A APPENDIX

Table 1. Derham et al. [13] proposed the scheme of mapping LIWC features with feedback impacts

Impact type	LIWC Features	Feature Abbreviation	Examples
Affective Impact	Positive emotion	*posemo*	good, strong, nice
	Negative emotion	*negemo*	difficult, missing, poor
	Reward focus	*reward*	gain, success, achieve
	Risk focus	*risk*	careful, caution, doubt
	Achievement	*achieve*	attain, advantage, effort
Cognitive Impact	Interrogatives	*interrog*	how, what, when
	Negations	*negate*	not, can't, shouldn't
	Discrepancy	*discrep*	could've, lack, should
	Differentiation	*differ*	but, else, otherwise
	Insight	*insight*	decide, consider, think
	Causation	*cause*	because, lead, result
	Assent	*assent*	agree, yes, alright
	Question mark	*QMark*	?
	Tentative	*tentat*	almost, might, maybe
	Certainty	*certain*	always, clearly, must
Relational Impact	Personal pronouns	*ppron*	I, your, we
	Impersonal pronouns	*ipron*	It, that, this
	Power	*power*	follow, request, weakness
	Affiliation	*affiliation*	let's, together, we

Table 2. Scheme of politeness features retrieved from [43]

Feature Name	**Description**	**Example**
Acknowledgement	Explicit statement of understanding	*"I understand your point"*
Adverb Limiter	Minimizing with "just", "only", simply"	*"It is just enough to be worth it"*
Affirmation	Short appreciation to start sentence	*"Cool, that will work out then"*
Agreement	Explicit statement of agreement	*"I mostly agree with that"*
Apology	"sorry", "oops", "excuse me", etc.	*"I'm sorry for being so blunt"*
Ask Agency	Request an action for self	*"Let me step back for a minute"*
Bare Command	Unconjugated verb to start sentence	*"Lower the price for me"*
By The Way	"by the way"	*"By the way, my old offer stands"*
Can You	Direct request	*"Can you lower the price?"*
Conjunction Start	Begin sentence with conjunction	*"And if that works for you"*
Could You	Indirect request	*"Could you lower the price?"*
Disagreement	Explicit disagreement	*"I don't agree with that"*
Filler Pause	Filler words and verbal pauses	*"That would be, um, fine"*
First Person Plural	First-person plural pronouns	*"it's a good deal for both of us"*
First Person Single	First-person singular	*"It would benefit me, as well"*
For Me	"for me"	*"It would be great for me"*
For You	"for you"	*"It would be great for you"*
Formal Title	"sir", "madam", "mister", etc.	*"Sir, that is quite an offer."*
Give Agency	Suggest an action for other	*"I want to let you come out ahead"*
Goodbye	"goodbye", "bye", "see you later"	*"That's my best offer. Bye!"*
Gratitude	"thank you", "i appreciate", etc.	*"Thanks for your interest"*
Hedges	Indicators of uncertainty	*"I might take the deal"*
Hello	"hi", "hello", "hey"	*"Hi, how are you today?"*
Impersonal Pronoun	Non-person referents	*"That is a deal"*
Informal Title	"buddy", "chief", "boss", etc.	*"Dude, that is quite an offer."*
Let Me Know	"let me know"	*"Let me know if that works"*
Negation	Contradiction words	*"This cannot be your best offer"*
Negative Emotion	Negative emotion words	*"that is a bad deal"*
Please	Expressing please	*"Let me know if that works, please"*
Positive Emotion	Positive emotion words	*"that is a great deal"*
Questions	Question mark count	*"Is this for real?"*
Reasoning	Explicit reference to reasons	*"I want to explain my offer price"*
Resassurance	Minimizing other's problems	*"Don't worry, we're still on track"*
Second Person Single	Second person pronoun	*"It would benefit you, as well"*
Subjectivity	Identifying personal perspective	*"I think that is fair"*
Swearing	Vulgarity of all sorts	*"The dang price is too high"*
Truth Intensifier	Indicators of certainty	*"This is definitely a good idea."*
WH Questions	Questions w/ WH words (how, why, etc)	*"Why did you settle on that value?"*
YesNo Questions	Questions w/o WH words	*"Is this for real?"*

