Sentiment analysis and predictors of optimism in AUA Presidential addresses, 1902-2019: A digitial humanities project

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Introduction: The annual addresses of the President of the American Urological Association (AUA) may articulate and reflect the contemporary goals, values, and concerns of contemporary AUA membership. There is no organized archive of such addresses. We aimed to create a searchable database of all AUA Presidents and their addresses to determine variables associated with speech sentiment including positivity, negativity, and emotional tone through the 117 years of the AUA's history.

Sources and Methods: We queried AUA archives, journals, recorded tape, and personal records, to create a database of all existing AUA Presidential addresses and biographic data. We applied natural language processing and machine learning techniques to evaluate the addresses for overall sentiment with validation using analog analyses (i.e reading and annotation). Multivariable logistic regression was performed to identify significant predictors of Presidential address sentiment.

Results: Between 1902-2019, a total of 113 annual AUA meetings were held. A total of 85 of 113 (75.22%) presidential addresses were transcribed and archived in the database representing 254,124 words by male presidents with a median (IQR) age of 61.43 (53.1-66.5) years. AUA Presidents during the second half of the history of the AUA (1960-2019) were significantly older at time of inauguration and gave more positive speeches in the active voice than presidents during the first half (1902-1959) (p < .05). The only significant independent predictor of the degree of positivity in an AUA President's annual address was speaker age (95% CI 1.007-1.119).

Conclusions: We created the first digital, searchable database of all AUA Presidential speeches from 1902-2019 and aim to add additional addresses prospectively. Artificial intelligence analyses mirrored the findings of human reading and demonstrated that from 1902-2019 AUA Presidential addresses became more positive and optimistic with increasing speaker age but without consistent predictors of a speech's emotional or factual content.

Keywords: AUA Presidents; sentiment analysis; machine learning; artificial intelligence

The annual address given by the President of the American Urological Association (AUA) has been a tradition at the national meeting of the AUA since 1902 when the first AUA President, Ramon Guiteras, said that "some remarks about the current state of the union, and its future, are in order".(1) There is no defined requirement for the content expected of each year's presidential address which is at the discretion of the speaker. Unlike the American College of Surgeons, which has a web-based publically available digital archive of 97 Presidential Addresses from 1913-2019, the AUA Presidential Addresses have not been collected, organized, or digitally preserved. The AUA Presidential Addresses may represent a valuable yet untapped source of information that reflect the viewpoints, challenges, and sentiments of the AUA membership at any given time.

Advances in computational natural language processing (NLP) have allowed multiple, unrelated texts, like the novels of Jane Austen or the billions of user comments on Twitter, to be analyzed for sentiment and attitudes.(2,3) NLP has also been used to better analyze medical records and shown benefit in understanding trends of care in nephrolithiasis, asthma, and preeclampsia, and may identify patients who have modifiable risk factors for sudden cardiac death.(4-7)

We hypothesized that NLP and reader-based linguistic analyses of the AUA Presidential Addresses may provide a similarly valuable data source to help understand the contextual history of the AUA and its membership.

METHODS

Demographics and Addresses.
Dates of birth and death were obtained from the William P. Didusch Center for Urologic History (Linthicum, Md) and publicly available obituary notifications. The inauguration date of the AUA President was defined for the study as the first day of the respective year's AUA annual meeting. City of residence in the year of the presidential term was used to assign AUA sectional affiliation.

AUA Presidential addresses were obtained from the meeting archives of the AUA (Linthicum, MD) (1902-1917), from the Journal of Urology (1920-1997), from AUA audio- or video-archives, or AUA past-Presidents' personal records (1998-2019). The corpus of transcribed text files were then subjected to analog (i.e. reading) and several digital analytical techniques as follows.

Natural Language Processing (NLP) and Sentiment Analyses.
We used Microsoft Word (Microsoft Corporation, 2010) "Readability Metric" tools to enumerate the number of passive sentences of a text and assign Flesch Reading Ease and Flesch-Kincaid Grade Level scores to an analyzed document.(8) NLP modalities typically utilize 'semantic' and 'syntactic' methods to gain insight into natural language.(9) Semantic analytical techniques rely on pre-trained machine learning classifiers to interpret context and sentence structure for meaning. (9) The 'syntactic' approach utilizes a pre-validated lexicon to analyze each line of text to compute overall document sentiment as 'polarity' and 'subjectivity' scores (Python TextBlob library Version 0.15.2).(10)

