

# Reference Structures of National Constitutions

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**Abstract.** Interpretability of legal texts is an important condition for the effective usage of the law. This holds even more strongly for constitutions because, next to legal experts, common citizens need to be able to understand the contents of the constitution in order to enforce its regulations. Previous research [11] has shown that variance in interpretability of constitutions is mainly a function of purely textual characteristics. One of these characteristics, which has not been subjected to systematic research, is the internal reference structure of a text. In this paper we present a first analysis of reference structures of national constitutions. We set up reference structures for all current constitutions and analyze them through (1) network analysis and (2) correlation with a number of other factors, such as length, number of topics covered and colonization history. We claim that an increase in the sheer number of references does not result in itself in a decrease in interpretability. It depends on the degree of organization of referential complexity whether this is the case. To back this claim we present a comparison between countries with low and high degrees of organization of their reference structures. Finally, our analysis yields a number of factors that help explain differences in degree of referential complexity.

**Keywords.** constitutions, reference structure, complexity, interpretability, network analysis

## 1. Introduction

In [11] it is argued that interpretability is an important virtue for all legal texts, but even more so for constitutions because ordinary citizens have to be able to read the constitution well to properly enforce its regulations. Moreover constitutions ought to be unifying and time-independent documents. They can only ensure national unity, inter-generational commitment and self-enforcement when the majority of people is able to understand them. Constitutional interpretability varies considerably. [11] have tested a number of hypotheses to find out why this is so. Interestingly they found that interpretability is primarily a function of textual characteristics, such as composition and structure of the text, and not so much of other things one would expect, such as distance in time to drafting or distance in culture.

Still, even when attention is narrowed to textual characteristics there is no unequivocal method to measure complexity of the law. This means that we have to rely on assessments of particular virtues. This is further complicated by the fact that interpretability may come into conflict with other virtues. An assessment of legal complexity must balance between such virtues as essentiality of norms, accuracy (legal security), applicability and genericity (hence simplicity), see [2] p.335. When drafting a constitution a trade-off takes place between these virtues, governed only by the demand of legal coherence.

In [11] it is pointed out that clarity and internal consistency may not always be desirable over vagueness. To ensure agreement on a general principle like, for example freedom of speech, we do not specify exactly what speech is. Further, vagueness can also help to avoid having permanent constitutional losers, as with vagueness there still is room to bargain.<sup>1</sup> On the other hand, when exactness of regulation is required, this may also run against interpretability. Balancing between virtues depends in part on the interests of the parties involved in drafting constitutions. Constitutions are conventions, in which ultimate effectiveness is determined by the players themselves rather than external actors. Demands of scope, that is the number of topics addressed, and detail, pull in different directions. Long constitutions can capture both, but if constitutions are short we must expect a trade-off.

In this paper we propose to measure complexity of national constitutions through reference structure analysis. We consider reference structures as distributed networks. This mode of representation allows us to perform network analysis. The potential usefulness of this approach has also been noted by others: The sciences that study complex systems, whether natural or artificial, provide concepts and tools that may be used to promote the emergence of new approaches to law and legal systems. [2] p.335. In [11] the reference structure of a text is explicitly mentioned as an important measure of readability: "Consider this passage from the Kenyan Constitution of 1963 (Art. 181.1), which refers the reader to six different sections in order to qualify the powers of the court of appeal: Subject to the provisions of sections 50(5), 61(7), 101(5) and 210 (5) of this Constitution and of subsection (4) of this section, an appeal shall lie as of right to the Judicial Committee from any decision given by the Court of Appeal for Kenya or the Supreme Court in any of the cases to which this subsection applies or from any decision given in any such case by the Court of Appeal for Eastern Africa or any other court in the exercise of any jurisdiction conferred under section 176 of this Constitution. These types of lexical gymnastics are not rare in our experience. A logical predictor of interpretability, then, is the linguistic complexity of the text's syntax. Our hypothesis is that more linguistically complex texts should be harder to interpret."