Table 3. Scheme of Writing Metrics extracted by Coh-Metrix [28]

Method	Feature Name	Description
Coh-Metrix	*DESPC*	Paragraph count, number of paragraphs
	DESSC	Sentence count, number of sentences
	DESWC	Word count, number of words
	DESPL	Paragraph length, number of sentences, mean
	DESPLd	Paragraph length, number of sentences, standard deviation
	DESSL	Sentence length, number of words, mean
	DESSLd	Sentence length, number of words, standard deviation
	DESWLsy	Word length, number of syllables, mean
	DESWLsyd	Word length, number of syllables, standard deviation
	DESWLlt	Word length, number of letters, mean
	DESWLltd	Word length, number of letters, standard deviation
	CRFNO1	Noun overlap, adjacent sentences, binary, mean
	CRFAO1	Argument overlap, adjacent sentences, binary, mean
	CRFSO1	Stem overlap, adjacent sentences, binary, mean
	CRFNOa	Noun overlap, all sentences, binary, mean
	CRFAOa	Argument overlap, all sentences, binary, mean
	CRFSOa	Stem overlap, all sentences, binary, mean
	CRFCWO1	Content word overlap, adjacent sentences, proportional, mean
	CRFCWO1d	Content word overlap, adjacent sentences, proportional, standard deviation
	CRFCWOa	Content word overlap, all sentences, proportional, mean
	CRFCWOad	Content word overlap, all sentences, proportional, standard deviation
	CRFANP1	Anaphor overlap, adjacent sentences
	CRFANPa	Anaphor overlap, all sentences
	LSASS1	LSA overlap, adjacent sentences, mean
	LSASS1d	LSA overlap, adjacent sentences, standard deviation
	LSASSp	LSA overlap, all sentences in paragraph, mean
	LSASSpd	LSA overlap, all sentences in paragraph, standard deviation
	LSAPP1	LSA overlap, adjacent paragraphs, mean
	LSAPP1d	LSA overlap, adjacent paragraphs, standard deviation
	LSAGN	LSA given/new, sentences, mean
	LSAGNd	LSA given/new, sentences, standard deviation
	LDTTRc	Lexical diversity, type-token ratio, content word lemmas
	LDTTRa	Lexical diversity, type-token ratio, all words
	LDMTLDa	Lexical diversity, MTLD, all words
	LDVOCDa	Lexical diversity, VOCD, all words
	CNCAll	All connectives incidence
	CNCCaus	Causal connectives incidence

	CNCLogic	Logical connectives incidence
	CNCADC	Adversative and contrastive connectives incidence
	CNCTemp	Temporal connectives incidence
	CNCAdd	Additive connectives incidence
	CNCPos	Positive connectives incidence
	CNCNeg	Negative connectives incidence
	SMCAUSv	Causal verb incidence
	SMCAUSvp	Causal verbs and causal particles incidence
	SMCAUSr	Ratio of casual particles to causal verbs
	SMCAUSlsa	LSA verb overlap
	SMCAUSwn	WordNet verb overlap
	DRNP	Noun phrase density, incidence
	DRVP	Verb phrase density, incidence
	DRAP	Adverbial phrase density, incidence
	DRPP	Preposition phrase density, incidence
	DRPVAL	Agentless passive voice density, incidence
	DRNEG	Negation density, incidence
	DRGERUND	Gerund density, incidence
	DRINF	Infinitive density, incidence
	WRDNOUN	Noun incidence
	WRDVERB	Verb incidence
	WRDADJ	Adjective incidence
	WRDADV	Adverb incidence
	WRDPRO	Pronoun incidence
	WRDPRP1s	First person singular pronoun incidence
	WRDPRP1p	First person plural pronoun incidence
	WRDPRP2	Second person pronoun incidence
	WRDPRP3s	Third person singular pronoun incidence
	WRDPRP3p	Third person plural pronoun incidence
	WRDFRQc	CELEX word frequency for content words, mean
	WRDFRQa	CELEX Log frequency for all words, mean
	WRDFRQmc	CELEX Log minimum frequency for content words, mean
	WRDAOAc	Age of acquisition for content words, mean
	WRDFAMc	Familiarity for content words, mean
	WRDCNCc	Concreteness for content words, mean
	WRDIMGc	Imageability for content words, mean
	WRDMEAc	Meaningfulness, Colorado norms, content words, mean
	RDFRE	Flesch Reading Ease
	RDFKGL	Flesch-Kincaid Grade Level
	RDL2	Coh-Metrix L2 Readability

