

Discourse cohesion in Xenophon's *On Horsemanship* through Sketch Engine

Abstract

We build a Sketch Engine corpus for Xenophon's classical Greek scientific treatise *On Horsemanship*. Sketch Engine is a web-based corpus-analysis tool that allows the user to inspect the lexical makeup of a text (cf. keyword lists), explore the surroundings of select items (cf. concordances) and identify fixed expressions in a text (cf. n-grams). We make available our corpus-preparation tool and our corpus configuration file for Sketch Engine. We use the Sketch Engine corpus to detect discontinuous verbal multi-word expressions, specifically support-verb constructions (e.g. *to take a decision*). We examine how support-verb constructions – through their structural and lexical properties – aid discourse coherence and cohesion throughout Xenophon's treatise. We furthermore examine how the recurring support-verb constructions in the treatise reflect the scientific register of the text. The article shows how an understudied category of lexico-syntactic device (support-verb constructions) in classical Greek majorly aids discourse cohesion, structurally and contextually speaking. It also shows how an understudied text in the form of a technical treatise (*On Horsemanship*) majorly furthers insight into scientific literacy of the classical period. Finally, by making available our corpus-preparation tool and code, we hope to further collaboration and adaptation and thus improvement of existing tools and counteract the multiplication of tools.

Keywords: cohesion, coherence, Xenophon, *On Horsemanship*, support-verb construction, Sketch Engine

The classical Greek historian Xenophon (5th / 4th c. BC) is best known for his literary works (*Anabasis*, *Hellenica*) describing war-time challenges. However, amongst his minor works is a treatise *On Horsemanship*. Xenophon's hands-on guide to choosing, caring for and training a horse differs from the descriptions of the equines of Greek literature, e.g. Achilles' Xanthos (in Homer's *Iliad*) and Bellerophon's Pegasus (in Hesiod's *Theogony*). In the epic, Xanthos is immortal (*Iliad* 16.148ff), weeps after Patroclus' death (*Iliad* 17.426ff), and prophecies Achilles' destiny (*Iliad* 19.392ff). Pegasus is immortal, winged and born out of Medusa's blood (Hesiod, *Theogony* 280ff). In the literary genres, the focus lies with the horses as protagonists rather than with the real-life challenges of horse keeping. Conversely, Xenophon's *On Horsemanship* is interested in the latter. It reflects attention to detail (Greer 2015) along with literacy in scientific discourse.

The treatise *On Horsemanship* is comparatively short (7,139 words), divided into twelve chapters (Bowersock & Marchant 2014), and written in prose. It covers (i) the conformation and character of the horse so as to be fit for the intended purpose [sections 1–3], (ii) the care for the horse by the groom [sections 4–6], (iii) the ridden education of the horse [sections 7–8], (iv) special cases (e.g. the spirited horse, the warhorse, and the parade horse) [sections 9–11], and (v) the arms for horse and rider [section 12]. Each section finishes with a brief interim summary.

Despite this clear sectioning, Xenophon's text 'flows', that is information is communicated effectively, comprehensibly and systematically to the reader. Linguistically, we cast this flow into the notions of coherence and cohesion. Coherence refers to how building blocks of a sentence are tied together; cohesion refers to the tying together of clauses and sentences (Webster 2019 p. 41). Both are needed for information to be communicated in such a way that the reader can establish links with the preceding discourse and the author can add new pieces of information incrementally. Classical Greek relies on a range of morpho-syntactic, lexical and pragmatic strategies to achieve coherence and cohesion.

Our aim in this article is threefold. We want to show how to use an application (Sketch Engine) widely used for modern languages for classical Greek and provide the reader with a corpus preparation tool that can be used (and adapted) for their own purposes, thus counteracting the multiplication of digital tools and refocusing on their functionalities. We want to show how an understudied category of lexico-syntactic device (support-verb constructions) in classical Greek majorly aids discourse cohesion, structurally and contextually speaking. We want to show how an understudied text in the form of a technical treatise (*On Horsemanship*) majorly furthers insight into scientific literacy of the classical period. These

aims translate into the following three research questions which underpin the following sections:

1. How can we choose and facilitate the application of existing corpus-analysis tools for Ancient Greek in a way that is cohesive, text-agnostic, scalable, flexible and freely-reusable?
2. How do support-verb constructions by means of the structural properties aid discourse cohesion and coherence?
3. How do support-verb constructions by their register-related properties aid discourse cohesion and coherence?

Research question 1 explains our choice of Xenophon's *On Horsemanship*. The treatise is not part of and differs in genre and register from the large literary classical Attic corpus which the Sketch Engine corpus was originally built for¹. We thus showcase adaptability and extensibility of our tool.

The article falls into five sections. Section 1 introduces the notions of coherence and cohesion and explains our choice of Sketch Engine. Section 2 outlines the process of building the corpus-preparation tool, adapting it for Xenophon's *On Horsemanship* and implementing the corpus into Sketch Engine. Section 3 uses this Sketch Engine corpus to examine support-verb constructions, a discontinuous lexical device creating both coherence and cohesion. Section 4 moves beyond coherence and cohesion achieved through structural means, assessing the adherence to the scientific register. Section 5 summarises the results and offers conclusions.

1 Introduction

Greek relies on a range of morpho-syntactic, lexical and pragmatic strategies to achieve coherence and cohesion. Relevant single-word items can relatively easily be extracted from a lemmatised corpus of text. However, the same is not true for multi-word items, especially discontinuous ones (e.g. *to have an idea* in *I **had** a great **idea** yesterday*). The below describes means to achieve coherence and cohesion in classical Greek discourse before introducing the reader to the structures of choice and the challenges they pose for automated extraction.

¹ Thucydides, Histories I–V; Xenophon, Anabasis I–IV, Memorabilia I–IV, Hellenica I–IV; Antiphon, Speeches 1–6; Isocrates, Speeches 1–6 and 13; Isaeus, Speeches 1–8; Lysias, Speeches 1, 3, 7, 12, 14, 19, 22, 30–32; Demosthenes, Speeches 1–4, 6, 9, 18; Plato, Gorgias, Phaedrus, Republic I–III; Aristotle, Rhetoric, Politics I–III.

Morpho-syntactically, coherence and cohesion can be achieved by means of structuring particles (e.g. μέν – δέ ‘on the one hand – on the other hand’, οὖν ‘thus’, γάρ ‘for’) (Bonifazi et al. 2016), conjunctions (e.g. ἀλλά ‘but’ and ὅτι ‘because’), and pronouns, which must have a clear anaphoric or kataphoric link to the item they stand in for (e.g. *I met Will yesterday. He is very well.* where ‘he’ can only be used once we have established who it refers to) (Halliday 1976; Luraghi 2003; Rysová 2017). Moreover, word-order choices play a role since Greek word order is information-structure driven (Celano 2013a, 2013b; Dik 1995; Mastronarde 2013). Slots in the word-order frame are not indicative of an argument function (e.g. subject, object), but of an information-structural value (e.g. topic / known information, focus / new information). E.g. in Herodotus, *Histories* 5.3.5 νόμοισι δὲ οὗτοι παραπλησίοισι πάντες χρέωνται κατὰ πάντα USAGES.DAT – YET.PARTICLE – THESE.NOM – ALIKE.DAT – ALL.NOM – THEY.USE – IN EVERYTHING ‘Yet all of them have similar habits in all things’, initial νόμοισι is the topic component, an unmarked element follows (Beschi 2018 pp. 181–182). In Sophocles, *Oedipus Colonus* 1656 Μόρῳ δ’ ὁποίῳ κεῖνος ὄλετ’ DEATH.DAT – YET.PARTICLE – WHAT.DAT – THAT.NOM – DESTROY.AOR.PASS.3SG ‘Yet through which type of death did he die?’, μόρῳ is the topic component, ὁποίῳ is a focus component, and an unmarked element follows (Beschi 2018 p. 179). Setting, topic and focus components are optional in the sentence, yet can aid discourse coherence (Beschi 2018 p. 181).

Lexically, coherence and cohesion can be achieved by the use of synonyms (e.g. *love* and *adore*) or antonyms (e.g. *love* and *hate*), the repetition of keywords (e.g. ἵππασία ‘horse exercise’ in Xenophon’s treatise) (cf. Hutchinson 2017), and scene-setting adverbial phrases, such as ‘in this treatise’ or ‘to sum up the previous discussion’.

Pragmatically, coherence and cohesion can be achieved by the adherence to a register and genre, any derivation from which would derail the reader. A genre is a culturally determined norm for a text type (Biber & Conrad 2009 p. 16), with genre markers appearing at the start and end of the text, e.g. *once upon a time* and *they lived happily ever after* in English fairy tales. A register is a situationally conditioned shape of a text (Biber & Conrad 2009 p. 6), with register markers appearing throughout a text, e.g. *tu* as opposed to *vous* in French informal vs formal discourses (see also J. Adams 2013 pp. 107–110; Bentein 2013, 2016; Willi 2003, 2010). The choice of and adherence to a genre and register determines the amount of drawing on shared / background knowledge (cf. inference), the amount of repetition needed, and the way of presenting several events (e.g. impressionistic vs sequential).

The present article focuses on a type of lexico-syntactic device which contributes to discourse cohesion at the lexical, syntactic and pragmatic levels, that is support-verb

constructions, such as *ἵππασίαν X ποιέομαι* ‘to do X horse-exercise’. Support-verb constructions are lexical devices in that their two elements (the verb and the noun) form a unit as regards meaning (Lipka 1992). However, given their frequent discontinuity, the two elements must be linked together by means of syntactic dependency, with the noun filling the object slot of the verb. Support-verb constructions contrast with simplex verbs of similar meaning, e.g. for *ἵππασίαν ποιέομαι*, there would be *ἵππεύω* ‘to ride’ and *ἵππάζομαι* ‘to drive / to ride’ (Xenophon, *On Horsemanship* 10.13), which are regular denominal formations (in -εῦω and -άζω/άζομαι) (van Emde Boas et al. 2019 pp. 274–275).

Support-verb constructions are characterised by their variability (e.g. *he breaks/broke her/the heart*), ambiguity (e.g. *he broke her chocolate heart* which has a literal reading), and discontinuity (e.g. *he broke her young heart*) (Pasquer et al. 2018 p. 2585). All three characteristics are problematic for automated extraction, since ‘if MWEs [sc. multi-word expressions] are treated by general, compositional methods of linguistic analysis, there is ... an overgeneration problem’ (Sag et al. 2002 p. 3). Overgeneration means that false positives are included in the output and impact on the F₁ score, which indicates the accuracy of the result:

$$F_1 = \frac{2}{\text{recall}^{-1} + \text{precision}^{-1}} = 2 \frac{\text{precision} \times \text{recall}}{\text{precision} + \text{recall}} = \frac{2tp}{2tp + fp + fn}$$

$$\text{precision} = \frac{\text{number of true positive results}}{\text{total number of positive results}}$$

$$\text{recall} = \frac{\text{number of true positive results}}{\text{total number of samples that should have been identified as positive}}$$

tp = a "true positive" (a support-verb construction the algorithm returns that is one)

fp = a "false positive" (a support-verb construction the algorithm thinks is one but is not)

fn = a "false negative" (a support-verb construction the algorithm does not think is one but is)

The F₁ score oscillates between ideal 1, i.e. maximum accuracy, and 0.