Polarity refers to the overall negativity or positivity of a given text represented by a most negative value of -1.0 to a most positive value of +1.0. Subjectivity is a measurement of the degree of non-factual personal opinion making. Perfectly factual statements, therefore, would have a subjectivity of 0 compared to a value of +1.0 for statements of a highly subjective, emotional, or opinionated nature.(10,11)

Analog sentiment analysis required each reader (JP, AD, or RP) to judge and count each sentence of each address, where possible, for its 'negative' or 'positive' tone, including salutations, but excluding statements of fact, questions, or quotes. (See Appendix for examples of 'negative' or 'positive' tone). A 'sentiment ratio' was the (number of positive counts) divided by (total positive plus negative counts) per address. Two-sample student's t-test was used to evaluate differences in scores.(12)

Thematic analysis.
Each address was categorized by the authors (JP, AS) as belonging to one of seven potential themes: the AUA; the History of Urology; 'Scope & Practice'; 'Arts & Philosophy'; 'Costs & Congress'; Education & Research; or Clinical.

Statistical Considerations.
SPSS Subscription Version v1.0.0.137 was utilized for all described statistical analyses.(13) Significant univariates from logistic regression analyses were entered into a stepwise multivariate model to predict dichotomous outcomes, using a two-tailed p-value of 0.05 to indicate model significance.

	1902-1959	1960-2019	p-value
Age at inauguration, median (IQR), years	53 (48-60)	66 (62-69)	<0.01
Age at death, median (IQR), years, n=66	75 (70-84)	77 (72-87)	0.16
Post-term survival, median (IQR) years, n=87	23 (14-34)	14 (12-25)	.02
AUA sections 1-4 (# presidents and (%))	26 (46.42)	27 (46.55)	
AUA sections 5-8 (# president and (%))	30 (53.57)	31 (53.44)	1.00*
Female Presidents (#)(%)	0 (0)	0(0)	1.00

Table 1. AUA Presidential characteristics, 1902-2019, and significant differences assessed with unpaired T-tests or *2 x 2 χ^2

RESULTS

Demographics: There were a total of 113 male and zero female AUA Presidents from 1902-2019 (The first AUA President, Ramon Guiteras, was the only President to serve more than one year (1902-1904)). Dates of birth were found for 109 of 113 (96.46%) AUA Presidents and dates of death were found for 87 of 88 (98.86%) known deceased ex-AUA Presidents. The median (IQR) age of an AUA President at inauguration was 61.43 (53.14-66.48) years (range, 36.62 (HH Young (1907-08)) to 74.83 years (PC Sogani (2013-14)). Presidents in the first half of the AUA (1902-1959) were younger at inauguration (median (IQR) 53 (48-60) years) compared to Presidents in the second half (median (IQR) 66 (62-69) years) (1960-2019) (p < 0.01)(Table 1).

The four most common AUA sections represented by number of AUA presidents were the North Central (20), New York (17), New England (15), and Western (13). However, there was nearly equivalent representation of the Atlantic bordering sections (i.e. Sections 1-4) vs the other sections (i.e. Sections 5-8) when comparing Presidential representation over the 117 years of the AUA (Table 1).

The AUA Presidential Addresses: There were no AUA meetings or addresses in 1918-19, 1943, 1945, or 2020. A total of 85 of 113 (75.22%) AUA Presidential addresses were found: 11 (13.1%) from the internal meeting transactions of the AUA (1902-1917); 61 (72.6%) published in the Journal of Urology (1920-1997); 11 (13.1%) from video- or audiotape recorded during the address itself (2002-2019), and one from personal files (JM Barry, 2008-09). One address was destroyed by its author (HH Young, 1907-08) purportedly due to errors in its 1908 transcription. We therefore restricted our subsequent analyses to the 85 Presidents who delivered their addresses at AUA meetings between 1902 and 2019. On average, AUA Presidential addresses were a median (IQR) length of 2811 (2039-3466) words and have remained similar in length over the study period (Table II, p-value 0.10).

