Linguistic Analysis of Phone Interviews of Nobel Laureates Reveals Differences in Communication Styles Between Economists and Scientists

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ABSTRACT

Language styles used by academics working in disciplines are different, possibly reflecting how different types of knowledge are conceived, communicated and taught. Most of the studies on the communication style of academics are based on analyses of pre-prepared academic writings and formal speeches. It is not known whether such differences in language styles are also practised in informal, colloquial communications. In this paper, we report a Linguistic Inquiry and Word Count (LIWC) analysis of the telephone interviews given by 82 Nobel Prize laureates in the fields of natural sciences (chemistry, physics, physiology, or medicine) and economic sciences. LIWC analysis identifies differences in usage frequency of words in various language categories. The result shows a higher use of money- and power-related words by economic laureates and a higher use of second-person pronouns among science laureates. When second-person pronouns were used, economic laureates tended to use them as a general reference, while scientists tended to use them as courtesy sentences or discourse markers. These observations indicate that different language styles are used by scholars of different research fields even in their impromptu verbal communications. It is possible that word choices by economists are influenced by the content of economic studies, which are concerned with influencing the external environment and by their preference in describing processes and actions. A more involved and high level of cautions, alertness, and precision in conversion may be indicated in the speaking style of natural scientists.

Introduction

People from different academic disciplines communicate in distinct styles. Giusta et al. (2020) compared the writings posted by the 25 most-followed scientists and economists on Twitter, and observed that economists adopted a more formal style and exclusive pronouns than scientists, whereas scientists used more inclusive pronouns. Corpus-based analyses on academic writings also indicate that lexical and stylistic characteristics, such as vocabulary use, specific terminology, and stylistic features, are distinct between economics and other fields (Goldschmidt & Szmrecsanyi, 2007). A plethora of research has indicated a strong correlation between language style and gender (Pânişoară, Sandu, Pânişoară, & Duță, 2015), academic performance (Robinson et al. 2013, Gunawan, Mayasari, & Masruddin, 2019), leadership personality traits (Pennebaker & King, 1999, Vries, Bakker-Pieper, & Oostenveld, 2009, Solaja, Idowu, & James, 2016), social hierarchies (Irvine, 1985, Pennebaker, 2011), interpersonal skills (Vries, Bakker-Pieper, Siberg, Gameren, & Vlug, 2009), narrative effects (Ireland & Pennebaker, 2010), and romantic relationships (Ireland, et al., 2010). However, it is not known what factors contribute to the differences in communication style used by scholars of different academic disciplines. It is possible that the communication style is shaped by academic training. The difference in communication styles may be a reflection of the fact that people with different personality traits tend

to flourish in different academic fields (Vedel et. al, 2015). It is also possible that different types of theoretical concepts or abstract idea can only be communicated via a particular language style (Morell, 2014). Hence, analyses of the communication style used by academics in their formal and informal discourses may provide glimpses of how the generation and communication of ideas and knowledge are shaped by language.

There are several limitations associated with analyses of written texts such as academic papers and social media posts. Published texts can be edited, sometimes over a prolonged period by multiple hands, obscuring the author's actual personality. Tweets are more spontaneous than published texts, but they are short (limited to 280 characters) and are often responses to highly diverse and personalized topics. It is not easy to systematically compare their expression styles among these heterogeneous themes. Some investigators have turned their attention to the analyses of speeches (Simpson-Vlach, 2006). These studies suggest that by studying speeches, we can get to know more about the spontaneous reactions of the people that we study, thus having a clearer picture of the communication and language style of the academic experts.