Furthermore, automated tools rely on training data, such as the annotated PARSEME shared task (<https://typo.uni-konstanz.de/parseme/index.php/results/shared-task>) for 18 modern languages, and very large and expandable corpora (e.g. Scheible et al. 2013).²

² They accommodate only the ‘full, auxiliary and modal verb’ options (Scheible et al. 2013 p. 4). Support verbs are neither full verbs nor auxiliaries, in that they retain a reduced argument grid (Butt 1997 p. 145f.; Cinque 2004 p. 172 n. 31; Loporcaro 2022 p. 216). In the further uses, they only accommodate verb-prepositional phrase structures (cf. Kamber 2008). Cap et al. (2015) however expand their approach to support-verb constructions in the form of verb-object structures.

Conversely, the classical Greek corpus of data is comparatively small and cannot be expanded easily, such that training data is difficult to obtain (see also Sheinfx et al. 2019). Furthermore, when drawing on previous work on languages other than classical Greek³, it must be borne in mind that support-verb constructions are language-specific, such that cross-linguistic studies can only point the direction (e.g. *eine Reise **machen*** vs *to **take** a trip*). Finally, contiguity / adjacency is not compulsory in support-verb constructions (Pasquer et al. 2018; Sheinfx et al. 2019). In Greek, no word-order constraint akin to the English subject-verb-object exists (e.g. Lysias, Speech 3.22 συνθήκας πρὸς αὐτὸν ποιησάμενος AGREEMENTS.ACC – WITH HIM – MAKING ‘making agreements with him’).⁴

Fully automated approaches rely on algorithms that classify the input data into output categories (here support-verb construction vs not support-verb construction).⁵ These are trained on a suitably prepared training corpus. Techniques of analysis combatting the above issues have been suggested in the literature, such as ‘listing words with spaces, hierarchically organized lexicons, restricted combinatoric rules, lexical selection, idiomatic constructions, and simple statistical affinity’ (Doucet & Ahonen-Myka 2004; Sag et al. 2002 p. 15). Furthermore, marking up support verbs in the training data improved support-verb-construction identification (Cap et al. 2015).⁶ Cordeiro and Candito (2019 p. 103) find a noticeable difference in performance between seen structures (max. $F_1 = 0.83$) and unseen structures (max. $F_1 = 0.31$), across classifiers evaluated.

We are not aware of existing work that algorithmically extracts support-verb constructions from classical Greek texts, nor have we opted for a fully automated approach. We build a corpus for Sketch Engine (Kilgarriff et al. 2014). Sketch Engine is a web-based corpus-analysis tool that allows the user to inspect the lexical makeup of a text (cf. keyword lists), explore the surroundings of select items (cf. concordances) and identify fixed expressions in a text (cf. n-grams) (see also Maiko 2020; McGillivray & Kilgarriff 2013).⁷ Sketch Engine

³ Classical and modern Greek differ significantly, such that e.g. the PARSEME shared task modern Greek corpus is not of use as training data.

⁴ Automated tools often had to restrict either the number and type of verbs or nouns, thus limiting the range of support-verb constructions from the outset and rarely detecting candidates such as reconceptualised concrete nouns, e.g. in *to take a photo* (Radimský 2011) and verbs of realisation, e.g. *on a donné <imposé, infligé, collé, filé> à Jean une amende de 30 euros* (Mel’čuk 2004).

⁵ The exact definition of support-verb constructions differs between researchers, not just approaches, such that comparison of approaches and results is often difficult.

⁶ Support-verb constructions are identified by means of the word-association measure of the log-likelihood. The log-likelihood is calculated based on item frequency.

⁷ Concordances are vertical tables that put the attestations of the word form or lemma queried for in a corpus one underneath the other with the context to the left and the right. N-grams are sequences of lemmata or word forms that always appear in exactly the same order (e.g. English *in spite of* which forms a compound preposition would be a strong n-gram in a corpus of modern English).

combines the following functionalities: (i) operation on lemmata rather than word forms, (ii) definition of any corpus, (iii) concordancing, and (iv) creation of n-grams.

Tools that operate on the word form as attested in the text are less informative for classical Greek than for e.g. English as classical Greek is a morphologically rich language, such that e.g. verbal lemmata change stems through the tenses (e.g. ‘to see’ – ὁράω present, ὄψομαι / ὀφθήσομαι future, εἶδον / ὤφθην aorist, ἑώρακα / ἐώραμαι / ὅπωπα / ὤμμαι perfect). Tools that predefine or/and allow for limited modification of the corpus of analysis only necessitate extensive manual correction when a different corpus is selected due to research objectives.

Concordances and n-grams make possible the extraction of support-verb constructions when one component is known (either the verb or the noun).⁸ Our approach does not take the human researcher out of the equation but facilitates their analysis by providing ranked and easily interpretable collocation metrics. For example, Sketch Engine provides the feature of analysed concordance tables, which can be sorted by various lexical affinity measures. We opt below for the *logDice*. The *logDice* is a measure of lexical affinity between two items with a maximum value of 14 (Rychlý 2008):

$$\logDice = 14 + \log_2 = 14 + \log_2 \frac{2f_{xy}}{f_x + f_y}$$

$$f_x = \text{number of occurrences of word } X$$

$$f_y = \text{number of occurrences of word } Y$$

$$f_{xy} = \text{number of co-occurrences of words } X \text{ and } Y$$

Co-occurrence needs to be defined either with regard to distance (i.e. number of intervening items) or with regard to structure (e.g. syntactic relationship between X and Y). Co-occurrence is here defined as appearing within 5 items of each other and in the same syntactic projection. Sketch Engine allows for individual definitions of co-occurrence to be applied.

2 The fabric of the text: building a Sketch Engine corpus for classical Attic

We built a corpus for Sketch Engine based on a large sample of classical literary Attic historiography, oratory and prose⁹ and adapted the code for *On Horsemanship*.

⁸ This distinguishes them from fully automated tools.

⁹ See footnote 1.

Approach It is necessary to tag each word in the source text (the input) and prepare the tagged corpus for import to Sketch Engine (the output). We rely on existing tools for tagging and analysis as far as possible and present a Python program that applies an existing tagging tool (Perseus) to each word in the original text and prepares the corpus for import to Sketch Engine.

Choice of external tools For analysing words, correctness and completeness are critical. We chose the Perseus Digital Library Project as an established, widely reviewed and freely-available source of analyses for individual words. We chose the commercial Sketch Engine tool due to its large feature set and ease-of-use. We are confident in the correctness of the tool due to widespread commercial use in other languages. Commercial applications enable development of a large feature set and easy-to-use user interface that could not be built within the scope of a research project.

Overview A Python program was written that converts TEI¹⁰-conformant Greek texts into a tagged corpus for the Sketch Engine tool. The program is extensible and could easily be used with other TEI-conformant texts. To enable anyone to run our open-source program and convert their own texts to a format that can be used by Sketch Engine, we make our program accessible in two formats:

1. as a web-based tool (powered by Google Colab), so that anyone can use our tool on their own texts with the click of a single button in their web browser, without having to download or install software;
2. for advanced users, a Python script in a git repository, so that our program can be used within other scripts, and any changes that users wish to make can be easily shared with us.

We hope that releasing our code as a web-based tool (that does not require any software to be downloaded or installed, or the user's computer to be configured in any way) enables the community to reproduce our results at the click of a single button. We also hope that by making all of our code open-source and easily accessible, the community may be able to apply Sketch Engine in their own work.

¹⁰ TEI describes a family of standards for electronically representing texts. More details on the TEI format can be found under <https://tei-c.org/release/doc/tei-p5-doc/en/html/ST.html> and <https://tei-c.org/release/doc/tei-p5-doc/en/html/HD.html>.

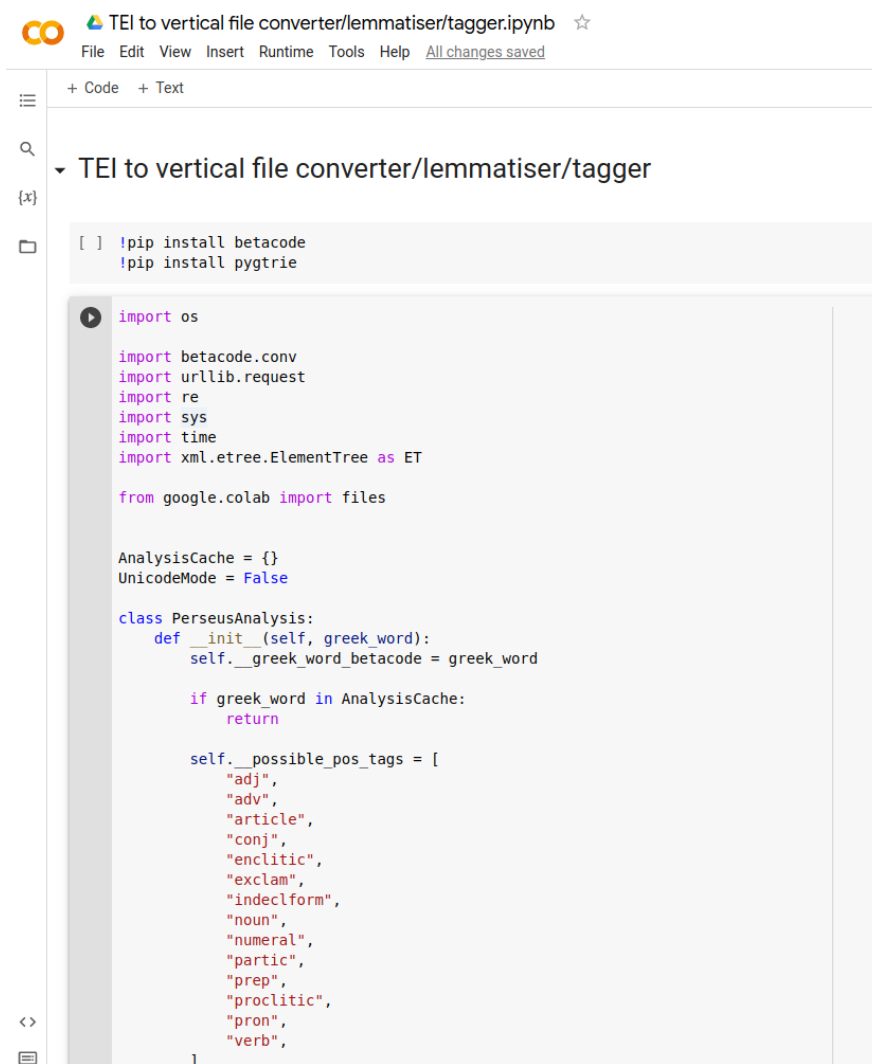
Accessing and running the program Our system is easy to use and we facilitate access through two platforms. The first option suitable for annotating small texts; the second option is more useful for large corpora.