This hypothesis has been tested in general in [11], but not specifically in relation to reference structures. It is our aim to gain more systematic insights in this aspect of textual complexity. We are especially interested in the relation between reference patterns, scope of topics and length of texts, because scope and detail are given as the most important factors influencing readability. Next to this we are also interested in identifying common causes for cases in which numerous references occur. We must consider whether

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<sup>1</sup>[6] offers a view on constitutions as living organisms. Flexibility, that is the ability to adapt to changing circumstances, is given as a strong indicator of constitutional longevity.

these causes are irreducible aspects of national constitutions or whether they allow for reduction of complexity.<sup>2</sup>

## 2. Generating reference structures

We have written a parser in Perl to create the reference structures of all current constitutions. The texts of these were available in English set in HTML through the constitutions project website.<sup>3</sup> We have traced internal references only, and excluded external references to other texts.<sup>4</sup> For each constitution we have retrieved the number of references, the level on which the reference occurs (article, chapter, paragraph, etc.) and whether it is a backward or forward reference. We have experienced problems with multiple references like 'see article 1-5', which should amount to 5 references instead of 1. This was solved through adding 'unpacking' script. We also had problems with the proper recognition of numerals and ordinals. This was solved by translating them first into numbers (in the right context) and then parse the text. The most challenging of problems came from detecting anaphora such as 'preceding', 'previous', 'this'. We have decided for the moment to ignore these, as they mostly occur with respect to inner-article referencing.<sup>5</sup>

The parser is still a bit coarse and if possible needs to be refined. When the use of numbers is not well ordered results become messy. This is for example the case with potentially interesting countries with a high number of references such as Sweden, South-Africa and Nigeria. We also would like to have a measure of vicinity of the target article to the source article because we suspect that a high vicinity ratio (i.e. source and target are close) indicates that there is less need for 'lexical gymnastics'. Our measure of weakly connected components excludes the direction of references, but a measure of strongly connected components, hence including direction of reference, provides other difficulties (see the remark on the measure of path-length below).

Notwithstanding these difficulties, we believe our research has already produced a number of interesting findings. The percentage of countries having little or no references is great. Yet there is also a considerable group of countries with 100 or more references. Most of these are former British colonies, with the group of West-Indies constitutions, strikingly at the top-end. Of the 39 countries with 100 or more references, 35 are former British colonies (if we include Greece). The other four, Sweden, Thailand, Belgium and Germany, have constitutions which are not related to a decolonization process (see Table 1). These countries are democracies and democracies tend to have longer constitutions than other political regimes (See [8]). Length (in terms of number of words) and number of references have a correlation of about 0.58, which means that not all increase in number of references can be explained with reference to increase in length.

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<sup>2</sup>In [2] it is claimed that articles of a constitution cannot lean too much on other articles because that would make these articles less constitutional. A French Constitutional Council has lambasted the occurrence of such legal complexity in constitutions, and advised to reduce it, whenever possible.

<sup>3</sup>See <http://comparativeconstitutionsproject.org>

<sup>4</sup>Interdependence of legal texts has been the main focus on research on reference resolution, see for example [5] and [7]. As constitutions ought to enforce themselves, intertextuality is less relevant in the context of constitutions.

<sup>5</sup>[5] provides a good overview and a useful discussion of these parsing problems.

On the other side of the scale we find all French former colonies, having very few references (Gabon scores highest with 17, see Table 2).<sup>6</sup> There is an issue of drafting style involved here, reflecting the civil law vs. common law distinction. Civil law is characterized by a policy implementing style and exhibits a preference for brevity, while common law exhibits a dispute resolving style [3]. While thinking in terms of a strong opposition between legal families, stemming from [14], has been seriously questioned in recent years (see [12]), the reference structures of national constitutions show a clear distinction between British and French former colonies, which must be seen as a reflection of the common and civil law styles of legal thought. Many former British colonies, for example, have had independence or constitutional conferences in London. British jurists were involved in drafting the new constitutions and hence the texts reflect their mode of legal thought.

### 3. Hubs and authorities

As said, the length of texts can only partly account for the number of references. Hence other reasons must be sought for the countries having a large number of references. We used concepts from Social Network Analysis to investigate the properties of the references structures. For each article in each constitution we calculated the hub score (number of outgoing references) and authority score (number of incoming references). In Table 3 we see the total number of references (column 2), the number of article with incoming references (authorities, column 3), and outgoing references (hubs, column 7), and the mean, maximum and standard deviation of hub (columns 4–6) and authority scores (columns 8–10) per country.

