to question 3.14

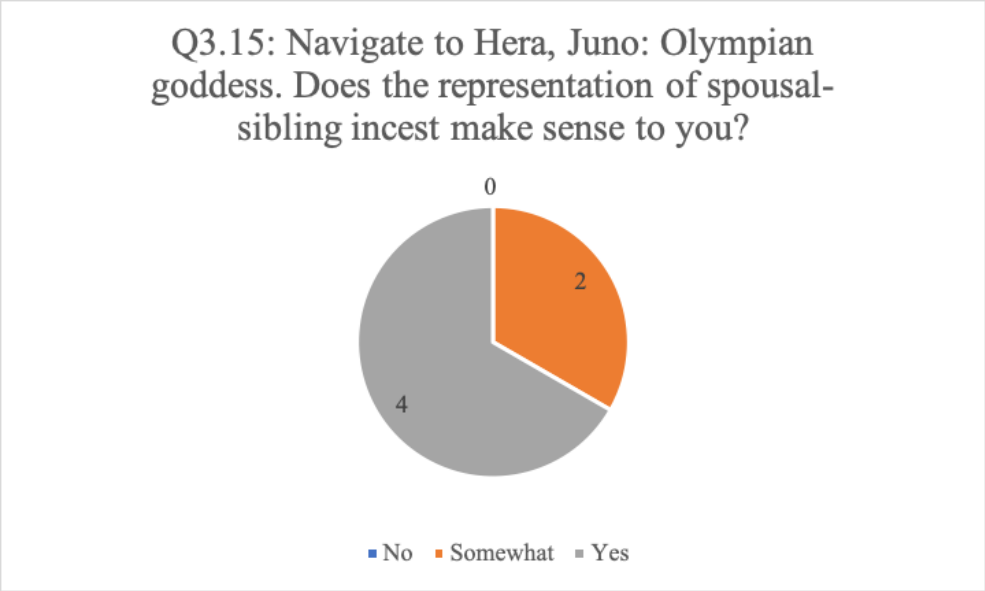

Figure 17: Collated quantitative responses to question 3.15

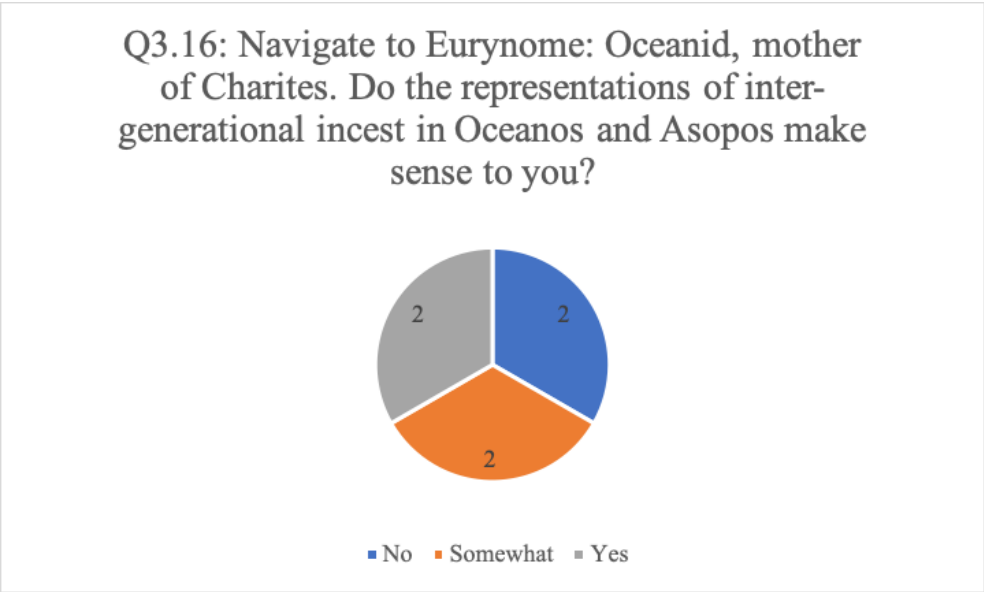

Figure 18: Collated quantitative responses to question 3.16

- "If the point is to point out incestuous unions, I think only their connection underneath should be green, not also above covering over sibling relationships."

Yes:

- "This has a stable, overlapping colored line that I mentioned above that would be useful for showing when one parent is uncontested or not all the children in a single branch are contested"
- "Yes, but I almost think that the green lines connecting Hera and Zeus above Poseidon are unnecessary, they seem to isolate him and the incestuous relationship would still be very clear if they were only connected from below."
- "Clear. The highlight is there even before I hover over it, so I immediately see the difference between Hera and Zeus and their other siblings."