Launching in 1901, the Nobel prize has been one of the most revered and recognizable awards of human achievements in modern history. There were 5 categories of prizes, including Physics, Chemistry, Physiology or Medicine, Literature, and Peace. In 1968, the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel was established (commonly known as Nobel Memorial Prize in Economic Sciences), to be awarded alongside the Nobel Prize in the 5 categories. The nomination process of the Nobel Prize starts in the September of the preceding year. Nominators invited are mostly academies, university professors, scientists, previous Nobel laureates, parliamentary assemblies members and other qualified people (The Nobel Prize, 2021). The selection process for the Nobel Prize in Chemistry and Physics is held by The Royal Swedish Academy of Science. Karolinska Institutet is responsible for the Prize in Physiology or Medicine and The Royal Swedish Academy of Science responsible for the Nobel prize in Economic Science (The Nobel Prize, 2021). Over the past 120 years, 934 people and 28 organisations have been awarded this prize (The Nobel Prize, 2021). This group provides a unique sample for researchers to study how achievements in different areas of human endeavours are made, measured and recognised. Characteristics in the education background (Li, Wang, & Liu, 2021), hobbies (Root-Bernstein, et al., 2008), collaboration style (Zuckerman, 1967), mentorship (Chariker, Zhang, Pani, & Rouchka, 2016) and family heritage (Rothenberg, 2005) among the Nobel laureates have been extensively studied. The communication styles of Nobel laureates have also begun to attract attention recently. For example, Bucchi, Loner & Fattorini (2019) conducted a quantitative analysis on speeches given by Nobel laureates in science during official Nobel banquets and observed that speeches by laureates are "more technical, less ceremonial and lecture-oriented" from 1901 to 2018. Exaltation of science as a profession becomes the dominant content in these speeches, especially among chemistry laureates. Similarly, Condit (2018) analysed 25 Nobel lectures in natural science from 2013 to 2015 and 15 Nobel banquet speeches from 2011 to 2015. They found that these laureates tended to regard fellow scientists in their own fields as the intended audience, regardless of the academic backgrounds of the actual audience.

While these studies might reveal the working of Nobel laureates' minds, it is presumed that most of these public speeches on these formal occasions were read from pre-prepared scripts and are as unspontaneous as written texts. To overcome this limitation, we turned our attention to Nobel laureates' interviews, as interviews are difficult to be prepared in advance. We focused on the first official telephone interviews by the laureates published on the Nobel Prize official website. These interviews were conducted within hours after these laureates were informed of their awards, so the emotional impact of the announcement might help to keep the expression style impromptu. Unlike Twitter feeds, which are short and highly contextualized, these telephone interviews were much longer and on very similar subjects. As an additional bonus, almost all the published interviews were conducted by the same interviewer, thus adding one more element of consistency to the setting. Therefore, these interviews are an invaluable archive of oral history and offer us a unique chance to compare the language style of experts from different academic disciplines on themes with highly similar context.

In this study, we investigated the speech pattern in the official phone interviews given by 82 Nobel laureates who are native English speakers. To analyse the expression style in these speeches, we used a computational linguistic

programme called Linguistic Inquiry and Word Count (LIWC2015) (Pennebaker, Boyd, Jordan, & Blackburn, 2015), an algorithm that quantitates the usage of 90 different linguistic categories. The word categories that are available in LIWC2015 include linguistic dimensions (for example, functional words including pronouns, articles, auxiliary verbs), different semantic dimensions, like word categories related to social processes (family, friends), drives (affiliation, achievement, power, reward, risk), personal concerns (work, leisure, home, money), and more. Table 1 shows the variations of words of the word categories we analysed. LIWC2015 is one of the most popular programmes for linguistics analysis, extensively used for a variety of purposes, from analysing cover letters for job applications (Brandt, 2020), to school-based consultations (Newman, Guiney & Barrett, 2015), romantic relationships (Ireland, et al., 2010), and the study of poetry (Encarnación, 2018).

Methods

Table 1. LIWC2015 Output Variable information related to our study (Pennebaker et al, 2015)

Category	Examples	Words in category
1st person singular pronoun	I, me, mine	24
1st person plural pronoun	we, us, our	12
2nd person pronoun	you, your, thou	30
Positive emotion	love, nice, sweet	620
Negative emotion	hurt, ugly, nasty	744
Power	superior, bully	518
Work	job, majors, xerox	444
Money	audit, cash, owe	226

In this study, we have collected the transcripts of 82 official phone interviews of Nobel laureates conducted by the Nobel Foundation. 24 interviews were given by the laureates of the economic sciences prize, 11 by the laureates of the chemistry prize, 26 by the laureates of the medicine or physiology prize, and 21 by the laureates of the physics prize. The audio files and the transcripts of these interviews are available on the official website of the Nobel prize. These interviews were all given by laureates born in English-speaking countries. These countries include the United States, Canada, United Kingdom, Ireland, Australia, and New Zealand. The interviews we collected are dated between 2004 and 2020, as Nobel Prize official phone interviews were only available starting from 2004. The transcripts of these 82 interviews contained an average of 565 words, with a standard deviation of 31.37 words, ranging from 92 words to 1735 words.