Further, the number of *Weakly Connected Components* (WCC, components of articles connected to each other through references) of the constitutions could be established. These are shown in Table 4 for the top 40 countries, ranked in terms of number of references in descending order.

In large components, central hubs and authorities play a role as meta-clauses, which can have a variety of purposes. Belgium is a clear example of a reference structure with central authorities. These involve regulations in terms of the country's multi-linguistic character. (see left side of Figure 1) We checked whether other multi-linguistic countries showed comparable patterns, but could not find these. We think that the reason for this is that often officially recognized languages do not coincide with distribution of executive power. But even in countries in which governmental organization is strongly related to linguistic diversity, such as for example Canada or Cyprus, no authorities similar to Belgium are present.

Thailand is a country with many references, but these involve a significant degree of organization in terms of WCCs. Thailand has one of the lowest WCC-ratio's. This indicates that the number of minute clusters is relatively small and hence can be taken as a measure of better (recognizable) organization structure (See right side of Figure 1).

There also are clear hubs at the end of the Thailand constitution involving specifications of articles which are not to be enforced in a period of transition of government. In other countries we find similar such hubs (Botswana, Lesotho). Poland has two clear

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<sup>6</sup>Length of texts and topic ratios are taken from the constitutionsproject website. For linguistic variation we have only included officially recognized languages

**Table 1.** Top end of the list of constitutions with references, length, topics, colonization and linguistic diversity

<b>Country</b>	<b># Refs</b>	<b>Length # words</b>	<b>Length-Ref ratio</b>	<b>Topic ratio</b>	<b>Colonizer</b>	<b># Off. lang.</b>
Papua_New_Guinea	403	58,490	145.14	0.47	GB	3
Tuvalu	403	34,801	86.35	0.4	GB	2
Sweden	344	13,635	39.64	0.61		
Thailand	329	44,756	136.04	0.73		
St_Kitts_and_Nevis	327	49,643	151.81	0.56	GB	
Jamaica	293	42,727	145.82	0.4	GB	
Malaysia	280	64,080	228.85	0.59	GB	2
India	279	146,385	524.68	0.6	GB	23
Lesotho	267	45,532	170.53	0.56	GB	2
South_Africa	254	43,062	169.53	0.64	GB	11
Trinidad_and_Tobago	251	36,302	144.63	0.51	GB	
St_Lucia	248	38,271	154.31	0.61	GB	
Belize	244	39,629	162.41	0.47	GB	
Dominica	231	36,080	156.19	0.54	GB	
Sierra_Leone	231	44,636	193.22	0.54	GB	
St_Vincent_and_the_Gr.	226	34,817	154.05	0.49	GB	
Swaziland	224	48,604	216.98	0.66	GB	2
Grenada	219	33,737	154.05	0.47	GB	
Antigua_and_Barbuda	217	38,464	177.25	0.56	GB	
Barbados	204	34,144	167.37	0.41	GB	
Singapore	194	40,076	206.58	0.5	GB	4
Nigeria	191	66,263	346.93	0.63	GB	
Zimbabwe	191	39,976	209.29	0.61	GB	3
Mauritius	178	36,333	204.11	0.47	GB	2
Sri_Lanka	169	40,085	237.19	0.67	GB	3
Fiji	167	40,000	239.52	nodata	GB	3
Guyana	164	46,221	281.83	0.59	GB	
Belgium	155	16,119	103.99	0.59		3
Kenya	152	48,818	321.17	0.81	GB	2
Botswana	143	30,713	214.77	0.41	GB	2
Cyprus	138	36,199	262.31	0.53	GB	2
Gambia	135	43,465	321.96	0.73	GB	
German_Fed._Rep.	126	27,236	216.15	0.71		
Solomon_Islands	119	31,836	267.53	0.63	GB	
Greece	110	27,177	247.06	0.73	GB	
Malawi	104	33,422	321.36	0.67	GB	2
Pakistan	104	56,240	540.77	0.64	GB	2
Seychelles	104	40,740	391.73	0.63	GB	3
Bahamas	100	41,835	418.35	0.47	GB	
Malta	92	31,820	345.87	0.47	GB	2