Option 1: Run the tool in your web browser

Open the Google Colab notebook:
https://colab.research.google.com/drive/1JEUWVe1t0AyBROb3NwnVMfufPOtzX_8?usp=s_haring

Click “Runtime -> Run All”. When prompted, choose an input file to upload. When the tagging is finished, the output vertical file will be downloaded automatically, as shown in [1]

[1] Web-based conversion tool



```
[ ] !pip install betacode
!pip install pygtrie

import os

import betacode.conv
import urllib.request
import re
import sys
import time
import xml.etree.ElementTree as ET

from google.colab import files

AnalysisCache = {}
UnicodeMode = False

class PerseusAnalysis:
    def __init__(self, greek_word):
        self.__greek_word_betacode = greek_word

        if greek_word in AnalysisCache:
            return

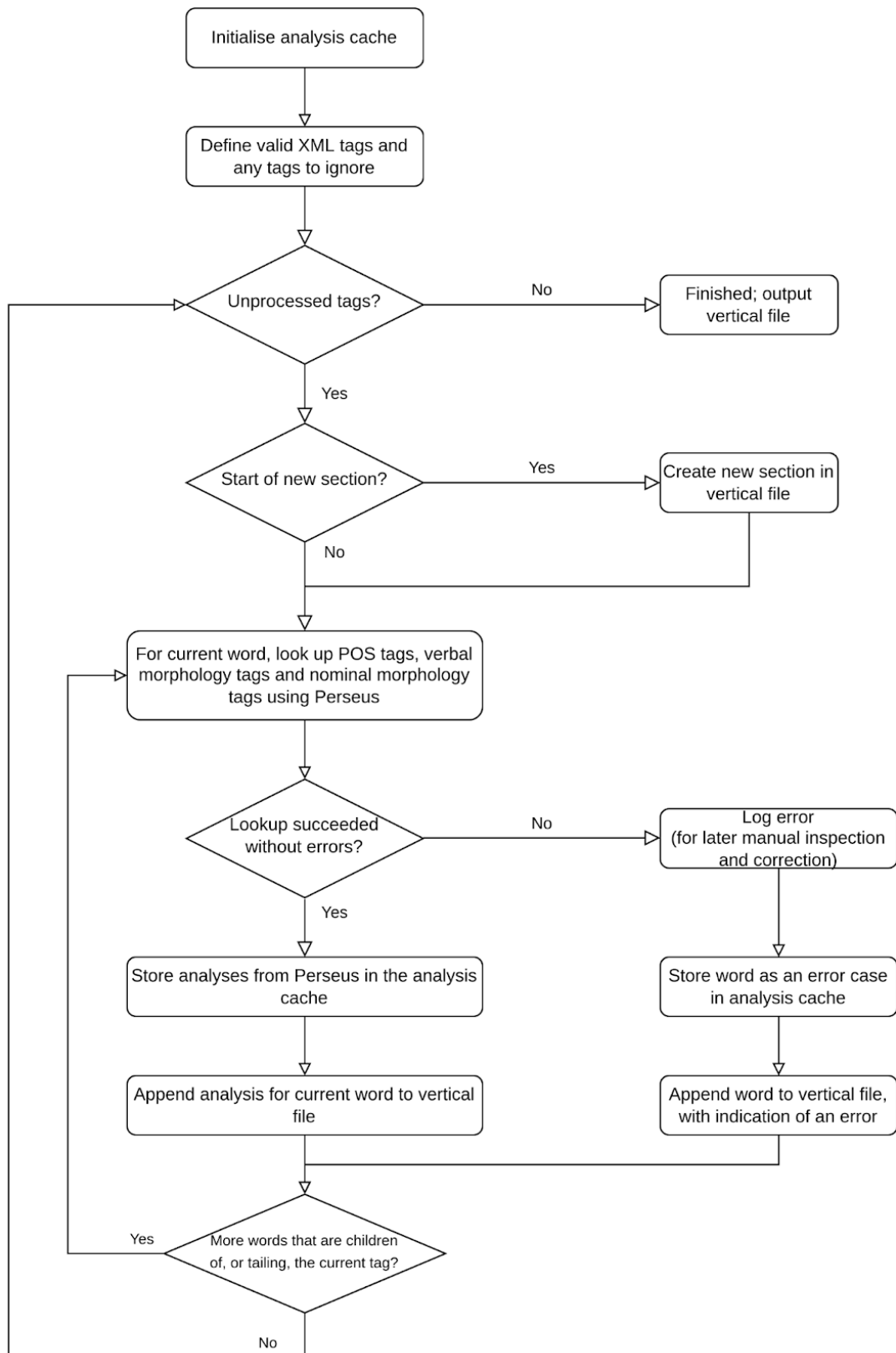
        self.__possible_pos_tags = [
            "adj",
            "adv",
            "article",
            "conj",
            "enclitic",
            "exclam",
            "indeclform",
            "noun",
            "numeral",
            "partic",
            "prep",
            "proclitic",
            "pron",
            "verb",
        ]
```

Option 2: (Advanced) Clone the git repository

The repository can be found here: https://github.com/MatthewIreland/xml_lemmatiser_tagger.

The Python program In the main loop, an analysis is looked up in Perseus and then appended to the output file for Sketch Engine (and also recorded in the Analysis Cache in case the word form appears again later in the text). Care is taken to make sure that metadata corresponding to markers in the source text (such as section numbers, chapter numbers or line numbers) is also recorded in the correct place in the output file so it can be used in Sketch Engine. If an error occurs (e.g. Perseus cannot analyse a word) we record this. Some words that cause errors can be manually annotated (the analysis cache can be initialised with these words on startup). The flowchart in [2] provides an overview of the process:

[2] Python program



If the same word appears multiple times in the source text, it is only looked up once in Perseus and the same results are printed to the vertical file wherever the word appears. After the word has been looked up using Perseus for the first time, it is added to the Analysis Cache. If the

word appears again, the analysis will be retrieved from the Analysis Cache rather than from Perseus. This reduces the overall execution time as fewer network requests are required.

Input and output formats The input files are obtained from the Perseus Digital Library. They are in a TEI-compliant format. The output format is a “vertical file” that can be imported into Sketch Engine. For each word in the corpus, the vertical file includes a lemma, POS tag, and nominal/verbal morphology tags.¹¹

Errors We focus on the reliability of our results. All errors (i.e. where Perseus fails to lemmatise or tag a word) are logged and manually inspected. Where errors can be corrected (e.g. through manual lemmatising or tagging), the manual annotations are added to the analysis cache on startup so that Perseus is not required for lemmatising/tagging and the words will be correctly lemmatised/tagged on a second pass through the data.¹²

Design choices Many have previously built parsers for TEI-compliant texts. Why build another one? We needed a fine level of control over the parser in order to manage errors and ensure reliability of results. Hence, we used Python’s XML parsing libraries rather than an existing parser specifically for TEI texts.

Another tool considered was Morpheus. However, we found that the results from Morpheus were very sensitive to the changes in the build configuration. Results may change when Morpheus has been built on different computers, such that it is difficult to trust the results. Hence, we opted to use the online version of Perseus, which seems to generate consistent and more reliable analyses.

The Perseus API permits the lemmata and tags to be returned in a structured format. However, a bug means that API parameters are not correctly parsed when data is returned in XML format. This bug was fixed by the Perseus authors when data is returned in HTML format, but not when data is returned in XML format. To see the bug (source version 20110527), look at the Perseus source code and compare [3a] and [3b]:

[3a] `./sgml/reading/src/perseus/controllers/document/MorphController.java`

[3b] `./sgml/reading/src/perseus/controllers/document/XmlMorphController.java`

¹¹ Perseus contains tags regarding (i) verbal morphology, (ii) nominal morphology, (iii) part of speech, (iv) dialect, (v) genre, (vi) word formation, (vii) semantics and the tag ‘rare’ regarding the attestation of items. The tags found in the classical Attic literary corpus were grouped manually into the above categories. Xenophon’s *On Horsemanship* did not show any tags that would have necessitated the creation of a new category.

¹² Note that Perseus does not currently have access to pre-defined multi-word expression structures in the form of ‘listening words with spaces’ or listing ‘idiomatic expressions’ (Constant et al. 2017 p. 844).

Note in MorphController.java the presence of the following code to decode a UTF-8 input parameter:

```
word = URLDecoder.decode(word, "utf-8");
word = new String(word.getBytes("8859_1"), "UTF-8");
if (language.equals(Language.GREEK)) {
    word = GreekEncodingAnalyzer.transcode(word, "PerseusBetaCode");
}
```

This is not present in the XmlMorphController but would be required in order to correctly parse inputs. Note in MorphController, the presence of the comment “//don't need this because user is only entering BetaCode”, which is not correct because forward and back slashes may be used in betacode. Since they will be encoded as URL parameters, they need decoding correctly in the Java source.

Modifications for *On Horsemanship* A small modification was required for Xenophon’s Minor Works, which *On Horsemanship* is one of, as it included a “group” XML tag that had not been seen in any previous text. By default, the program throws an error if it sees an unknown tag, so that the user can decide how this tag should be processed (e.g. should metadata from this tag be copied to the output). However, as there is only one “group” tag in the text, the software did not need to take any further action upon seeing this tag. Therefore, the only modification required was to add “group” to the list of known XML tags so that this tag did not cause an error. The Perseus analysis succeeded for every word in *On Horsemanship* text and there were no errors. The processing of this text executed in 11 minutes at 4 seconds.

Implementation in Sketch Engine In order for our .vert file to be correctly read by Sketch Engine, especially with regard to (i) the column names (lemma, POS tag, verbal morphology, nominal morphology), (ii) the section and sentence markers and (iii) the types of metadata we include, we produced a modified corpus configuration file: <https://github.com/MatthewIreland/linguini/blob/main/files/configFile.txt>.¹³

Accuracy tests The errors.txt file is created by the Python program while looking up each word form of a text on Perseus. The word forms for which the lookup fails are appended to errors.txt. Word forms can cause errors related to the POS tag (‘cannot find POS tag’), the morphological tag (‘cannot find verbal / nominal morphology’) and the lemma (‘cannot find lemma’). The error.txt file is then processed to find *unique errors*, i.e. the minimum set of

¹³ We owe thanks go to Barbara McGillivray (Turing Institute London) for letting us see the configuration file for her Latin Sketch Engine corpus for comparison.

words that would have to be manually annotated and used for initialising the analysis cache to reduce the total error count to zero. [4] summarises the error rates for the classical literary corpus¹⁴, a manually annotated sub-sample of this corpus¹⁵, and *On Horsemanship*.

[4] error.txt file

Corpus	Number of words	Number of unique errors in error.txt	Percentage of error
Corpus of text	492,620	451	0.09%
Test sample	117,783	56	0.05%
<i>On Horsemanship</i>	7,144	0	0.00%

The second measure is manual assessment of the Test sample using the *Thesaurus Linguae Graecae* (TLG henceforth), in Text search – proximity – lemma. The results for select items are presented in [5].