All texts were processed by the LIWC2015 software, the computational linguistic programme (Table 1). In each transcript, we analysed the frequency of words that belong to the following three categories: dependent factors, positive control factors, and negative control factors. Dependent factors include power-related words (518 words related to power, control, or authority), you-words (second-person pronouns), and work-words (444 words related to socially defined ways of doing work). Positive control factors include money-words. The negative control factors include positive-emotion-words, negative-emotion-words, I-words, and we-words.

Table 2. Average percentage of positive emotion words. Laureates in natural sciences have a slightly higher usage of positive emotion words than the laureates in economics.

	Sample Size	Speech content mean (%)
Laureates in natural sciences	58	4.99
Laureates in economics	24	4.62

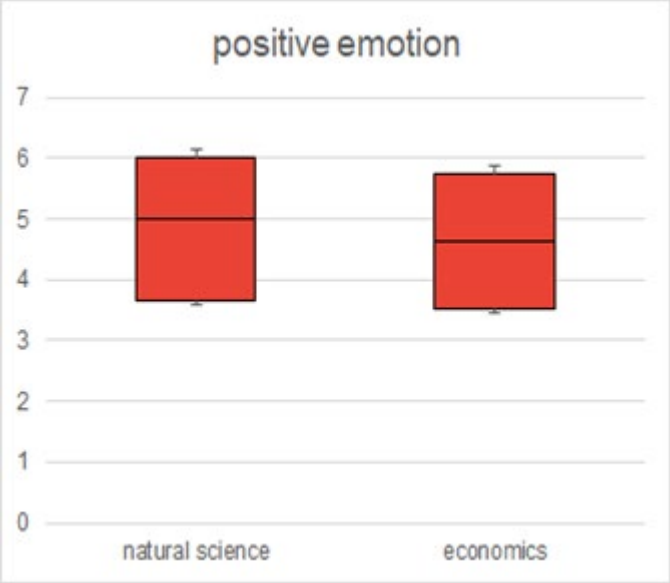

Figure 1. Box plot of the average percentage of positive emotion words. The box represents the standard error of the samples. Standard errors are 0.24 for the laureates in natural sciences, and 0.30 for laureates in economics. The solid line in between the boxes is the means of the samples.

Table 3. Average percentage of negative emotion words. Laureates in natural sciences have a slightly higher usage of negative emotion words than the laureates in economics.

	Sample Size	Speech content mean (%)
Laureates in natural sciences	58	0.75
Laureates in economics	24	0.65

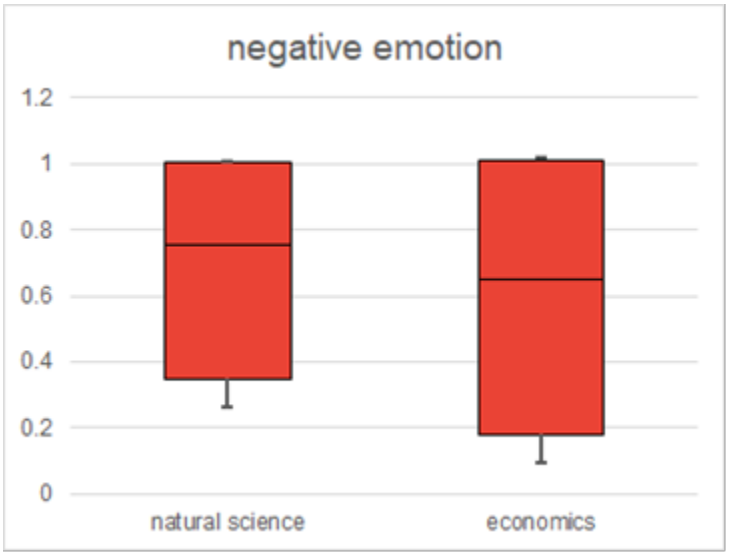

Figure 2. Box plot of the average percentage of negative emotion words. The box represents the standard error of the samples. Standard errors are 0.078 for the laureates in natural sciences, and 0.109 for laureates in economics. The solid line in between the boxes is the means of the samples.