Q3.16 responses

Here is the reasoning alongside the answers (if provided):

No:

- "Confusing graph lines."
- "I might just be rusty about these myths, but I do not immediately understand how these lines are working"

Somewhat:

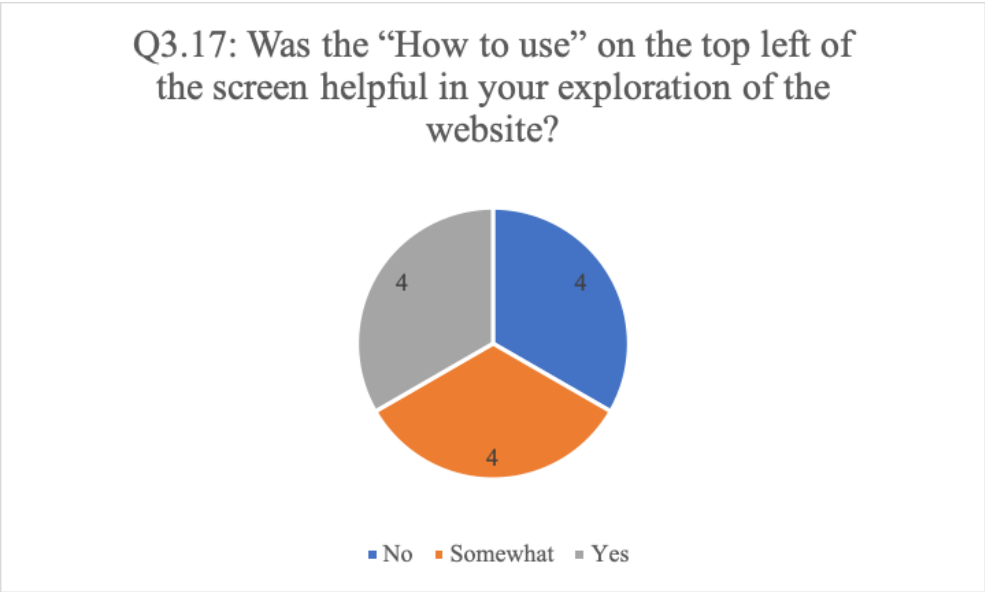

Figure 19: Collated quantitative responses to question 3.17

- "It's clear enough: the "or" labels help. However, this is a good example where the tree is too big for my browser to let me see it all in one go. It's awkward to navigate."

Yes: no reasoning given.

Q3.17 responses

Here is the reasoning alongside the answers (if provided):

No:

- "I did not need it"
- "I did not use it when first exploring the website."
- "I didn't notice it, to be honest."
- "I didn't even see it :)"

Somewhat:

- "I didn't use it."

Yes:

- "My comment relates to the source material. Will other sources eventually be added? For example, Autolykos, Odysseus' grandfather."
- "Although I did not notice it was there until this question mentioned it"

D.3 Part 4: Qualitative Evaluation of the Website

Q4.2 Compared to how you normally explore Greek myth, how would you rate your interactions with this platform?

- "For a summary of the weird Greek God relationships, this is by far the best I have seen. When younger, I tried to draw some Greek God genealogical graphs, and finally gave up in confusion. This would have solved my (then-present) headache."
- "It has a lot of promise, and it is good to see the new features! The data cards are fantastic because it is pulled from expertly curated data and is easy to read. The graphs present problems because of the overlap of genealogical lines, but that they are highlighted when hovering over the lines is a nice feature."
- "Useful, but limited in that the sources are limited."
- "It's good for understanding relationships, but wouldn't replace storytelling, which I believe is the most engaging way to explore myth."
- "I really like having this particular aspect of Greek mythology mapped out like this and this is a helpful tool. Well done!"
- "clear and simple, easy to navigate, useful that it also includes the roman names"
- "It was different in a way that I appreciate. It gave the basic information in a visual format in a quick and efficient way that other resources are not capable of. Additionally the links to Apollodorus made interaction with primary resources much easier and very smooth. It also showed that there was contested information much better than any other resources I use now."
- "I liked the interactive graphs and the clarity of the platform overall, there was no excess text or media anywhere on the page, which helped focus my attention. Linking each entity to others helped me learn quickly about different relationships. The big lists of entities (like the Suitors of Penelope) will be very useful in future and were an excellent feature of the platform."
- "On the whole, I believe this tool will be extremely useful!!"
- "I like the ability to "see" relationships in overview, then explore particular relations / individuals, and, above all, get to the source(s). I can see this of being of great value when there's more than one source, particularly what I might call the distinction between cataloguers (like Apollodoros, who attempt a mythical overview) and narrators (like Homer or Sophocles, who provide particular versions of myth). Of course, how to visualise multiple sources which don't necessarily agree with each other (on every single point) will have further design challenges."