[5] *Thesaurus Linguae Graecae* vs Sketch Engine

Lemma	<i>Thesaurus Linguae Graecae</i>			Sketch Engine Test sample			<i>LogDice</i>
	Total	Co-occurrence with PN	<i>logDice</i>	Total	Co-occurrence with PN	<i>logDice</i>	error vis-à-vis TLG data
δίκη (PN)	114	n/a		113	n/a		
λαμβάνω	257	28	11.27	253	26	11.18	0%
δίδωμι	171	53	12.57	171	47	12.40	1.4%
ἀπολείπω	15	∅	n/a	15 ¹⁶	∅	n/a	
φεύγω	92	3	8.898	102	3	8.84	0%
συμμαχία (PN)	55	n/a		55	n/a		
ποιέω	608	17	9.71	622	15	9.50	2.2%
ἀνίημι	8	2	10.02	80 ¹⁷	∅	n/a	
ἀφίημι	34	2	9.52	62 ¹⁸	∅	n/a	

¹⁴ See footnote 1.

¹⁵ Thucydides, Histories V; Xenophon, Anabasis I–IV; Isocrates, Speech 4; Lysias, Speeches 1, 3, 7, 12, 14, 19, 22, 30–32; Plato, Gorgias; Aristotle, Politics I.

¹⁶ Lemmatised as ἀπολιμπάνω

¹⁷ The preposition ἄνευ ‘without’ and the adverb ἄνω ‘above’ can be parsed as forms of ἀνίημι.

¹⁸ ἄπειμι ‘I will go’ shares several forms with ἀφίημι.

ὄπλον (PN)	75	n/a		75	n/a		
ἔχω	760	11	8.75	756	11	8.76	0%
παραδίδωμι	58	12	11.53	58	10	11.27	2.3%

As both the number of attestations and the number of co-occurrences factor into the *logDice*, we calculate the percentage of error for the *logDice* as an overall measure of performance. Sketch Engine performs at the 2.5% threshold, i.e. the percentage of error for all the measurements taken falls below this threshold.

Errors that are likely to appear when using our code on a new corpus include (i) *hapax legomena*, (ii) personal names (that are not catalogued in standard dictionaries), (iii) words that are misspelled and (iv) any not yet considered punctuation marks or textcritical marks that are fused with word forms and thus prevent the lookup from being successful. Moreover, e.g. epic, dialectal or post-classical word forms (and associated lemmata) cause errors due to the limitations of the standard dictionaries which Perseus accesses.

3 Cohesion / coherence through discontinuity: support-verb constructions

Support-verb constructions are combinations of a verb and a noun that fill the predicate slot of a sentence (e.g. *I took the decision to do it*) (Butt 1995). The noun is the semantic head of the construction (Nagy et al. 2013 p. 329) and since filling the predicate slot needs to be predicative or reconceptualised as predicative (e.g. *I took a picture of him* (Radimský 2011)).²⁰ The agent of the event referred to by the noun must be co-referential with the grammatical subject of the verb, at least in non-causative and non-passive support-verb constructions (e.g. *I paid attention to the talk* vs *I caught his attention* vs *I directed their attention to him*).²¹ The noun and the verb contribute to the argument structure (e.g. *I gave him the impression that I wanted to leave* where the verb is the head of the indirect object (sc. *him*) but the noun is the head of the direct object (sc. *that I wanted to leave*)), unlike in auxiliary-verb constructions (e.g. *I have read him the book*) (Bower 2008; Butt 2010; Butt et al. 2013; Butt & Lahiri 2013). The noun and the verb contribute to the semantic structure (e.g. *I gave him the impression that ...* vs *I got the*

²⁰ This is unlike in internal-object structures, such as English *to run a race*, in which the verb is the semantic head and the noun qualifies this head (van Emde Boas et al. 2019 pp. 364–365). Pompei (2006) argues for such structures to univertate in the form of noun incorporation (e.g. οἰκοδομέω from οἶκος ‘house’ + δομέω ‘to build’). The same cannot happen for support-verb constructions given their differing internal structure.

²¹ The link between active, causative and passive support-verb-construction patterns in the sense of the causative and passive as derivations of the active is captured in the idea of prototypes by Gross (1998), Mel’cuk (1996, 2004) and Kamber (2008).

impression that ...), such that removal of either component would break up the support-verb construction.²² Support-verb constructions in classical Greek have not received much scholarly attention, with the exception of the support verb ποιέομαι ‘to do’ (Baños 2015; Cock 1981; Fendel 2021; Jiménez López 2011, 2012, 2016, 2021; Marini 2010; Zilliacus 1956, 1967).

For their functioning as devices to further discourse cohesion, three aspects of support-verb constructions are of interest (see also Storrer 2009):

- (i) They are multi-morphemic, thus (often) allowing modification of either component (e.g. *He confidently gave a long speech* where the verb is modified by the adverb of manner *confidently*, whereas the noun is modified by the adjective of degree *long*).²³ This allows for the fine-tuning of the predicate expression (Didakowski & Radtke 2020). Moreover, their being multi-morphemic and in many cases internally analytic allows for the condensation of several support-verb constructions by deletion of a recurring support verb (e.g. *He made **a suggestion and an assumption** at the same time* (Gross 1998)); it also allows for the expansion of a support-verb construction across a stretch of discourse, e.g. by means of relativisation (e.g. *The idea **which** I had yesterday was really useful.*) and pronominalisation (e.g. *I had a great idea yesterday, I suddenly had **it** on the train to London.*).²⁴ Finally, it allows for the noun to be used recurrently in the discourse without being part of the same support-verb construction at all times (see ἵππασία ‘horsemanship / horse exercise’ in *On Horsemanship*) (Jackson 2016 pp. 16–21).
- (ii) They are discontinuous, thus (often) allowing for items to intervene between the noun and the verb, while the support-verb construction is held together by the syntactic dependency relation between the verb and the noun (e.g. *I had **a great idea***).²⁵ This allows for the bracketing of pieces of information, thus assigning them unequivocally to the support-verb construction, e.g. Lysias, Speech 3.22 συνθήκας **πρὸς αὐτὸν** ποιησάμενος AGREEMENTS.ACC – WITH HIM – MAKING ‘making agreements with him’.

²² For a formal decision tree, which illustrates the many decisions to be made: https://parsemefr.lis-lab.fr/parseme-st-guidelines/1.0/?page=060_Specific_tests_-_categorize_VMWEs/020_Light-verb_constructions (accessed 28 June 2021).

²³ Diachronically, there is the potential for univerbation under certain circumstances, e.g. λόγον ποιέομαι into later λογοποιέομαι ‘to report’ (Creissels 2016; Lehmann 2020; Rosén 2020).

²⁴ In Greek, inference of a contextually salient support verb and / or predicative noun is permissible even without pronominalisation (e.g. Plato, *Gorgias* 479d καὶ αἰὲν τὸν ἀδικοῦντα τοῦ ἀδικουμένου ἀθλιώτερον εἶναι καὶ τὸν μὴ δίδόντα δίκην τοῦ **διδόντος** ‘and that the wrongdoer is always more wretched than the wronged and the unpunished than the **punished**’).

²⁵ ‘The *syntactic distance* between two components is defined as the number of elements in the syntactic dependency chain between these two components, regardless of the direction of the dependencies and excluding the components themselves’ (Pasquer et al. 2018 p. 2589).

More generally, this ties in with Lakoff and Johnson's (1980 p. 130) observation that a semantic link is reflected in the formal expression (cf. principle of iconicity). They conclude that *I taught Greek to Harry* and *I taught Harry Greek* differ in that only the latter refers to the acquisition of Greek, which is reflected in the formal expression by the positioning of *Harry* (see also Frenda 2017).

(iii) They are semi-compositional, thus (often) developing a meaning different from and more specific than the related simplex verb (Sanroman Vilas 2009; Storrer 2009) (e.g. *unterrichten* 'to teach' vs *Unterricht erteilen* 'to give a lesson'). Support-verb constructions reflect a range of degrees of compositionality. For example, in *to have an idea*, abstracting from concrete *to possess* / *to have* to *to belong to* / *to have* explains the meaning of the support-verb construction (Hermann 2020 pp. 58–61); in *to take a picture*, we need to reconceptualise the meaning of the noun to refer to the process resulting in the object rather than the concrete object (Radimský 2011); in *to take heart*, we need to metaphorically extend the meaning of the noun to refer to feelings / emotions and specifically courage (Nunberg et al. 1994; Sheinflux et al. 2019). They are also semi-productive in the lexicon, such that they cannot be generated at random or according to a fixed set of rules (Kamber 2008), e.g. *to make a trip* is unnatural in English.²⁶ Rather, lexical affinity between the verb and the noun governs the creation of support-verb constructions.

In Xenophon's short treatise, three support-verb constructions recur, *ἵππασίαν ποιέομαι* 'to do horse exercise' including the topical keyword *ἵππασία*, along with *τεκμήρια παρέχομαι* 'to give an indication' and *πεῖραν λαμβάνω* 'to put to the test', which refer to the scientific method of finding evidence and drawing conclusions based on it. In the below we focus on those support-verb constructions. A full list of support-verb constructions in *On Horsemanship* can be found in the appendix.

ἵππασία is a keyword in the treatise. It appears 17 times in differing syntactic environments, as shown in [6].

[6] Sketch Engine concordance of *ἵππασία* in *On Horsemanship*

²⁶ For later tendencies with *facere* 'to do' in Latin, see however Galdi (2018).