Address Themes: We identified seven potential 'themes' in the 85 archived addresses from 1902-2019. (Figure 1) The "AUA" was the theme of 29 of 85 address (34.1%); followed by 15 (17.6%) addresses on the 'Arts & Philosophy' of medicine; 13 (15.3%) on the 'Scope & Practice' of urology; eight (9.4%) on urologic training and research; seven (7%) on 'Costs & Congress' including financial, legislative, and advocacy issues; seven (7%) on urologic history; and six (6%) on a purely clinical topic. There were differences in the topic theme and the age of the speaker. For example, speakers

n=85	1902-1959	1960-2019	p-value
Word Count	2828 (2031-3599)	2654 (2093-3356)	0.10
Unique Words	701 (574-952)	722 (623-843)	0.25
Percent Passive Voice	25 (21-35)	18 (11-23)	<0.01
Flesch Reading Ease Score	36 (32-42)	38 (34-44)	0.32
Flesch Kinkaid score,	14 (13-16)	13 (12-15)	0.07
Positive statements/address	18 (12-27)	25 (17-38)	<0.01
Negative statements/address	12 (8-20)	15 (10-25)	0.05
Sentiment ratio	0.58 (0.53-0.67)	0.63 (0.55-0.74)	0.27
Polarity score (SD)	0.12 (0.09-0.14)	0.15 (0.12-0.18)	<0.01
Subjectivity score (SD)	0.44 (0.43-0.46)	0.42 (0.40-0.45)	0.11

Table 2. Readability and Sentiment of AUA Presidential Addresses, first vs second half of AUA history, 1902-2019, as median (IQR)

on the 'Scope & Practice' of urology were significantly younger than those who spoke on 'Arts & Philosophy' (median ages (IQR) 52.3 (43.5 -61.2) vs 61.9 (58.4- 67.8), respectively, p-value, <.01).
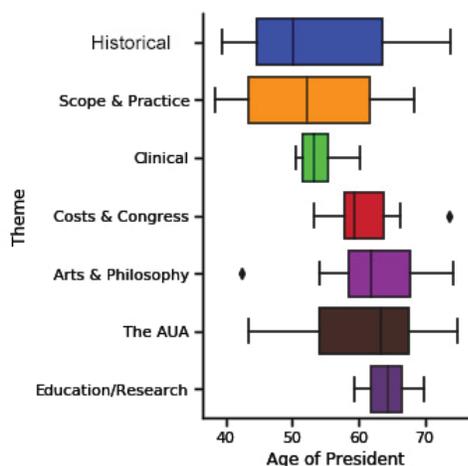

Figure 1. Annual AUA Presdent's address theme versus speaker age, displaying range and median age on horizontal bars (diamonds represent outliers). Median age of 'Arts & Philosophy' speakers (median (IQR) 61.9 (58.4- 67.8) was significantly older than those of speakers on the 'Scope & Practice' of urology (median (IQR) 52.3 (43.5 -61.2), p-value, <.01)

Natural Language Processing.

A median (IQR) of 25 % (21-35) of the sentences in addresses from 1902-1959 were in the passive voice compared to a median (IQR) of 18 % (11-23) of the sentences from 1960-2019 (p<.01) and decreased linearly (IQR) grade level of the AUA Presidential Addresses over the same time period (p<.01)(data not shown) 14. The AUA Address with the lowest and highest Flesh Kinkaid scores were "AI, Robotics, and the Future of Urology" (score: 8.3, JB Thrasher, 2018) and "The AUA: Advancing Urology Globally" (score: 22.4, PC Sogani, 2014), respectively.

Computational sentiment analysis: As described in the methods, we measured 'polarity', or the negative/positive tone of an address (scale -1.0 to +1.0) and 'subjectivity' or the fact/opinion based nature of an address (scale 0 to +1.0). Of the 85 AUA Presidential Addresses in the study, the median (IQR) polarity was 0.14 (0.10-0.16) and subjectivity 0.43 (0.40-0.46) (Figure 3). There were no "negative" speeches as defined by polarity scores less than zero in sentences

from 1960-2019 (p<.01) and decreased linearly (IQR) grade level of the AUA Presidential Addresses over the same time period (p<.01)(data not shown).(14)
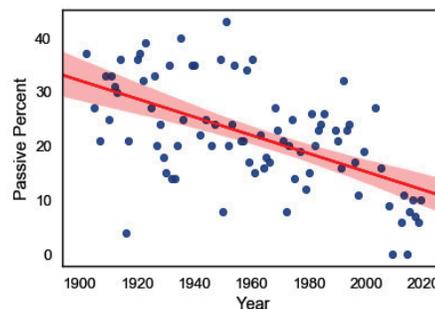

Figure 2. Use of the passive voice in AUA Presidential Addresses, 1902-2019, displaying percent of passive voice sentences/per address vs year of address (R2 0.34, p < .01).

The AUA Address with the lowest and highest Flesh Kinkaid scores were "AI, Robotics, and the Future of Urology" (score: 8.3, JB Thrasher, 2018) and "The AUA: Advancing Urology Globally" (score: 22.4, PC Sogani, 2014), respectively.