Table 4. Average percentage of first-person singular words (I). Laureates in natural sciences have a slightly higher usage of first-person singular words than the laureates in economics.

	Sample Size	Speech content mean (%)
Laureates in natural sciences	58	0.75
Laureates in economics	24	0.65

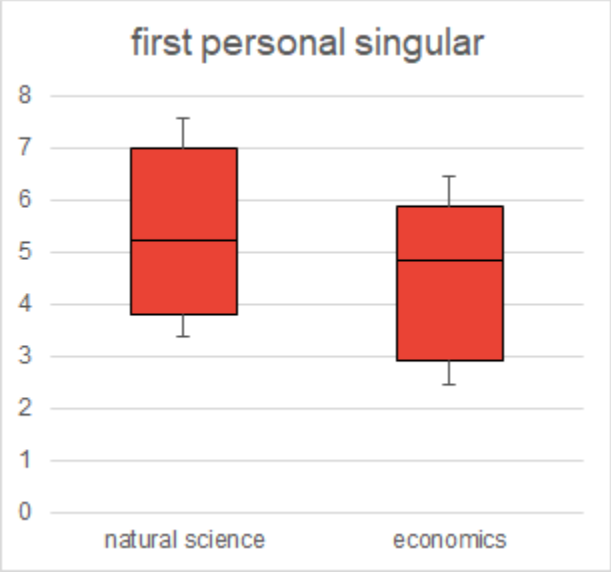

Figure 3. Box plot of the average percentage of first person singular. The box represents the standard error of the samples. Standard errors are 0.279 for the laureates in natural sciences, and 0.422 for laureates in economics. The solid line in between the boxes is the means of the samples.

Table 5. Average percentage of first-person plural (We). Laureates in natural sciences have a slightly higher usage of first-person plural words than the laureates in economics.

	Sample Size	Speech content mean (%)
Laureates in natural sciences	58	1.51
Laureates in economics	24	1.29

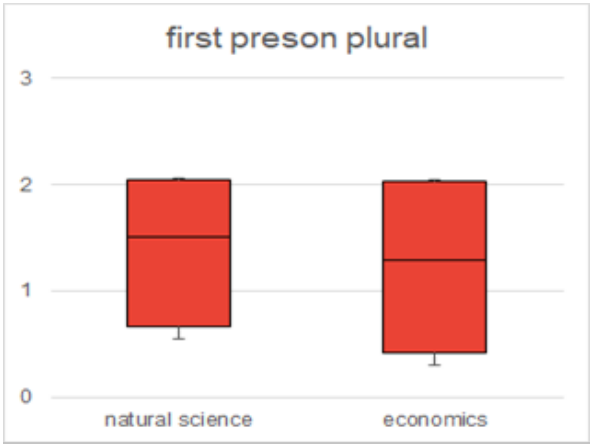

Figure 4. Box plot of the average percentage of first-person plural. The box represents the standard error of the samples. Standard errors are 0.141 for the laureates in natural sciences, and 0.195 for laureates in economics. The solid line in between the boxes is the means of the samples.

Results and Discussions

Linguistic Inquiry and Word Count Analysis of Nobel Interviews

Table 6. Average percentage of money-related words. Laureates in economics have a significantly higher usage of money-related words than the laureates in natural sciences.

	Sample Size	Speech content mean (%)
Laureates in natural sciences	58	0.18
Laureates in economics	24	1.95

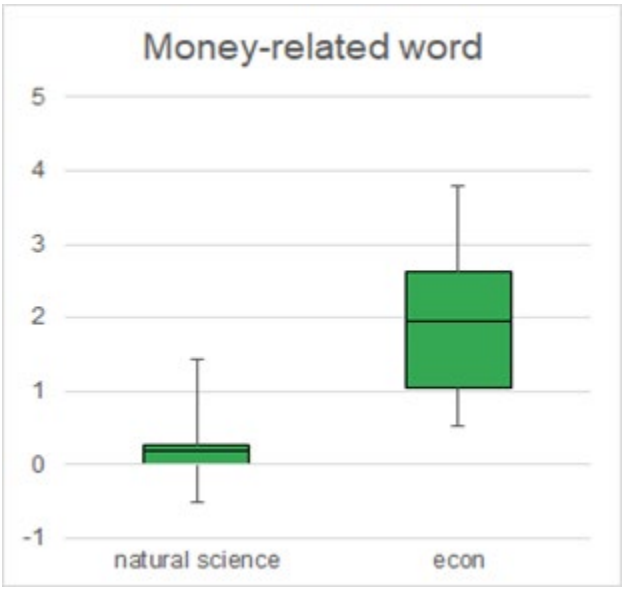

Figure 5 Box plot of the average percentage of money-related words. The box represents the standard error of the samples. Standard errors are 0.034 for the laureates in natural sciences, and 0.20 for laureates in economics. The solid line in between the boxes is the means of the samples.