CONCORDANCE		Xenophon On Horsemanship	
lemma ἵππασία • 17 2,433.79 per million tokens • 0.24%			
<input type="checkbox"/> Details	Left context	KWIC	Right context
1	<input type="checkbox"/> doc#0 καὶ γοργότερον τὸν ἵππον ἀποδεικνύουσι</s></s>καὶ γὰρ ὅταν ὀργίζηται ἵππος ἵπῳ ἢ ἐν	ἵππασίᾳ	θυμῶται εὐρύνει μάλλον τοὺς μυκτῆρας</s></s>καὶ μὴν κορυφῇ μὲν μείζων ὧτα δὲ μικρ
2	<input type="checkbox"/> doc#0 εἰ</s></s>τοῦτο δὲ ποιῶν ἅμα γοργότεραν τε καὶ ἰσχυροτέραν ἔξει τὴν ὑπόβασιν τε καὶ	ἵππασίαν	καὶ ἅπαντα βελτίων ἔσται ἑαυτοῦ</s></s>τεκμήριο δ' ἂν καὶ ἀπ' ἀνθρώπων ὅταν γὰρ τι
3	<input type="checkbox"/> doc#0 υς</s></s>εἰσὶ δὲ οἱ διὰ κακῆν ἀγωγὴν καὶ πρὸς τὰς οἰκάδας ἀφόδους φεύγουσιν ἐκ τῶν	ἵππασίων	</s></s>τοὺς γε μὴν ἑτερογνάθους μὴνύει μὲν καὶ ἡ πέδη καλουμένη ἵππασία πολὺ δὲ μ
4	<input type="checkbox"/> doc#0 ν ἐκ τῶν ἵππασίων</s></s>τοὺς γε μὴν ἑτερογνάθους μὴνύει μὲν καὶ ἡ πέδη καλουμένη	ἵππασία	πολὺ δὲ μάλλον καὶ τὸ μεταβάλλεσθαι τὴν ἵππασίαν</s></s>πολλοὶ γὰρ οὐκ ἐγχειροῦσιν
5	<input type="checkbox"/> doc#0 ις μὴνύει μὲν καὶ ἡ πέδη καλουμένη ἵππασία πολὺ δὲ μάλλον καὶ τὸ μεταβάλλεσθαι τὴν	ἵππασίαν	</s></s>πολλοὶ γὰρ οὐκ ἐγχειροῦσιν ἐκφέρειν ἢ μὴ ἅμα συμβῇ ἢ τε ἀδικος γνάθος καὶ
6	<input type="checkbox"/> doc#0 >ἦν δὲ μὴ μόνον ὅταν πονεῖν μέλλῃ χαλινῶται ἀλλὰ καὶ ὅταν ἐπὶ τὸν στόν καὶ ὅταν ἐξ	ἵππασίας	εἰς οἶκον ἀπάγῃται οὐδὲν ἂν εἰῇ θαυμαστόν εἰ ἀρπάζῃ τὸν χαλινὸν αὐτόματος προτείν
7	<input type="checkbox"/> doc#0 τὰ δεξιὰ στρεφόμενος τοῖς δεξιῇσιν ἀφηγείσθαι εἰς εὐάνωμα δὲ τοῖς ἀριστεροῖς</s></s>	ἵππασίαν	δ' ἐπαινοῦμεν τὴν πέδην καλουμένην ἐπὶ ἀμφοτέρω γὰρ τὰς γνάθους στρέφεσθαι ἐθίξ
8	<input type="checkbox"/> doc#0 :π' ἀμφοτέρω γὰρ τὰς γνάθους στρέφεσθαι ἐθίξει</s></s>καὶ τὸ μεταβάλλεσθαι δὲ τὴν	ἵππασίαν	ἀγαθὸν ἵνα ἀμφοτέρω αἱ γνάθοι καθ' ἑκάτερον τῆς ἵππασίας ἰσάζωνται</s></s>ἐπαινοῦμ
9	<input type="checkbox"/> doc#0 τὸ μεταβάλλεσθαι δὲ τὴν ἵππασίαν ἀγαθὸν ἵνα ἀμφοτέρω αἱ γνάθοι καθ' ἑκάτερον τῆς	ἵππασίας	ἰσάζωνται</s></s>ἐπαινοῦμεν δὲ καὶ τὴν ἑτερομήκη πέδην μάλλον τῆς κυκλοτεροῦς</s>
10	<input type="checkbox"/> doc#0 καιρός ἢ μήτε ἐν ἵπποις ποτὲ καταβαίνειν μήτε παρὰ σύστασιν ἀνθρώπων μὴτ' ἔξω τῆς	ἵππασίας	ἀλλ' ὅπουπερ καὶ πονεῖν ἀναγκάζεται ὁ ἵππος ἐνταῦθα καὶ τῆς ῥοστώνης τυχευόμεν</s>
11	<input type="checkbox"/> doc#0 > ἔχει καὶ τὸ ἄλλοτε μὲν ἐν ἄλλοις τόποις ἄλλοτε δὲ μακρὰς ἄλλοτε δὲ βραχείας τὰς	ἵππασίας	ποιεῖσθαι</s></s>ὁμοιόστερα γὰρ καὶ ταῦτα τῷ ἵπῳ τοῦ ἀεὶ ἐν τοῖς αὐτοῖς τόποις καὶ οἱ
12	<input type="checkbox"/> doc#0 </s></s>ὁμοιόστερα γὰρ καὶ ταῦτα τῷ ἵπῳ τοῦ ἀεὶ ἐν τοῖς αὐτοῖς τόποις καὶ ὁμοίως τὰς	ἵππασίας	ποιεῖσθαι</s></s>ἐπεὶ δὲ δεῖ ἐν παντοίοις τε χωρίοις τὸν ἵππον ἀνά κράτος ἐλαύνοντα ἔ
13	<input type="checkbox"/> doc#0 : τεταράχθαι καὶ κινδυνεύειν</s></s>ταῦτα δ' ἐστὶν ἵππων ἔργα τῶν μάλιστα ἀχθομένων	ἵππασίᾳ	καὶ αἰσχρὰ καὶ οὐ καλὰ ποιούντων</s></s>ἐάν δὲ τις διδάξῃ τὸν ἵππον ἐν χαλαρῷ μὲν τῷ
14	<input type="checkbox"/> doc#0 προῆν ἅπερ αὐτὸς σχηματοποιεῖται ὅταν μάλιστα καλλωπίζεται οὕτως ἡδόμενόν τε τῇ	ἵππασίᾳ	καὶ μεγαλοπρεπῇ καὶ γοργὸν καὶ περιβλεπτόν ἀποφαίνει τὸν ἵππον</s></s>ὡς οὖν ἡγοῦμ
15	<input type="checkbox"/> doc#0 πένειν ὡς ἱππασσῶντι βουλόμενον οὕτω γὰρ μάλιστα θαρρῶν πρόεισιν εἰς τὴν ταχείαν	ἵππασίαν	</s></s>ὡς δὲ καὶ τῷ ταχὺ θεῖν ἵππος ἡδεῖται τεκμήριον ἐκφυγῶν γὰρ οὐδεὶς βόδιον πορ
16	<input type="checkbox"/> doc#0 ὁ ἱππάζεσθαι μετὰ τοῦ κυδρὸς ἀφηγόμενος ἢ εἰσηγόμενος μὲν δὴ ποῦ ἤμιν ἦν ἐν τῇ πρώτῃ	ἵππασίᾳ	ἐκ τῶν στροφῶν εἰς τὸ θάττον ὀρμίσσθαι</s></s>ἦν δὲ τις τοῦτο μὲν μεμαθηκὸς αὐτ
17	<input type="checkbox"/> doc#0 εἶρειν ὀρθῶς δὲ χρῆται καὶ ἐν τοῖς πρὸς πόλεμον μελετήμασι καὶ ἐν ταῖς πρὸς ἐπίδειξιν	ἵππασίας	καὶ ἐν τοῖς πολεμικοῖς ἀγωνίσμασι τί ἐτι ἐμποδὼν τοῦτ' οὐκ οὐκί πλεονόν τε ἀξίους ἵπ

In 8 of 17 instances, ἵππασία appears in an adverbial phrase (with a preposition) (rows 1, 3, 6, 9, 10, 15, 16, 17). In 2 of 17 instances, ἵππασία takes the form of an adverbial dative with a verb of emotion (rows 13 and 14). In 4 of 17 instances, ἵππασία is the subject (row 4) or object (rows 5, 7, 8) of the sentence. The remaining three passages are instances of support-verb constructions.

In [7], ἵππασία is combined with the support verb ποιέομαι to mean ‘to do horse exercise / to exercise the horse’. The qualifying adjectives (μακράς ‘long’, βραχείας ‘short’, and ὁμοίως ‘similar’) are spaced out across the sentence.

[7] Xenophon, *On Horsemanship* 8.9

Ὅρθῶς δ' ἔχει καὶ τὸ ἄλλοτε μὲν ἐν ἄλλοις τόποις, ἄλλοτε δὲ μακράς, ἄλλοτε δὲ βραχείας τὰς ἵππασίας ποιεῖσθαι. ὁμοιόστερα γὰρ καὶ ταῦτα τῷ ἵπῳ τοῦ ἀεὶ ἐν τοῖς αὐτοῖς τόποις καὶ ὁμοίως τὰς ἵππασίας ποιεῖσθαι.

‘It is right to do exercise sometimes in different places, sometimes for a long time, sometimes for a short time. For these things (i.e. exercising in different places and with diversity of exercises) are less troublesome to the horse than to do exercise in the same places and the same exercise all the time.’

This allows for a contrast to be established between lengths of exercise (μακράς, βραχείας) and for these lengths of exercise to be linked to different spatial settings without repetition of the predicate but while maintaining that this refers to one and the same event (‘to exercise the horse’). The same support-verb construction appears in the second sentence in [7], yet this time

the adjective accompanying the noun is an adjective of manner forming the final part of a climax (ἀεί ‘always’ – ἐν τοῖς αὐτοῖς τόποις ‘in the same places’ – ὁμοίας τὰς ἵππασίας ‘the same exercises’) highlighting what is to be avoided when training a horse.²⁷

The use of a simplex verb would change the type of parallelism underlining the contrast in length in the first sentence and the type of climax underlining the degree of preference/dispreference in the second sentence. A simplex verb could only be modified externally, by means of an adverb, but not internally, by means of an adjective (Didakowski & Radtke 2020). E.g. *to give a good speech* evaluates the content of the speech vs *to give a speech well* comments on the presentation of the speech. Equally, *to do an extended / short exercise* evaluates the exercise itself, whereas *to do exercise for a long / short time* comments on the execution of the exercise.²⁸ In the former, the focus is on the exercise itself and its type; in the latter, the focus is on the circumstances of doing the exercise. Xenophon’s passage evaluates the type of exercise rather than the circumstances of the exercise.

In [8], ἵππασία is combined with the support verb ἔχω to mean ‘to have ridden work / to behave under saddle’. Unlike in [7], the noun is not only qualified by adjectives of manner (γοργοτέραν ‘fiercer’ and ισχυροτέραν ‘more powerful’) but is also conjoined with a second noun ὑπόβασιν ‘movement’.

[8] Xenophon, *On Horsemanship* 1.14 τοῦτο δὲ ποιῶν ἅμα γοργοτέραν τε καὶ ισχυροτέραν ἔξει τὴν ὑπόβασιν τε καὶ ἵππασίαν καὶ ἅπαντα βελτίων ἔσται ἑαυτοῦ.

‘Doing this, (the horse) will have a fiercer and more powerful movement / gait and ridden work and he will be better than his former self in every way.’

While [7] illustrated how a support-verb construction can tie together many pieces of information about the event in question seamlessly, [8] shows how a support-verb construction can be used to condense information. Since the two co-ordinated nouns in [8] can both function as nouns in a support-verb construction and both accept the support verb ἔχω, one instance of the verb is deleted (Gross 1998).

²⁷ The comparative ἀμειότερα explicitly links the two instances of the support-verb construction. The type of link is not left to contextual inference.

²⁸ Support-verb constructions in Greek can be modified by both adverbs and adjectives. While the modification by adverbs is not constrained, the modification by adjectives is constrained as analysability and compositionality of the support-verb construction is required in many cases, except if the adjective is a fixed component of the structure (e.g. German *erste Hilfe leisten*).

Similar condensation appears with the one-off structures ἀσχολίαν / ἀθυμίαν παρέχω ‘to provide a lack of rest / a lack of confidence’ in section 3.12. Their combination underlines the unpleasantness of the situation for the rider, accentuated by the parallel alpha privative at the start of both nouns. The focus on contrasting items by means of a support-verb construction may underlie κόσμον παρέχω ‘to adorn’ in section 12.2, there describing the rider’s headwear. The verb παρέχω ‘to give’ is contrasted in the parallel structure with δέχομαι ‘to receive’ and the noun κόσμον ‘ornament’ with τὸ πρόσωπον ‘the face’. While the parallel structure does not qualify as a support-verb construction, the parallelism underlines the interplay between the armour and its wearer.