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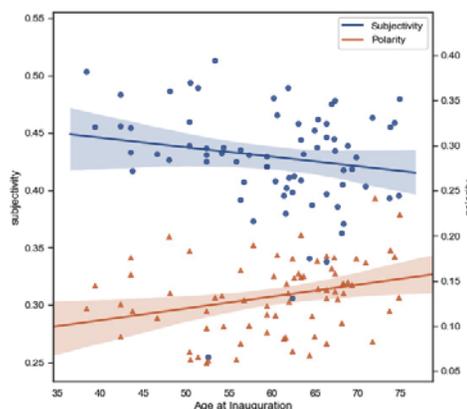

Figure 3. Distribution of polarity (orange data points) and subjectivity (blue data points) scores 85 AUA Presidential addresses versus age at inauguration. Age is associated with increasing speech polarity (OR 1.059 (1.007-1.113) (p=0.025) but not subjectivity (OR 0.958 (0.913-1.005) (p=0.082).

'subjectivity' or the fact/opinion based nature of an address (scale 0 to +1.0). Of the 85 AUA Presidential Addresses in the study, the median (IQR) polarity was 0.14 (0.10-0.16) and subjectivity 0.43 (0.40-0.46) (Figure 3). There were no "negative" speeches as defined by polarity scores less than zero. For comparison, we found that Abraham Lincoln's 1863 "Gettysburg Address" had

a polarity/subjectivity of 0.16/0.55 and ML King Jr.'s 1963 "I Have a Dream" speech of 0.14/0.48.(15,16) In contrast, Germany's 1941 declaration of war against the Soviet Union had a polarity/subjectivity of 0.02/0.37. Subjectivity scores allowed for identification of the least and most opinion-based addresses. The least opinion-based address was given in 1935 by Miley B. Wesson (subjectivity 0.25) entitled "History of the Western Branch Society". In comparison, the address by R Flannigan (2018-2019) "117 Years of the AUA" had the highest subjectivity of 0.53. Presidential addresses between 1960-2019 were found to be significantly more positive (polarity 0.15) than those between 1902-1959 (polarity 0.12) (p < 0.01) without substantial differences in subjectivity (p = 0.11). (Table 3)

Analog Sentiment Analysis: We counted the number of positive and negative statements in the 85 addresses as described in the methods to generate a 'sentiment ratio'. There was no significant difference in sentiment ratios by three scorers in six randomly selected addresses (p=0.501). The sentiment ratios over the course of the first half of the AUA was similar to those of the second half (p=0.27) although sentiment ratios increased with AUA Presidential age (p<.01). Addresses within the theme of the 'Arts & Philosophy' had the highest number of positive statement counts while talks on 'Costs & Congress' had the highest number of negative statement counts. We found that the digital

	Univariate		Multivariate	
Address variables	*OR (95% CI)*	*p-value*	*OR (95% CI)*	*p-value*
Year given	1.013 (1-1.027)	0.055	-	
Age	1.059 (1.007-1.113)	0.025	1.061 (1.007-1.119)	0.027
Total Words	1 (.999-1)	0.143	-	
Unique Words	0.999 (.998-1)	0.379	-	
Passive	0.943 (.898-.989)	0.016	-	
Sentiment Ratio	1.667 (1.160-2.395)	0.006	1.679 (1.154-2.444)	0.007
Flesh Ease	0.996 (.950-1.045)	0.883	-	
Flesh Grade	1.066 (.878-1.293)	0.520	-	
Theme of the Address				
The AUA	Ref	Ref	Ref	
Arts & Philosophy	1.053 (.282-3.935)	.939	-	
Clinical	0.105 (.011-1.029)	.053	-	
Costs & Congress	0.088 (.009-.833)	.034	-	
Education	0.164 (.062-1.601)	.316	-	
History	0.702 (.131-3.771)	.68	-	
Scope & Practice	0.451 (.119-1.710)	.242	-	
AUA Sections represented				
Sections 5-8	Ref	Ref	Ref	
Sections 1-4	1.511 (.634-3.602)	0.351	-	

Table 3. Univariate and multivariate predictors of speech polarity or 'optimism' by AUA Presidents, 1902-2019

computation of positivity, as measured by polarity, strongly correlated with the manual measurement of positivity, as expressed by sentiment ratios with an R^2 of 0.23 (p<.01).