**Table 2.** Constitutions of former French colonies

Country	# Refs	Length # words	Length-Ref ratio	Topic ratio	Colonizer	# Off. lang.
Gabon	17	11804	694.35	0.6	FR	
Tunisia	14	nodata	nodata	nodata	FR	2
Madagascar	13	15759	1212.23	0.6	FR	
Morocco	12	15897	1324.75	0.64	FR	3
Senegal	12	10866	905.50	0.53	FR	
Algeria	11	10038	912.55	0.61	FR	3
Burkina_Faso	9	9000	1000.00	0.51	FR	
Haiti	9	17423	1935.89	0.63	FR	
Guinea	8	12707	1588.38	0.64	FR	
Mauritania	8	6997	874.63	0.49	FR	
Benin	7	11386	1626.57	0.56	FR	
Cambodia	7	8936	1276.57	0.61	FR	
Lebanon	6	6296	1049.33	0.46	FR	
Mali	6	7503	1250.50	0.54	FR	
Niger	6	14806	2467.67	0.66	FR	
Central_African_Republic	5	10197	2039.40	0.64	FR	2
Chad	5	11768	2353.60	0.57	FR	2
Monaco	5	3814	762.80	0.37	FR	
Socialist_Republic_of_Vietnam	5	11344	2268.80	0.51	FR	
Syria	5	8154	1630.80	0.63	FR	
Congo	4	9970	2492.50	0.56	FR	
Djibouti	4	6666	1666.50	0.41	FR	2
Cote_D'Ivoire	2	7897	3948.5	0.5	FR	



**Figure 1.** Belgium (left) and Thailand (right)

**Table 3.** The number of references and the maximum and mean number of references incoming (authority) and outgoing (hub) of the top 40 countries.

Country	# refs	Authority				Hub			
		Total	Max.	Mean	st.dev.	Total	Max.	Mean	st.dev.
Papua_New_Guinea	403	257	17	1.56	1.43	293	16	1.37	1.12
Tuvalu	403	231	13	1.74	1.58	26	7	1.52	1.1
Thailand	329	134	12	2.45	2.08	165	16	1.99	1.75
St_Kitts_and_Nevis	327	159	11	2.05	1.73	198	13	1.65	1.25
Jamaica	293	183	6	1.6	1.02	16	11	1.78	1.47
Malaysia	280	126	16	2.22	2.01	188	7	1.48	1.03
India	279	154	17	1.81	1.89	19	8	1.43	1
Lesotho	267	160	23	1.66	2.04	17	9	1.51	1.03
South_Africa	254	153	10	1.66	1.31	163	27	1.55	2.26
Trinidad_and_Tobago	251	145	10	1.73	1.44	191	4	1.31	0.62
St_Lucia	248	124	11	2	1.81	110	12	2.25	1.92
Belize	244	141	12	1.73	1.51	16	6	1.44	0.85
Dominica	231	161	8	1.43	0.97	156	6	1.48	0.9
Sierra_Leone	231	155	5	1.49	0.83	157	11	1.47	1.05
St_Vincent_and_the_Gr.	226	15	9	1.45	1.07	146	9	1.54	1.12
Swaziland	224	168	6	1.33	0.76	178	11	1.25	1.09
Grenada	219	136	8	1.61	1.18	14	6	1.54	0.91
Antigua_and_Barbuda	217	145	7	1.49	1.01	143	11	1.51	1.15
Barbados	204	88	10	2.31	1.96	75	14	2.72	2.81
Singapore	194	77	9	2.51	1.84	150	6	1.29	0.69
Nigeria	191	68	38	2.8	5.34	80	34	2.38	4.73
Zimbabwe	191	124	8	1.54	1.18	164	4	1.16	0.55
Mauritius	178	111	5	1.6	0.97	136	4	1.3	0.56
Sri_Lanka	169	74	9	2.28	1.75	119	6	1.42	0.88
Fiji	167	36	27	4.63	6.36	42	18	3.97	4.36
Guyana	164	78	22	2.1	2.98	12	6	1.35	0.88
Belgium	155	43	49	3.6	8.3	76	7	1.65	1.24
Solomon_Islands	119	95	6	1.25	0.69	96	3	1.23	0.53
Greece	110	57	8	1.92	1.42	79	5	1.39	0.78
Malawi	104	75	3	1.38	0.6	85	4	1.22	0.58
Pakistan	104	69	4	1.5	0.	74	7	1.4	0.97
Seychelles	104	51	6	2.03	1.44	54	9	1.92	1.61
Bahamas	100	53	9	1.88	1.54	91	3	1.09	0.33

hubs which regulate what to do in case of emergency such as natural disaster. In other countries these also involve regulations in case of war or armed conflict. Sometimes central nodes (both hubs and authorities) are related to the political structure of a country. Bhutan for example expresses a clear hierarchical structure starting with the King's authoritative power. Other clear examples are Mauritius, Uganda and Zimbabwe.<sup>7</sup> In other cases central nodes specify civil rights. But these too, often have the character of meta-clauses. That is, these nodes are central because they specify when other articles (tem-