The other two recurring support-verb constructions concern not the keyword but the key aim of Xenophon’s treatise, that is a scientific approach to horse care and training. In [9], the support-verb construction πείραν λαμβάνω recurs three times in quick succession.

[9] Xenophon, *On Horsemanship* 3.7

ἐπεὶ δὲ πολεμιστήριον ἵππον ὑπεθέμεθα ὠνεῖσθαι, **ληπτέον πείραν** ἀπάντων ὅσων περ καὶ ὁ πόλεμος **πείραν λαμβάνει**. ἔστι δὲ ταῦτα, τάφρους διαπηδᾶν, τειχία ὑπερβαίνειν, ἐπ’ ὄχθους ἀνορούειν, ἀπ’ ὄχθων καθάλλεσθαι· καὶ πρὸς ἄναντες δὲ καὶ κατὰ πρανοῦς καὶ πλάγια ἐλαύνοντα **πείραν λαμβάνειν**· πάντα γὰρ ταῦτα καὶ τὴν ψυχὴν εἰ καρτερὰ καὶ τὸ σῶμα εἰ ὑγιὲς δοκιμάζει.

‘Since we hypothesized that the horse fit for war is to be bought, it must be put to the test in everything which war usually puts it to the test in too. These aspects are (i) leaping across ditches, (ii) overcoming walls, (iii) jumping up a bank, (iv) leaping down from banks. In addition, (it is necessary that) by riding uphill and downhill and sideways he put (sc. the horse) to the test. For all these tests indicate whether (the horse) is strong in spirit and healthy in the body.’

Unlike ἵππασίαν ποιέομαι, πείραν λαμβάνω seems to assume a highly specific meaning, possible acquired through lexicalisation.²⁹ πείραν λαμβάνω seems to mean specifically ‘to put to the test’. The subject slot seems to be filled by who or what is doing the testing (ὁ πόλεμος

²⁹ Lipka (1981 p. 120): ‘Unter Lexikalisierung verstehe ich die Erscheinung, daß einmal gebildete komplexe Lexeme bei häufigem Gebrauch dazu tendieren, eine einzige lexikalische Einheit mit spezifischem Inhalt zu werden. Durch die Lexikalisierung geht der Syntagmachearakter in mehr oder weniger starkem Maße verloren’ (see further Lipka 1992). Examples are compounds such as *housewife* (Hopper & Traugott 2003 p. 53) and *Feierabend*. The meaning of the compound is in both cases a lexical unit with a meaning different from the meaning of its parts.

‘the war’ and ἐλαύνοντα referring to the implied subject ‘the rider’). The entity to be tested (here the horse) is contextually salient but is not explicitly mentioned. This is not surprising given the general observation that support-verb constructions help to de-transitivise, that is to decrease the number of event participants (e.g. *to suggest (something)* vs *to make a suggestion*) (Marini 2010). The focus is thus shifted to the event of testing and away from the patient of the event (Foley 2007). The area of testing is indicated by means of an objective genitive (see πάντων ‘everything’), thus it seems to be specifically the patient that the structure is intended to eliminate. Xenophon’s choice of the support-verb construction (‘to put to the test’) over the simplex verb (πειράω, πειράζω ‘to examine / to test’) focuses the reader’s attention on the event of testing in more fact-based a way than the integration of a second participant (the horse) could.³⁰

Similarly, τεκμήρια παρέχομαι ‘to give an indication of’ in [10a] and [10b] reflects Xenophon’s interest in the scientific method. However, unlike πείραν λαμβάνω ‘to put to the test’ and more like ἵππασίαν ποιέομαι ‘to do horsemanship / horse exercise’, he availed himself of the option of qualifying just one component of the support-verb construction. Thus, in both [10a] and [10b], we find adjectives of manner qualifying the noun (πάνυ σαφῆ ‘very clear’ and ἱκανά ‘strong’).

[10a] Xenophon, *On Horsemanship* 1.1

τοῦ μὲν τοίνυν ἔτι ἀδαμάστου πώλου δῆλον ὅτι τὸ σῶμα δεῖ δοκιμάζειν· τῆς γὰρ ψυχῆς οὐ πάνυ σαφῆ **τεκμήρια παρέχεται** ὁ μήπω ἀναβαινόμενος.

‘It is obvious that it is necessary to assess the body (sc. only) with regard to a still unbroken colt. For the one who has not yet been mounted does not give any clear indication of his temperament.’

[10b] Xenophon, *On Horsemanship* 3.11

ὅσοι δ’ ἂν πεπονηκότες ἐθέλωσι πάλιν ὑποδύεσθαι πόνους ἱκανὰ **τεκμήρια παρέχονται** ταῦτα ψυχῆς καρτερᾶς.

³⁰ The same may be true of φόβον παρέχω in section 6.15 οἱ δὲ πληγαῖς ἀναγκάζοντες ἔτι πλείω φόβον **παρέχουσιν**· οἶονται γὰρ οἱ ἵπποι, ὅταν τι χαλεπὸν πάσχωσιν ἐν τῷ τοιούτῳ, καὶ τούτου τὰ ὑποπτευόμενα αἷτια εἶναι. ‘Those forced with beating show even greater fear. For the horses believe, when they suffer something terrible in a certain situation, that the thing which they are suspicious of is responsible (for that too).’ φόβον παρέχω is here not causative (‘to scare’) but intransitive (‘to show fear / to be afraid’) (Itzès 2007, 2015; Machounis 2004; Marini 2018).

‘All those (horses) who are willing to delve into work again after having worked out give (this as) a strong indication of a steadfast character.’³¹

The aspect indicated is specified in the form of an objective genitive in [10a] and [10b] (τῆς ψυχῆς ‘of the disposition’ and ψυχῆς καρτερᾶς ‘of the steadfast character’). The simplex verb τεκμαίρομαι ‘to judge from signs’ differs in meaning; the active τεκμαίρω ‘to make proof’ comes closer to the meaning of the support-verb construction but is rare throughout the history of Greek as searches in the *Thesaurus Linguae Graecae* show (<http://stephanus.tlg.uci.edu>). Of the 51 instances only 3 are classical. These appear in Pindar’s odes (6th / 5th c. BC) and Aeschylus’ tragedies (6th / 5th c. BC).³² Thus, it seems that the support-verb construction here may not only provide Xenophon with advantages as regards discourse cohesion but may also have filled a gap in the paradigm of the verb (see also Aerts 1965; Bentein 2016 p. 76; Ledgeway & Vincent 2022). Similarly, in the case of ἐξουσίαν παρέχω ‘to give the power to’ in section 6.9, a related simplex verb only develops in later Greek.

4 Scientific language as a specialised literacy: cohesion through register continuity

Xenophon defines his intended audience at the beginning of his treatise as the next generation of horsemen (section 1.1 τοῖς νεωτέροις τῶν φίλων ‘the younger ones amongst the friends / companions’). Thus, he seems to expect his audience to belong to the same community of practice as himself, that is people interested in the purchase, care and training of horses especially for cavalry purposes. A community of practice is a group of people that share knowledge and/or skills, often related to a specific area of expertise, through interactions (Unwin et al. 2007).³³

Xenophon’s treatise is only accessible to someone who has domain-specific literacy, that is a ‘competence or knowledge in a particular area’ (OED s.v. literacy 2). However, in addition to basic background knowledge in the care and training of horses (Maienschein’s

³¹ An anonymous reviewer pointed out correctly that the anaphoric pronoun ταῦτα functions as the object and τεκμήρια thus moves closer to a predicative element in [10b]. This is true and structures like this are otherwise omitted from the data collection. However, firstly, Greek support-verb constructions are on occasion found with an accusative object (e.g. Ittész 2007; but also Lowe 2017), and secondly, one could equally argue that ταῦτα is appositional or even parenthetical, thus functioning outside the sentence grammar (Koev 2022), or that the predicative relation works the other way round, i.e. with ταῦτα as the predicative element. The parallel with [10a] makes us include the passage here, yet with the caveats just outlined.

³² Pindar, *Olympia* 6.73; Pindar, *Nemea* 6.8; Aeschylus, *Prometheus vincitus* 605. The fourth instance appears in Aratus, *Phaenomena* 1.18. Aratus’ work is a didactic poem and dates slightly later (4th / 3rd c. BC).

³³ Greer (2015) aligns Xenophon’s treatise with modern approaches to horsemanship. While differences certainly exist, which may partly be due to the intended purpose of Xenophon’s horses, his focus on the care and the behaviour of horses is noticeable (cf. McGreevy 2012; McIlwraith & Rollin 2011).

(1998) science literacy), Xenophon's reader must also be familiar with his way of arriving at and presenting pieces of information (Maienschein's (1998) scientific literacy). This familiarity, the reader gains partly through engagement with the process of knowledge production in a scientific context (see also Durant 1994; Howell & Brossard 2021), partly through engagement with the norms governing the communication of knowledge (the scientific register).

The support-verb constructions discussed in Section 3 reflect three aspects of scientific writing that are evident from Xenophon's text also elsewhere, that is (i) precision, through the use of specialised terms, (ii) methodical working, through the establishment of a clear structure, and (iii) incremental results, through the linking backwards and forwards in the discourse. We illustrate these three traits one by one before mapping them onto support-verb constructions.

Precision In section 4.2, Xenophon considers the case of a horse that is unwell as indicated by the horse not taking in food normally (ὅταν [μὴ] ἐκκομίζῃ τὸν σῖτον ὁ ἵππος 'when the horse does not take in his feed'). Xenophon considers the options of (i) too much blood in the body, (ii) exhaustion, and (iii) ailments such as laminitis (κριθίασις). κριθίασις is throughout Greek literature a word that is rare and which appears exclusively in treatises on horsemanship, as searches in the *Thesaurus Lingae Graecae* show.³⁴ κριθίασις seems etymologically related to κριθή 'barley' / κριθάω 'to be fed with barley'. Anderson (1961 pp. 162 and 207) argues for it to refer to laminitis rather than colic, both specific illnesses affecting horses. Xenophon, by using the word, shows not only great attention to detail but displays familiarity with technical terms of the community of practice of horsemen. Moreover, κριθίασις fits in with the scheme of the creation of a 'systematic scientific' vocabulary in the 5th / 4th c. BC by means of deverbal derivations in -σις, such as διαλέγω / διάλεξις 'argumentation', περιλέγω / περίλεξις 'circumlocution', καταλαμβάνω / κατάληψις 'comprehension', κρούω / κρούσις 'attempts at deception' in Aristophanes, *Clouds* 316–318, all related to rhetoric (Galdi 2018 p. 242; Langslow 2000; Willi 2003 p. 67).

Methodical working The introduction to *On Horsemanship* shows Xenophon justifying himself as a competent author, stating unequivocally the objective of his work and aligning himself with past work in the same area of expertise.