Logistic regression analysis: We wished to identify predictors of AUA presidential address sentiment. We found that variables positively associated with speech polarity, that is, the speeches were more 'positive' in sentiment, were AUA President age (95 % CI 1.007-1.113), reader sentiment ratios (95% CI 1.160-2.395), and use of the passive voice (95% CI 0.898-.989), while speeches on financial and legislative matters were associated with lower or more 'negative' polarity (95% CI 0.009-0.833)(p<.05). On multivariate analysis, only presidential age and sentiment ratios were independent predictors of address polarity (p<.001). A higher than average subjectivity score of an address, that is a more emotional than fact-based speech, was only associated with addresses in the 'Arts and Philosophy' category (95% CI 1.126-13.425), p-value <.01) but not on multivariate analysis. (Table 3)

DISCUSSION

This study constructed a digital archive of all extant AUA Presidential Addresses to analyze variables associated with speaker sentiment over the 117-year history of the AUA. Using computational and analog techniques, we found that an independent predictor of the positive sentiment of an AUA Presidential address was speaker age but not AUA meeting year, section membership, speech length, readability, or use of the passive voice. We also found that our digital approach, using natural language processing of greater than 250,000 words in 85 addresses, arrived at the same conclusions as an analog approach whereby readers manually judged and tallied the number of positive and negative sentiment statements of each address.

The study revealed several characteristics of the AUA Presidents as a group. AUA Presidents were significantly older in the second half of the AUA's history than the first half. Over 117 years, the Presidential representation has been evenly distributed amongst the eight AUA sections. Addresses have made significantly less use of the passive voice over time, a long-held surrogate marker of better, more direct writing.(17)

Our findings that older AUA Presidents had an overall more positive tone to their addresses is consistent with previous observations that link optimism and psychological well-being with longevity.(18) Lee et al., for example, showed that the most optimistic quintile of a 1,117 male VA population had a 60% greater chance (95% CI OR 1.0-2.4, p<.001) of reaching 85+ years than men in the lowest quintile, after adjusting for health conditions and behaviors.(19)

Sentiment analysis is of increasing interest not just in the humanities and the interpretation of online content but in health care. In a study of 27,000 ICU patients, sentiment 'polarity', or the positive tone of clinicians' notes, was associated with a decrease in 30-day mortality while increasing polarity in 2,500 psychiatric discharge notes was associated with decreased hospital readmission rates.(11,20)

There are several important limitations to our study. First, no AUA meetings were held during many of the years of the World Wars so there was no opportunity to assess changes in sentiment during the two potentially most influential epochs of the 20th century. Of the remaining 108 AUA meetings, there were 17 (16%) missing addresses, which we continue to locate for the archive. No addresses were published after 1997 and subsequent AUA audio or video archiving was inconsistent. Our final dataset of 85 addresses, therefore, was a relatively small study population and limited the number of factors evaluable in multivariable regression modeling.(21) Our analog analyses were prone to the subjective biases inherent to reading such as the scoring of address sentiment ratio or the assignment of a 'theme' to an address. Still, our analog sentiment analyses did appear to correlate well with the computational methods. It should also be noted that the computation of 'polarity' and 'subjectivity' are measures of the sentiment value of an entire address not the relative impact of keynotes phrases or statements, which at times may have a far more durable effect on a participant, as may be observed in some of history's most famous speeches. For example, we found that Winston Churchill's June 1940 Parliamentary address ("We will never surrender") and Martin Luther King's August, 1963 Washington DC ("I have a Dream") speech had polarity scores of 0.11 and 0.14, respectively, or no more positive than the AUA Presidential addresses in our study, yet may be regarded as some of the most influentially positive speeches in the English canon.

We believe that our findings concerning the increasing positivity of the older AUA President, after a career of service, accomplishment, and peer-recognition, are reasonably intuitive. We believe that the database is the first of its kind archiving an important element of

the AUA's history and will serve as a valuable addition to scholarly work through the Didusch Center for Urologic History Website (urologichistory.museum).

CONCLUSION

A digital archive of 85 extant AUA Presidential Addresses was created representing the history of the AUA's highest office holder from 1902-2019. After multivariable analysis, AUA President age was an independent predictor of positive sentiment address.