Q4.3 Was there anything that was comparatively worse, or was there a feature that you missed?

- "Perhaps a rectangle around the "Legend" to visually separate it from the graph below? Perhaps a little more prominence given to the "manual/help" rectangle? Otherwise fine!"
- "A feature down the line (after multiple data sets are entered) is to be able to search by author or between authors. But that is not for this current project!"
- "Does not provide variations, or a history of representation. For example, variations on Herakles, when first attested in surviving texts."
- "What about versions from different authors?"
- "I really like that the search bar makes suggestions. Given the fact that someone might not know how to spell a name completely, this is a great idea."
- "The organisation of search results could be better, for example searching Hera will give you many results before the goddess"
- "The visual overview is not very clear."
- "I didn't like the graph legend, and not just because of the colours.... You need it, since it explains the interface. But I didn't like where it is. Front and centre you need the mythical figure / relationships, I would say. Generally, I'd want to be able to see *everything* without having to scroll down. So, the two key things — the "card record" and the graph need to be seen on the same screen, at least initially. Then perhaps you can click on either to expand and explore. The legend should be top right or somewhere which is clear but not dominating."

Q4.4 Did you discover anything new about Greek myth while using this website?

- "The disparate mythological origins can be systematically and clearly represented in a genealogically-inclined graph."
- "Not particularly, but since I'm one of the co-directors, I helped enter most of this data!"
- "Aeneas had a brother?"
- "No"
- "No"
- "Yes! Quite a few connections I don't think I ever fully conceptualized before seeing them side by side in the graphs"

- "Always"

Q4.5 If you have never explored genealogies in Greek myth before, what did you like or not like about the website, and what are some general improvements you'd like to see?

- "The graphs are not easily presented on screen, especially since there are many characters that have lots of children. Perhaps the boxes with the names could be a bit smaller? I know there is a balance in presentability and space and readability."
- "Eventually horizontal genealogies would be very useful. So would significant relationships/encounters."
- "Not online, no. I'd be curious to see how this would look with more sources incorporated. I looked up Peleus first, and I couldn't figure out why Polymele is not linked to a mother. I can imagine why without looking it up, but some sort of notation for instances like this would be helpful. The way someone complicated is displayed (the children of Heracles) is confusing."

Q4.6 Under what circumstances would you use this website in the future?

- "Whenever asked about Greek God genealogy. The clickable reference links to the original source of the represented relationship, is an enormously handy and time-saving feature."
- "I would use it for many reasons—to have an easy visualization of characters and where the contested materials are."
- "I'd use it as a source."
- "As a reference/resource for my students."
- "Not sure. Perhaps in an assignment in a mythology class, but I'm not sure what type of assignment."
- "When I need to quickly confirm or recall a genealogical connection. I would definitely recommend it to students, and I would perhaps use screen shots to put on hand outs and slides if more generations could fit on the screen at once. For example, being able to show the whole house of Thebes from Cadmos to Oedipus would be some very useful that does not seem possible in the current version."
- "Researching for a project or paper, to clarify something that I was reading in Greek myth (i.e. if I forgot who someone's father was, or didn't understand a relationship between two entities)."

- “To use as reference for origins and relationships between mythical characters”
- “To check relations and especially to find the primary source citations. This will be a valuable resource once "linked up with" other resources. A kind of primary source mytho-pedia as it were.”

Q4.7 Do you have any other comments?

- “Wow!”
- “Great progress on a project that features the ugly messiness of Greek myth!”
- “Transliteration: * I find the combination of Greek and Latin transliteration confusing (e.g. Glaucos instead of Glaukos or Glaucus). * In some cases ’Greek’ and Latin transliteration is offered (e.g. Asopus, Asopos), in others it is not.”
- “Keep up the good work! I’m excited!”
- “As Greta knows, we’re currently annotating Pausanias. Have you done any work on this yet? Would it be helpful if we were to use the Manto IDs when annotating, which would then give you references to mythical figures in Pausanias. On a related subject: Pausanias often includes mythical figures to provide a genealogy for quasi, and real, historical figures — which, of course, Greek communities did throughout the ages (trace their lines back to heroic figures, that is). Where do you draw the line? When does a figure stop being mythical? Would it, indeed, be useful not to make a distinction, but to (continue on to) show the "historical" figures who claim heroic descendants?”