<sup>7</sup>This can be relevant to interpretability because the presence of 'multiple executives' apparently decreases readability [11]

**Table 4.** The number of weakly connected components and the wcc ratio

Country	Number of WCCs	WCC ratio
Papua_New_Guinea	128	0.44
Tuvalu	84	0.32
St_Kitts_and_Nevis	71	0.36
India	87	0.45
Trinidad_and_Tobago	80	0.42
Malaysia	57	0.3
Swaziland	108	0.61
Lesotho	83	0.47
Belize	68	0.4
Thailand	20	0.12
Jamaica	68	0.41
Zimbabwe	88	0.54
South_Africa	77	0.47
Sierra_Leone	74	0.47
Dominica	71	0.46
Singapore	40	0.27
St_Vincent_and_the_Gr.	64	0.44
Antigua_and_Barbuda	69	0.48
Grenada	58	0.41
Mauritius	60	0.44
Guyana	44	0.36
Sri_Lanka	40	0.34
Kenya	72	0.61
Botswana	66	0.57
St_Lucia	30	0.27
Cyprus	42	0.39
Gambia	53	0.53
Belgium	11	0.11
Solomon_Islands	62	0.65
Bahamas	45	0.49
Malawi	54	0.64
Nigeria	30	0.38
Greece	23	0.29
Ghana	52	0.67
German_Fed._Rep	32	0.42
Barbados	20	0.27
Kiribati	39	0.53
Pakistan	47	0.64
Uganda	41	0.63
Tanzania	34	0.54

porary) lose their force or in which situations they can be repealed or amended. Thus regulations with overriding force in special situations are the most frequently occurring authorities and hubs and in some cases, take up the bulk of references altogether.

Finally we found that path length, which is otherwise a good measure of complex-



ity, could not help us very much in the analysis of the reference structures of national constitutions. While there are many paths of three or more nodes, the problem is that from a single article there is often more than a single possible path to follow. Measuring the total number of paths therefore is not a useful measure for our purposes. Moreover we very rarely find a string of targets which are sources in their own right, which would force the reader to follow a significant amount of references in order to come to a proper understanding of the original source article. Because of these problems we decided to ignore the path length variable, but it is certainly something we have to look into in future research.

#### 4. Reference structures and interpretability of constitutions

In the final section of this paper we check how our analysis relates to findings on differences in readability of national constitutions. We defend the following thesis: an increase in number of references can in itself not be taken as a sign for a decrease in interpretability. What matters is recognizability of patterns in the reference structure. Such patterns significantly reduce the demand on mental gymnastics of readers. The patterns are given by (1) presence of hubs and authorities (scale free networks) and (2) component analysis. The presence of lots of weakly connected components indicate less organization. In these cases references are isolated and when this frequently happens we suspect that this is difficult to process for readers. An exact threshold or tipping point in which a text goes from unreadable to readable cannot be given. Hence, because of the gradual nature of this change, transitions in structural organization are best considered as phase transitions. This can be related to the theory of phase transitions in [15]. In the case of reference structures in constitutions, transitions towards more organization must be valued positively in terms of readability<sup>8</sup>

We support our thesis by considering the countries that are reported in [11] to score high (Haiti, Thailand, Pakistan) and low (France, India, Mexico, Guyana) on readability and add why Belgium probably scores high and Kenya low.<sup>9</sup>