REFERENCES

1. Guiteras R: The evolution of urology. NY Med J 1902; 76: 617–22.
2. Draxler B and Spratt D: Engaging the Age of Jane Austen: Public Humanities in Practice. 1 edition. Iowa City: University Of Iowa Press; 2019.
3. Saif H, He Y, Fernandez M, et al: Contextual semantics for sentiment analysis of Twitter. Information Processing & Management 2016; 52: 5–19.
4. Jungmann F, Kämpgen B, Mildenberger P, et al: Towards data-driven medical imaging using natural language processing in patients with suspected urolithiasis. International Journal of Medical Informatics 2020: 104106.
5. Juhn Y and Liu H: Artificial intelligence approaches using natural language processing to advance EHR-based clinical research. Journal of Allergy and Clinical Immunology 2020; 145: 463–469.
6. Xie F, Im T and Getahun D: A computerized algorithm to capture patient's past preeclampsia and eclampsia history from prenatal clinical notes. Health informatics journal 2019; 25: 1299–1313.
7. Moon S, Liu S, Scott CG, et al: Automated extraction of sudden cardiac death risk factors in hypertrophic cardiomyopathy patients by natural language processing. International journal of medical informatics 2019; 128: 32–38.
8. Kincaid JP, Braby R and Mears JE: Electronic authoring and delivery of technical information. Journal of instructional development 1988; 11: 8–13.
9. Liu B and Zhang L: A Survey of Opinion Mining and Sentiment Analysis. In: Mining Text Data. Edited by CC Aggarwal and C Zhai. Boston, MA: Springer US 2012; pp 415–463. Available at: http://link.springer.com/10.1007/978-1-4614-3223-4_13, accessed April 9, 2020.
10. Loria S: textblob Documentation. Release 0.15 2018; 2.
11. McCoy TH, Castro VM, Cagan A, et al: Sentiment measured in hospital discharge notes is associated with readmission and mortality risk: an electronic health record study. PloS one 2015; 10.
12. McDonald JH: Handbook of biological statistics. sparky house publishing Baltimore, MD; 2009.
13. SPSS I: IBM SPSS Statistics for Windows, version 25. Armonk, NY: IBM SPSS Corp 2017.
14. Ostermeier DE: Keeping It Simple: Obama Records 2nd Lowest Flesch-Kincaid SOTU Grade Level Score Since FDR. Smart Politics 2011. Available at: https://editions.lib.umn.edu/smartpolitics/2011/01/27/keeping-it-simple-obama-record/, accessed April 23, 2020.
15. Lincoln A: The Gettysburg Address. Reprint edition. Boston: HMH Books for Young Readers; 1998.
16. King ML: I Have a Dream: Writings and Speeches That Changed the World, Special 75th Anniversary Edition. 75th Anniversary ed. edition. San Francisco: HarperOne; 2003.
17. King S: On Writing: A Memoir of the Craft. Anniversary edition. New York: Scribner; 2010.
18. Reed AE, Chan L and Mikels JA: Meta-analysis of the age-related positivity effect: age differences in preferences for positive over negative information. Psychology and aging 2014; 29: 1.
19. Kim ES, Hagan KA, Grodstein F, et al: Optimism and cause-specific mortality: a prospective cohort study. American journal of epidemiology 2017; 185: 21–29.
20. Lee LO, James P, Zevon ES, et al: Optimism is associated with exceptional longevity in 2 epidemiologic cohorts of men and women. Proceedings of the National Academy of Sciences 2019; 116: 18357–18362.
21. Peduzzi P, Concato J, Kemper E, et al: A simulation study of the number of events per variable in logistic regression analysis. Journal of clinical epidemiology 1996; 49: 1373–1379.

APPENDIX

Representative examples of positive versus negative tone statements used in the manual scoring method of the AUA Presidential Addresses, 1902-2019:

Negative statements:

● "Skyrocketing medical costs are receiving increasing and well-deserved publicity, as well as consumer anxiety." Kerr WS, "Challenges in Urology", J Urol 1977; 118(3):359.
● "The world is in a very hectic state" Lowsley, OS, "Urology in a Changing World", J Urol 1942; 48(5):459.
● "There are great dangers ahead for both medicine and religion" Rusche, C. "Not by Medicine Alone", J Urol 1950; 64(3):441.
● "At the same time we need to be aware of potential threats to our organization", SS Lacy, 2012 (AUA Video Archive, Linthicum, MD)

Positive statements:

● "This is excellent!!" Hoffman, CA. "The American Urological Association- The Voice of Urology", J Urol 1968. 100(5):587.
● "The future is bright." Ainsworth, T. "The Anatomy of Change", J Urol 1972. 108(5):663
● "The financial condition of our association is secure." Higgins, C. "The Present Organization of the American Urological Association", J Urol 1949. 62(6):799.
● "Life is to be cherished and enjoyed." DA Pessis 2013 (AUA Video Archive, Linthicum, MD)