[11] Xenophon, *On Horsemanship* 1.1

³⁴ Apart from Xenophon, we find it in (i) the grammarian Aristophanes (3rd / 2nd c. BC), (ii) the rhetorician Pollux (2nd c. AD), (iii) in the compilation of the *Hippiatrica* (9th c. AD), and finally in the (iv) the encyclopaedia of the Suda (10th c. AD). 17 instances are attested in total.

[qualification of author] Ἐπειδὴ διὰ τὸ συμβῆναι ἡμῖν πολὺν χρόνον ἵππεύειν οἰόμεθα ἔμπειροι ἵππικῆς γεγενῆσθαι,

[objective of the work] βουλόμεθα καὶ τοῖς νεωτέροις τῶν φίλων δηλῶσαι ἥ ἂν νομίζομεν αὐτοὺς ὀρθότατα ἵπποις προσφέρεσθαι.

[past research] συνέγραψε μὲν οὖν καὶ Σίμων περὶ ἵππικῆς, ὃς καὶ τὸν κατὰ τὸ Ἐλευσίνιον Ἀθήνησιν ἵππον χαλκοῦν ἀνέθηκε καὶ ἐν τῷ βάθρῳ τὰ ἑαυτοῦ ἔργα ἐξετύπωσεν·

[procedure] ἡμεῖς γε μέντοι ὅσοις συνετύχομεν ταῦτα γνόντες ἐκείνῳ, οὐκ ἐξαλείφομεν ἐκ τῶν ἡμετέρων, ἀλλὰ πολὺ ἥδιον παραδώσομεν αὐτὰ τοῖς φίλοις, νομίζοντες ἀξιοπιστότερα εἶναι ὅτι κακεῖνος κατὰ ταῦτα ἡμῖν ἔγνω ἵππικὸς ὢν· καὶ ὅσα δὴ παρέλιπεν ἡμεῖς πειρασόμεθα δηλῶσαι.

‘[qualification of author] Because we have been involved in horsemanship for a long time and believe to be experienced in horsemanship,

[objective of the work] we want to show to our younger friends how we think that they treat horses correctly.

[past research] In fact, also Simon has written about horsemanship, a man who offered a bronze horse at the Athenian Eleusinium and inscribed his own achievements on the pedestal.

[procedure] However, we do not leave out all those points in which we concur with him, but we will present these to the friends with great pleasure, considering them to be even more reliable because he too, such a great horseman, concurred. All those points which he has left out, we will try to clarify.’

While the quoting of past works either verbatim or with modifications was a regular process in Greek literature (S. Adams & Ehorn 2015; Finnegan 2011 chap. 8), Xenophon’s scientific interest seems to be to fill gaps in the community’s knowledge. He positions himself with regard to his contemporary’s work in particular, Simon’s *De forma et delectu equorum*, as Simon covered the same area of expertise. Xenophon’s introduction in [11] is more than a condensed overview of the plot, it characterises him as a valid member of the community of practice to whose knowledge base he wants to contribute.³⁵

³⁵ At the very end, in section 12.14, he reiterates almost like a disclaimer that his notes only pertain to the private person, whereas the cavalry leader is directed to another book.

Incremental results Throughout *On Horsemanship*, Xenophon facilitates it for the reader to tie pieces of the discourse together by means of interims summaries (e.g. sections 1.17, 2.3, 3.12, 9.1, and 10.17) and topic sentences foreshadowing what is to come next (e.g. 7.1, 9.1, and 12.1). In section 8.2, he explains why what may seem like repetition (διλογέω ‘to say twice’) is necessary rather than redundant: ὅτε μὲν γὰρ ἐωνεῖτο, πειρᾶσθαι ἐκελεύομεν εἰ δύναιτο ὁ ἵππος ταῦτα ποιεῖν· νῦν δὲ διδάσκειν φαμὲν χρῆναι τὸν ἑαυτοῦ καὶ γράψομεν ὥς δεῖ διδάσκειν. ‘For when he bought (the horse), we said to try out whether the horse can do these things. But now we say that it is necessary to teach one’s own horse and we will write down how this must be done.’ Xenophon’s aim with these metatextual notes is to guide the reader through his work, so as to ensure that the reader appreciates the logical progression through the aspects discussed.

Support-verb constructions play a role in all three aspects – precision, methodical working, and incremental results. Firstly, they can develop, often through lexicalisation, a meaning that is different from that of the related simplex verb and often more specific. In Section 3, we saw the domain-specific support-verb construction τεκμήρια παρέχομαι ‘to give an indication of’. Many of these lexicalised support-verb constructions are structurally rather fixed, although this is not a compulsory relation between structure and meaning (Ledgeway & Vincent 2022; see Nunberg et al. 1994; vs Sheinflux et al. 2019).

Secondly, support-verb constructions seem to be involved in the development of a systematic vocabulary for the purposes of a community of practice. As mentioned, the 5th / 4th c. BC saw an increase in deverbal derivations in -σις in the context of creating a systematic terminology for areas such as rhetoric. These nouns were integrated into the predicate slot of a sentence by means of the support verb ποιέομαι. This is visible when drawing up the collocational field of common support verbs in a large corpus of classical literary Attic by means of Sketch Engine: ἄγω ‘to act’, δέχομαι ‘to receive’, δίδωμι ‘to give’, ἔχω ‘to have’, λαμβάνω ‘to take / receive’, παρέχω ‘to provide’, ποιέομαι ‘to do’, τίθημι ‘to put’, φέρω ‘to bring’, τυγχάνω ‘to get’ and χράομαι ‘to use’.³⁶ All the candidates except for ποιέομαι form strong collocations with a small number of nouns, which can receive a support-verb construction reading (Pasquer et al. 2018 p. 2583). By contrast, ποιέομαι enters into a large number of loose combinations with nouns in -σις (deverbal formations) and -ία (deadjectival formations). This resembles Galdi’s (2018 pp. 239–240 and 242) findings for later Latin *facere* ‘to do’ support-verb constructions, which specifically in technical contexts flourish with nouns

³⁶ See footnote 1.

in *-io* (deverbal formations), e.g. *Mulomedicina Chironis*, 26 *simili modo sanguinis detractioem in eis facies, sicut in prioribus demonstravi* ‘in the same way you will do the extraction of blood in them, as I have described before’ (vs *detraho* ‘to extract’).³⁷ ποιέομαι support-verb constructions almost seem like a default systemic means to integrate the newly-created technical terms (cf. Langer 2004). Section 3 examined topical ιππασίαν ποιέομαι ‘to do horsemanship / horse exercise’.

Thirdly, support-verb constructions serve to tie pieces of information together within sentences (coherence) and across sentences (cohesion) by means of their discontiguity and analyticity, as explained in Section 3. This happens through bracketing pieces of information with the predicate (cf. Lysias, Speech 3.22 συνθήκας πρὸς αὐτὸν ποιησάμενος ‘to reach agreements **with him**’), establishing long-distance relationships through pronominalisation and/or inference of one component (e.g. Plato, *Gorgias* 479d καὶ ἀεὶ τὸν ἀδικοῦντα τοῦ ἀδικουμένου ἀθλιώτερον εἶναι καὶ τὸν μὴ διδόντα δίκην τοῦ διδόντος ‘and that the wrongdoer is always more wretched than the wronged and the unpunished than the **punished**’), and the repetition of keywords (cf. ιππασία in *On Horsemanship*). Furthermore, support-verb constructions can serve to focus attention on the event by eliminating participants which could act as distractors, as shown for πεῖραν λαμβάνω ‘to put to the test’ in *On Horsemanship*. This allows Xenophon to focus the audience’s attention on the logical progression of events in the treatise.

5 Summary and conclusion

We have built a Sketch Engine corpus for the classical scientific treatise *On Horsemanship*. We used this corpus to detect discontiguous verbal multi-word expressions, specifically support-verb constructions. We examined how support-verb constructions – through their structural and lexical properties – aid discourse coherence and cohesion throughout Xenophon’s treatise.

Section 1 introduced the means of achieving coherence, which refers to how building blocks of a sentence are tied together, and cohesion, which refers to the tying together of clauses and sentences, in classical Greek. Section 2 presented the corpus preparation tool, which we built to tag and lemmatise a classical Greek corpus for Sketch Engine, and the modified corpus configuration file to implement the corpus into Sketch Engine. Section 3 discussed the support-

³⁷ The other context in which Galdi’s Latin and our Greek ‘to do’ support-verb constructions are common is multilingual contexts (e.g. translations), which pose their own problems (P. Bakker 2003 p. 132; Myers-Scotton 2002 pp. 134–139; Reintges 2001; Ronan 2012 p. 231; Rutherford 2010 p. 203).

verb constructions in *On Horsemanship* from the angle of coherence and cohesion, especially ἵππασίαν ποιέομαι ‘to do horsemanship / horse exercise’, πείραν λαμβάνω ‘to put to the test’, and τεκμήρια παρέχομαι ‘to give an indication (of)’. Section 4 outlined the features of scientific writing in *On Horsemanship* and mapped these onto the support-verb constructions identified.

We find that our Sketch Engine corpus performs with an error rate below 2.5%. Support-verb constructions are detected through the generation of collocations and n-grams, with specific items. This implies a focus on the identification of seen structures rather than discovery of new structures (Pasquer et al. 2020). This limitation concerns research on support-verb constructions in general, e.g. Cordeiro and Candito (2019) find that at best 31% of unseen support-verb constructions are detected by their tool. The issues surrounding automatic discovery of support-verb construction is linked to (i) their variability, both internally (e.g. inflection of the verb and the noun involved) and externally (e.g. their discontinuous structure) (Constant et al. 2017 p. 844; Pasquer et al. 2018), (ii) their mostly discontinuous structure which necessitates reliance on syntactic analysis (Constant et al. 2017 p. 842; Pasquer 2017 p. 8; Savary et al. 2018 p. 112 and 123), and (iii) their semi-productivity such that unseen structures with some support verbs abound because they appear rarely (Nagy et al. 2013 p. 331; Savary et al. 2018 p. 128). We can determine the most frequent support verbs in classical Greek based on a large corpus of classical literary Attic and draw up collocational fields using Sketch Engine for each support verb in question. Sketch Engine has been successfully used for the study of support-verb constructions in English (Sheinfux et al. 2019), Italian and Russian (Maiko 2020), for instance.