Table 4. Full results for the comparison of selected features between the **Increase** group and **Not Increase** group. Features marked with † were examined by Chi-square test and Cramer's Phi effect size whereas the remaining features were examined by Mann-Whitney U test and Rank-Biserial effect size

Row ID	Artefact Attributes	Feature Clusters	Features	Increase		Not Increase		Difference	
				M	SD	M	SD	P-val	E.S
		Knowledge Level	*assgmt_1_grades*	1.50	1.03	3.16	1.10	<0.01	0.72
Attr.1	**Comments strengthen teacher and learner relationships**	Politeness	*Hedges*	0.97	1.55	0.51	1.13	0.01	-0.19
			Positive.Emotion	4.29	2.13	4.21	3.00	0.31	-0.09
			Negative.Emotion	0.74	0.79	0.36	0.64	<0.01	-0.27
			Impersonal.Pronoun	1.98	2.18	1.40	2.28	<0.01	-0.23
			Negation	0.18	0.39	0.19	0.50	0.59	-0.03
			Informal.Title	0.02	0.12	0.01	0.12	0.94	0.00
			Could.You	0.03	0.17	0.02	0.14	0.67	-0.01
			Can.You	0.00	0.00	0.01	0.17	0.51	0.01
			For.You	0.02	0.12	0.03	0.18	0.44	0.02
			Reasoning	0.33	0.64	0.27	0.58	0.44	-0.05
			Reassurance	0.02	0.12	0.00	0.00	0.14	-0.02
			Ask.Agency	0.05	0.21	0.01	0.12	0.16	-0.03
			Give.Agency	0.24	0.50	0.08	0.26	<0.01	-0.14
			Please	0.06	0.24	0.10	0.30	0.40	0.04
			First.Person.Plural	0.00	0.00	0.01	0.08	0.51	0.01
			First.Person.Single	0.15	0.40	0.16	0.48	0.76	-0.02
			Second.Person	2.12	1.91	1.92	1.79	0.56	-0.05
			Agreement	0.00	0.00	0.03	0.16	0.18	0.03
			Acknowledgement	0.00	0.00	0.01	0.08	0.51	0.01
			Subjectivity	0.02	0.12	0.02	0.14	0.79	0.01
			Bare.Command	0.27	0.51	0.16	0.42	0.06	-0.10
			WH.Questions	0.02	0.12	0.01	0.08	0.57	-0.01
			YesNo.Questions	0.14	0.43	0.05	0.24	0.07	-0.07
			Gratitude	0.02	0.12	0.01	0.08	0.57	-0.01
			Truth.Intensifier	0.05	0.21	0.05	0.23	0.78	0.01
			Affirmation	0.82	0.58	0.84	0.69	0.99	0.00
			Adverb.Just	0.02	0.12	0.02	0.14	0.79	0.01
			Conjunction.Start	0.08	0.27	0.03	0.18	0.19	-0.04
		Relational Impact (LIWC)	*ppron*	3.40	2.67	4.30	3.57	0.15	0.12
			affiliation	0.24	0.51	0.13	0.45	0.04	-0.10
			power	1.53	1.51	1.89	2.92	0.81	-0.02
			ipron	3.05	3.28	2.51	3.17	0.13	-0.13