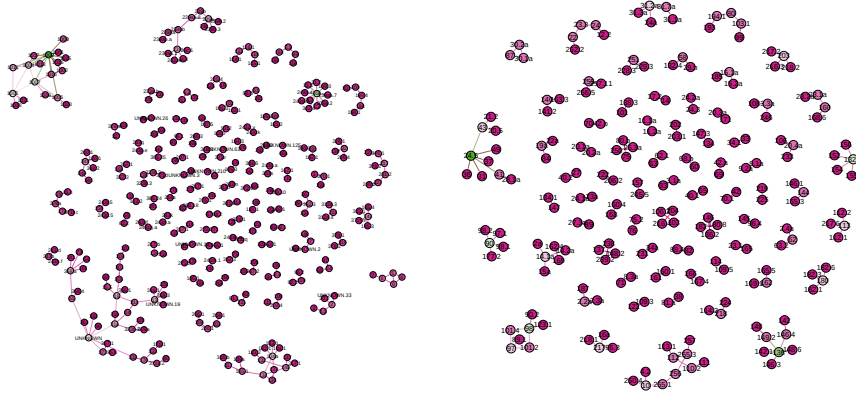
Thailand has one of the largest amount of references but both the low WCC ratio (0.12) and the presence of hubs presumably maintain readability. The same holds for Belgium with a WCC ratio of 0.11, the difference being that Belgium's well-organized referential structure is given by authorities (it has one of the highest indegree means), instead of hubs. A much more even distribution of references we find in countries such as India and Kenya (note that we analyzed a later Kenyan constitution than the one referred to in the quote above). See Figure 2.

The references in these networks are so evenly distributed that they closely resemble random graphs. Their loose connectedness makes them score low in terms of textual organization. Kenya, for example, has one of the highest WCC ratios. India and Mexico on the other hand do not fit this picture as the WCC ratios are much lower. However these constitutions are among the longest and they also contain a large number of topics. Hence they score high in terms of scope and detail, and this negatively influences interpretability.

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<sup>8</sup>But this may not hold for other aspects, such as the endurance of the constitution.

<sup>9</sup>The parser finds no references for Haiti so we have nothing to say about this constitution.



**Figure 2.** India (left) and Kenya (right)

It is hard to say which structural element sorts the most clear effect on readability. It is however natural to assume that a combination of negative scores on reference-length ratio, wcc ratio, number of references, number of hubs and authorities, etc., suggest with confidence that a text is hard to interpret. Two countries do however score opposite values across the board, to the expected ones. France comes out in the test in [11] as a badly readable constitution. Yet it has a low WCC ratio and fairly high indegree and outdegree values. Moreover the constitution is short and covers only half of the possible topics. Perhaps it is the case that France simply does not have enough references (a total of 52) to justify firm conclusions on interpretability. On the other hand the length-reference ratio is below 200, which indicates an above average frequency of references.

For Pakistan the anomalous result can certainly not be explained away on the grounds of having too little references. Still Pakistan has a high WCC ratio of 0.63 and modest outdegree and indegree means of 1.4 and 1.5. It is also one of the longest constitutions and covers 0.64 of the possible topics. On all these scores the constitution of Pakistan should lead to problems of interpretability but the opposite appears to be the case. This is a mystery, which we must leave unexplained.

## 5. Conclusion

We have presented an analysis of the texts of national constitutions in terms of distributed networks of internal references. We find a group of countries with a huge amount of references but also a group of countries having little or no references at all. This distribution appears to reflect the civil law vs. common law distinction as almost all former British colonies have elaborate reference structures while former French colonies do not. References occur for a variety of reasons but when central nodes (hubs and authorities) are

present this is often in the form of a meta-clausule. Such nodes are articles which specify circumstances in which other articles are not effective, or under which circumstances changes to the constitution can come about. Such referential structure cannot easily be reduced, but luckily the virtue of interpretability is *promoted*, instead of undermined, by the presence of central nodes. Referential complexity is in itself not a sign that legal texts are unintelligible. It depends on the clarity of organization of the references whether this is the case. Countries with a low WCC ratio and with a significant number of hubs and/or authorities continue to score well on interpretability even if they have a large number of references. Our analysis can support most, but not all, earlier findings on readability of the constitutions. We suggest that more research is required on the factors influencing readability of texts to make the picture complete. After all [11] was only based on a number of tests with a group of legal students which is not enough to count as compelling evidence. We would also like to be able to say more about a possible threshold from which the number of references really becomes a relevant factor. Finally it would be interesting to add a diachronic perspective to our referential complexity research and investigate by comparison if, how and why, reference structures of subsequent constitutions of individual countries have changed. As always, the attempt to solve one problem leads to more open questions than one started out with.

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