In future, the performance of Sketch Engine on classical Greek could be improved by writing and implementing a dependency grammar for classical Greek in order to disambiguate the analysis of word forms that return a long list of options (e.g. ἀνίημι with ἄνευ and ἄνω). Furthermore, the integration of classical Greek in projects such as PARSEME, which provides manually annotated corpora for verbal multi-word expressions in 18 languages including modern Greek could improve discovery of new items (yet Savary et al. 2018 on issues).³⁸

We find that support-verb constructions in *On Horsemanship* aid coherence and cohesion throughout the treatise, both structurally and lexically speaking, as exemplified for the recurring support-verb constructions: ἵππασίαν ποιέομαι ‘to do horsemanship / horse exercise’ contains the keyword ἵππασία which appears throughout the treatise and thus ties

³⁸ https://parsemefr.lis-lab.fr/parseme-st-guidelines/1.0/?page=060_Specific_tests_-_categorize_VMWEs/020_Light-verb_constructions (accessed 01 July 2022).

pieces of information together through lexical repetition, thus aiding cohesion. Aiding coherence structurally, *ἵππασίαν* in *ἵππασίαν ποιέομαι* is used to spread out pieces of information across a sentence while tying them together through their linking to one event (see adjectival modifiers with *ἵππασίαν*); *ἵππασίαν* in *ἵππασίαν ἔχω* ‘to have riding-related skill’ is co-ordinated with another predicative noun thus condensing information by fusing two support-verb constructions under the same support verb.³⁹ *πεῖραν λαμβάνω* ‘to put to the test’ focuses attention on the event by eliminating event participants from the surface structure (here the horse). This helps the reader not to lose the golden thread. *τεκμήρια παρέχομαι* ‘to give an indication of’ fills a gap in the lexicon since *τεκμαίρω* (in the active voice) remains rare throughout the history of Greek. Using a support-verb construction allows Xenophon to express precisely what he wants to say.

Extra-linguistically, all three recurring support-verb constructions reflect an aspect of scientific writing: *ἵππασίαν ποιέομαι* is a representative of the creation of a systematic scientific vocabulary in the 5th / 4th c. BC and its integration in the predicate slot by means of highly productive *ποιέομαι* ‘to do’ (Savary et al. 2018 p. 128), thus broadcasting the author’s methodical working; *πεῖραν λαμβάνω* de-transitivises the event expressed and thus focusses the reader’s attention on the logical progression of events by eliminating distractors (such as event participants); *τεκμήρια παρέχομαι* fills a gap in the lexicon, thus reflecting the author availing himself of each and any productive patterns in order to achieve maximum precision of the expression. Thus, rather than just through their structural and lexical properties, support-verb constructions in Xenophon’s *On Horsemanship* seem to align with the register of the text and thus align Xenophon with the community of practice of his intended audience.

We found that support-verb constructions are a mixed bag, as has been observed by others for modern languages (e.g. Kamber 2008; Nunberg et al. 1994; Pasquer 2017; Sheinflux et al. 2019; Tutin 2016). In Xenophon’s *On Horsemanship*, they seem to reflect specificity of expression (Storrer 2009) as well as markedness for register (Fendel 2020), rather than be related to the colloquial sphere or to stylistic choices (Zilliacus 1956, 1967). Their variability makes their automatic identification and especially discovery difficult even in morphologically less rich languages with unlimited corpora of data. We therefore suggest Sketch Engine as a tool for the further study of support-verb constructions while focusing on seen structures, in

³⁹ The subject of *ἵππασίαν ἔχω* is the horse, thus riding-related skill are here in the sense of accepting and working with the rider.

order to improve tools for the discovery of support-verb constructions in the future (Pasquer et al. 2020).

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Appendix: Support-verb constructions in Xenophon’s *On Horsemanship* [18 in total]

*In square brackets, the number of attestations of the verbal lemma in *On Horsemanship* is provided. Only instances in which the lemma acts as a support verb are listed.

- 1 ἄγω [9] – none
- 2 δίδωμι [6] – none
- 3 φέρω [6] – none
- 4 τίθημι [1] – none
- 5 πάσχω [6] – none
- 6 κομίζω [0] – none
- 7 κτάομαι [4] – none

- 8 λαμβάνω [12]

πειραν λαμβάνω ‘to put to the test’

3.7 ἐπεὶ δὲ πολεμιστήριον ἵππον ὑπεθέμεθα ὠνεῖσθαι, **ληπτέον πείραν** ἀπάντων ὅσωνπερ καὶ ὁ πόλεμος **πείραν λαμβάνει**. ἔστι δὲ ταῦτα, τάφρους διαπηδᾶν, τειχία ὑπερβαίνειν, ἐπ' ὄχθους ἀνορούειν, ἀπ' ὄχθων καθάλλεσθαι· καὶ πρὸς ἄναντες δὲ καὶ κατὰ πρανοῦς καὶ πλάγια ἐλαύνοντα **πείραν λαμβάνειν**.

9 τυγχάνω [4]

ῥαστώνης τυγχάνω 'to get relief'

7.19 ὅταν γε μὴν καταβαίνειν ἤδη καιρὸς ᾗ, μήτε ἐν ἵπποις ποτὲ καταβαίνειν μήτε παρὰ σύστασιν ἀνθρώπων μήτ' ἔξω τῆς ἵππασίας, ἀλλ' ὅπουπερ καὶ πονεῖν ἀναγκάζεται ὁ ἵππος, ἐνταῦθα καὶ **τῆς ῥαστώνης τυγχανέτω**.

11.5 ἡμεῖς γε μέντοι τὸ κράτιστον τῶν διδασκαλίων νομίζομεν, ὥσπερ αἰεὶ λέγομεν, ἣν ἐν παντὶ παρέπεται τὸ ἐν ᾧ ἂν ποιήσῃ τῷ ἀναβάτῃ κατὰ γνώμην **τυγχάνειν ῥαστώνης** παρ' αὐτοῦ.

10 δέχομαι [10]

κόσμον δέχομαι 'to get decorated / to get adorned'

12.2 τοῦτο γὰρ ἅμα **κόσμον τε παρέξει καί**, ἣν οἶον δεῖ εἰργασμένον ᾗ, **δέξεται** ὅταν βούληται τῷ ἀναβάτῃ τὸ πρόσωπον μέχρι τῆς ρίνος.

11 χράομαι [13]

ὄπλοις χράομαι 'to use weapons / to fight'

8.10 ἐπεὶ δὲ δεῖ ἐν παντοίοις τε χωρίοις τὸν ἵππεά ἀνὰ κράτος ἐλαύνοντα ἔποχον εἶναι καὶ ἀπὸ τοῦ ἵππου **τοῖς ὄπλοις** καλῶς δύνασθαι **χρῆσθαι**, ὅπου μὲν ἐστὶ χωρία ἐπιτήδεια καὶ θηρία, ἅμεμπτος ἢ ἐν θήραιο μελέτη τῆς ἵππικης.

12 ποιέομαι [42]

ἵππασίας ποιέομαι 'to do horse exercise'

8.9 Ὅρθῳς δ' ἔχει καὶ τὸ ἄλλοτε μὲν ἐν ἄλλοις τόποις, ἄλλοτε δὲ μακράς, ἄλλοτε δὲ βραχείας τὰς **ἵππασίας ποιεῖσθαι**. ἀμισέστερα γὰρ καὶ ταῦτα τῷ ἵππῳ τοῦ αἰεὶ ἐν τοῖς αὐτοῖς τόποις καὶ ὁμοίαις τὰς **ἵππασίας ποιεῖσθαι**.

ἔλκη ποιέω / ποιέομαι 'to get sores / to make sores for themselves'

5.1 πολλάκις γὰρ κνῶν ὁ ἵππος ἐπὶ τῇ φάτνῃ τὴν κεφαλὴν, εἰ μὴ ἀσινῆς ἢ φορβειὰ περὶ τὰ ὦτα ἔσται, **πολλάκις ἂν ἔλκη ποιοίη**. **ἐλκουμένων** γε μὴν τούτων ἀνάγκη τὸν ἵππον καὶ περὶ τὸ χαλινοῦσθαι καὶ περὶ τὸ ψήχεσθαι δυσκολώτερον εἶναι.

13 παρέχω [13]

τεκμήρια παρέχω ‘to give an indication’

1.1 τῆς γὰρ ψυχῆς οὐ πάνυ σαφῇ **τεκμήρια παρέχεται** ὁ μήπω ἀναβαινόμενος.

3.11 ὅσοι δ’ ἂν πεπονηκότες ἐθέλωσι πάλιν ὑποδύεσθαι πόνους ἱκανὰ **τεκμήρια παρέχονται** ταῦτα ψυχῆς καρτερᾶς.

ἀσχολίαν παρέχω ‘to provide a lack of rest / to make restless’; ἀθυμίαν παρέχω ‘to provide a lack of confidence / to make insecure’

3.12 οἱ δὲ ἢ διὰ βλακείαν ἐλάσεως πολλῆς δεόμενοι ἢ διὰ τὸ ὑπέρθυμοι εἶναι πολλῆς θωπείας τε καὶ πραγματείας **ἀσχολίαν** μὲν ταῖς χερσὶ τοῦ ἀναβάτου **παρέχουσιν**, **ἀθυμίαν** δ’ ἐν τοῖς κινδύνοις.

ἐξουσίαν παρέχω ‘to empower (to)’

6.9 ὁ μὲν γὰρ ἄγαν πρὸς αὐταῖς τυλοῖ τὸ στόμα, ὥστε μὴ εὐαίσθητον εἶναι, ὁ δὲ ἄγαν εἰς ἄκρον τὸ στόμα καθιέμενος **ἐξουσίαν παρέχει** συνδάκνοντι τὸ στόμιον μὴ πείθεσθαι.

φόβον παρέχω ‘to scare’

6.15 οἱ δὲ πληγαῖς ἀναγκάζοντες ἔτι πλείω **φόβον παρέχουσιν**.

κόσμον παρέχω ‘to decorate / to adorn’,

12.2 τοῦτο γὰρ ἅμα **κόσμον τε παρέξει καί**, ἣν οἶον δεῖ εἰργασμένον ἦ, **δέξεται** ὅταν βούληται τῷ ἀναβάτῃ τὸ πρόσωπον μέχρι τῆς ῥινός.

14 ἔχω [37]

σχῆμα ἔχω ‘to have a shape / form’

1.8 καὶ βιάζεσθαι δὲ ἥκιστ’ ἂν δύναιτο ὁ τοιοῦτον **σχῆμα ἔχων** καὶ εἰ πάνυ θυμοειδὲς εἴη.

ὑπόβασιν ἔχω ‘to have power to go forward’; ἵππασίαν ἔχω ‘to have riding-related skill’

1.14 τοῦτο δὲ ποιῶν ἅμα γοργοτέραν τε καὶ ἰσχυροτέραν ἔξει τὴν ὑπόβασίν τε καὶ ἱππασίαν καὶ ἅπαντα βελτίων ἔσται ἑαυτοῦ.

χαλεπότητα ἔχω ‘to have difficulty’

3.10 δεῖ δὲ καὶ εἶ τινα **χαλεπότητα ἔχοι** ὁ ἵππος καταμανθάνειν, εἴτε πρὸς ἵππους εἴτε πρὸς ἀνθρώπους, καὶ εἰ δυσγάργαλὶς γε εἴη.

Abbreviations

NOM	nominative case (subject case in classical Greek)
ACC	accusative case (object case in classical Greek)
DAT	dative case (indirect object case in classical Greek)
OED	Oxford English Dictionary (www.oed.com)

Data

.vert files for Xenophon’s *On Horsemanship*:

<https://gist.github.com/MatthewIreland/81e75b4653a3812fca2c02741ba21e34>

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