Row ID	Artefact Attributes	Feature Clusters	Features	Increase		Not Increase		Difference	
				M	SD	M	SD	P-val	E.S
Attr.2	**Comments that encourage learner agency**	Cognitive Impact (LIWC)	*interrog*	1.69	2.11	0.98	1.95	<0.01	-0.31
			negate	0.99	6.15	0.42	1.58	0.54	-0.03
			discrep	4.38	2.61	4.60	3.56	0.97	0.00
			differ	2.62	1.84	2.47	2.80	0.16	-0.12
			insight	2.36	2.07	3.01	3.39	0.52	0.05
			cause	1.45	1.71	1.33	2.64	0.04	-0.16
			assent	0.00	0.00	0.01	0.10	0.51	0.01
			QMark	0.58	1.05	0.37	1.02	0.04	-0.13
			tentat	3.40	2.83	3.55	3.93	0.52	-0.06
			certain	2.31	1.42	2.03	2.15	0.06	-0.16
Attr.3	**Comments encourage positive learner affect**	Affect Impact (LIWC)	*posemo*	5.76	2.31	10.89	12.17	<0.01	0.48
			negemo	0.56	0.85	0.50	1.00	0.35	-0.07
			reward	4.90	3.46	7.96	9.68	0.06	0.16
			risk	0.61	0.74	0.43	0.74	0.07	-0.13
			achieve	4.50	2.52	7.48	11.88	0.09	0.15
		Feedback Model	†*Self*	0.48	0.50	0.59	0.49	0.16	0.10
Attr.4	**Comments that highlight strengthen of performance**		†*Task_Pos*	0.61	0.49	0.56	0.50	0.54	0.04
Attr.5	**Comments that provide critiques about performance**		†*Task_Neg*	0.44	0.50	0.25	0.43	<0.01	0.19
Attr.6	**Comments that provide actionable information for future performances**		†*Task_Ex_Cor*	0.86	0.35	0.77	0.42	0.11	0.11
			†*Process*	0.85	0.36	0.60	0.49	<0.01	0.25
			†*Forward*	0.95	0.21	0.88	0.33	0.08	0.12
Attr.7	**Comments promote learner independence**		†*Self_regulate*	0.38	0.49	0.24	0.43	0.04	0.14
Attr.8	**Comments are usable for learners**		†*Up*	0.91	0.29	0.62	0.49	<0.01	0.29
			†*Back*	0.82	0.39	0.68	0.47	0.04	0.14
		Writing Metrics (Coh-Metrix)	*DESPC*	0.98	0.12	0.99	0.12	0.94	0.00
			DESSC	3.65	2.10	3.00	2.35	0.01	-0.23
			DESWC	73.03	22.55	52.04	35.43	<0.01	-0.48
			DESPL	3.65	2.10	3.00	2.35	0.01	-0.23

DESSL	27.93	21.23	21.23	15.96	0.02	-0.21
DESSLd	11.05	10.90	8.04	8.86	0.03	-0.19
DESWLsy	1.58	0.26	1.48	0.29	<0.01	-0.33
DESWLsyd	0.93	0.20	0.76	0.27	<0.01	-0.41
DESWLlt	5.31	0.83	5.02	0.89	<0.01	-0.32
DESWLltd	5.31	0.83	5.02	0.89	<0.01	-0.32
CRFNO1	0.18	0.20	0.12	0.17	0.05	-0.15
CRFAO1	0.21	0.21	0.16	0.20	0.07	-0.15
CRFSO1	0.18	0.20	0.13	0.18	0.06	-0.15
CRFNOa	0.57	0.80	0.40	0.59	0.14	-0.12
CRFAOa	0.69	0.87	0.51	0.74	0.13	-0.12
CRFSOa	0.60	0.79	0.43	0.65	0.07	-0.14
CRFCWO1	0.02	0.03	0.02	0.03	0.07	-0.15
CRFCWO1d	0.02	0.03	0.02	0.02	0.21	-0.10
CRFCWOa	0.08	0.11	0.07	0.11	0.05	-0.17
CRFCWOad	0.08	0.10	0.07	0.09	0.10	-0.14
CRFANP1	0.30	0.25	0.24	0.25	0.05	-0.17
CRFANPa	0.10	0.12	0.08	0.12	0.05	-0.16
LSASS1	0.18	0.20	0.11	0.15	<0.01	-0.23
LSAPP1	0.59	0.27	0.65	0.28	0.12	0.13
LSAPP1d	0.25	0.14	0.24	0.17	0.83	0.02
LSAGN	0.82	0.13	0.87	0.16	<0.01	0.31
LSAGNd	0.71	0.12	0.78	0.15	<0.01	0.35
LDTTRc	69.50	22.29	55.41	29.97	<0.01	-0.32
LDTTRa	0.75	0.20	0.48	0.39	<0.01	-0.38
LDMTLDa	7.45	3.18	5.36	3.47	<0.01	-0.38
LDVOCDa	1.09	0.89	0.73	0.79	<0.01	-0.24
CNCAll	3.02	1.60	2.25	1.65	<0.01	-0.28
CNCCaus	0.26	0.47	0.16	0.37	0.17	-0.08
CNCLogic	0.24	0.50	0.23	0.44	0.89	0.01
CNCADC	2.85	1.52	1.99	1.62	<0.01	-0.33
CNCTemp	7.11	3.13	5.08	3.33	<0.01	-0.38

CNCAdd	0.33	0.54	0.28	0.58	0.27	-0.07
CNCPos	0.29	0.70	0.40	1.01	0.71	0.02
CNCNeg	1.38	0.99	1.12	1.32	0.01	-0.21
SMCAUSv	4.64	2.35	3.60	2.87	<0.01	-0.31
SMCAUSvp	1.01	0.85	0.64	0.75	<0.01	-0.27
SMCAUSr	0.44	0.22	0.39	0.20	0.13	-0.13
SMCAUSlsa	0.28	0.18	0.28	0.26	0.24	-0.10
SMCAUSwn	6.58	3.04	4.94	3.56	<0.01	-0.32
DRNP	0.40	0.32	0.26	0.32	0.01	-0.22
DRVP	0.40	0.32	0.26	0.32	0.01	-0.22
DRAP	19.92	6.51	14.70	10.05	<0.01	-0.41
DRPP	7.45	3.52	5.47	3.82	<0.01	-0.33
DRPVAL	2.41	1.56	1.65	1.63	<0.01	-0.31
DRGERUND	1.76	3.23	0.90	1.73	0.35	-0.07
DRINF	0.05	0.21	0.12	0.42	0.32	0.04
WRDNOUN	0.32	0.53	0.25	0.51	0.33	-0.06
WRDADJ	24.86	9.41	16.99	12.50	<0.01	-0.42
WRDADV	7.52	3.59	5.50	3.85	<0.01	-0.33
WRDPRO	5.95	3.07	4.14	3.35	<0.01	-0.39
WRDPRP1s	2.44	1.63	1.72	1.66	<0.01	-0.27
WRDPRP1p	4.18	3.20	3.39	2.93	0.08	-0.15
WRDPRP2	0.15	0.40	0.16	0.47	0.74	-0.02
WRDPRP3p	2.03	1.83	1.82	1.67	0.53	-0.05
WRDFRQc	0.20	0.40	0.21	0.43	0.87	0.01
WRDFRQa	0.00	0.00	0.01	0.08	0.51	0.01
WRDCNCc	419.23	79.73	346.31	163.48	<0.01	-0.26
WRDIMGc	578.99	103.22	555.03	151.38	0.43	-0.07
WRDMEAc	256.17	46.74	246.45	68.95	0.79	0.02
RDFRE	276.82	50.81	266.37	74.55	0.74	0.03
RDFKGL	304.20	57.62	292.36	81.72	0.95	0.01
RDL2	5.55	0.96	6.29	1.79	<0.01	0.30

Table 5. Marking Rubric for the assignments of introductory data science course

Criteria	High distinction (HD)	Distinction (D)	Credit (C)	Pass (P)	Fail (F)
Analyse the role of data in different styles of business	Provides a sophisticated critical analysis.	Provides some critical analysis.	Provides limited critical analysis.	Provides minimal analysis.	Provides description rather than analysis.
Analyse different parts of data science project from the perspective of the data science process and from the perspective of the roles such as statistician, archivist, analyst and systems architect	Provides critical analysis of different parts of a data science project. Provide distinct classification of data scientist roles.	Provides some analysis of different parts of a data science project. Provide some classification of data scientist roles.	Provides limited analysis of different parts of a data science project. Provide limited classification of data scientist roles.	Provides minimal analysis of different parts of a data science project. Provide minimal classification of data scientist roles.	No analysis of different parts of a data science project. No clear classification of data scientist roles.
Demonstrate the size and scope of data storage and data processing and classify the basic technologies in use	Clearly demonstrates the size and scope of data storage and data processing and classification of the basic technologies in use.	Provides some demonstration of the size and scope of data storage and data processing and classification of the basic technologies in use.	Provides limited demonstration of the size and scope of data storage and data processing and classification of the basic technologies in use.	Provides minimal demonstration of the size and scope of data storage and data processing and classification of the basic technologies in use.	No clear demonstration of the size and scope of data storage and data processing and classification of the basic technologies.
Classify the kinds of data analysis and statistical methods available for a data science project	Provides distinct classification of the kinds of data analysis and statistical methods that are available.	Provides some classification of the kinds of data analysis and statistical methods that are available.	Provides limited classification of the kinds of data analysis and statistical methods that are available.	Provides minimal classification of the kinds of data analysis and statistical methods that are available.	No clear classification of the kinds of data analysis and statistical methods.
Locate and assess resources, standards, software and tools for a data science project	Provides clear and succinct assessment of standards, software and tools for a data science project in an organisation.	Provides some assessment of tasks required for standards, software and tools for a data science project in an organisation.	Provides limited assessment of standards, software and tools for a data science project.	Provides minimal assessment of standards, software and tools for a data science project.	No clear assessment of tasks required for standards, software and tools for a data science project..
Creative and critical thinking	Thinks out of the box, creates or extends to a novel or unique idea. Provides a sophisticated critical analysis.	Collect ideas, solutions and other information in good ways. Provides detailed justification and analysis	Reformulates a collection of available information. Provide some justification and analysis.	Mostly repeats existing information. Provide limited justification and analysis.	Just repeats existing information. Do not provide any justification or analysis.
Presentation, structure, expression, grammar and spelling	Well structured, with impressive fluency and flow. Appropriate use of sub-headings and relevant content sections. Adheres to Specifications (word limit, duration, file format)	Well-structured and generally good links and flow. Adheres to specifications (word limit, duration, file format)	Satisfactory structure, mostly satisfactory links and flow. Adheres to specifications (word limit, duration, file format)	Overall basic structure is adequate, but lacks links and flow. Adheres to specifications (word limit, duration, file format)	Poorly structured, lacking linkages and flow. Does not adhere to specifications (word limit, duration, file format).

Supporting the Data Science proposal with realistic data, authentic models and output	Project well-constructed and explained using real (or a realistic) dataset with impressive suggestions or mockups of authentic models and output/ visualizations for various stakeholders.	Supports the project sufficiently by identifying realistic datasets and their descriptions. Demonstrates some modelling were performed with output generated.	Satisfactory explanation with data. Report demonstrates good understating of data sources and datatypes. Limited demonstration of modelling and output. Limited results/mockup on how the results will be presented to stakeholders.	Provides basic understanding of data required. Provides links and descriptors of few realistic datasets/sources. Lacks evidence of using the dataset for modeling but provides some discussion on the nature of the output.	No evidence of using any real or realistic dataset to support the proposal.

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