In the study, we conducted an LIWC analysis on 24 interviews of the laureates of the economic sciences prize and 58 interviews of the laureates of natural science prizes. Out of the eight groups of vocabularies that belonged to three major categories, statistically significant differences in the frequency of four word-groups were found between the economic sciences laureates and science laureates. The most pronounced difference was found in money-related words (Table 6). Economists are 10.8 times more likely to use money-related words in their interviews than scientists. Such a difference is expected, as these interviews were conducted within hours after the prize announcement, so discussions on these laureates' careers, especially their Nobel prize-winning achievements, were inevitable. Interviews with economic sciences laureates generally involved discussions on economic issues, which are by definition related to money affairs, like the tax system and resource distribution. For example, in the interview of Eric S. Maskin, the 2007 Nobel laureate in economic sciences, he said,

"Again, there you have particular social goals, you are interested in using taxes to improve the income distribution, to help those at the lower end. But you don't want to choke off the incentives of individuals to earn income, that is you don't want to stifle initiative."

Three money-related words (in italic) were used in two sentences. Such frequent use of money-related words was not seen in discussions on natural sciences. Therefore, we interpret the dramatic difference in the usage of money-related words between economists and scientists an indication that our LIWC analysis can accurately reflect the context of the interviews.

Higher Usage of Power-related and Word-related Words by Economic Sciences Laureates

Table 7. Average percentage of power-related words. Laureates in economics have a significantly higher usage of power-related words than the laureates in natural sciences.

	Sample Size	Speech content mean (%)
Laureates in natural sciences	58	1.46
Laureates in economics	24	2.32

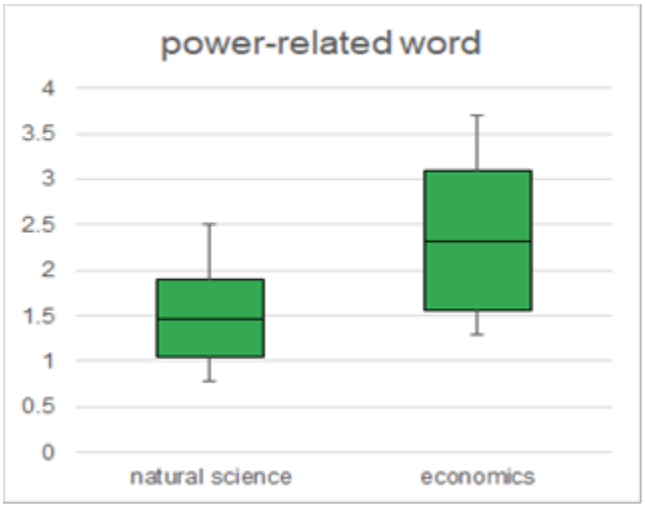

Figure 6. Box plot of the average percentage of power-related words. The box represents the standard error of the samples. Standard errors are 0.090 for the laureates in natural sciences, and 0.227 for laureates in economics. The solid line in between the boxes is the means of the samples.

The laureates of the economic sciences prize tended to use power-related words more often than natural science laureates (Table 7). Like money-related words, power-related words are related to status, dominance and social hierarchies, and were more frequently used by economic sciences laureates because their research is related to resources allocation or social hierarchy. During the discussion of these scholar's careers, power-related words like "order", "allow", "power" and "privilege" are inevitably used. For example, Edmund S. Phelps, the Nobel laureate of economic study in 2006, said in his interview "but central banks are no longer under pressure to keep lowering interest rates to boost employment" (power word in italic) or Oliver Hart, the Nobel laureate of economic study in 2016, said "even a simple thing like people often think that one side dictates the terms to the other side." "Pressure" and "dictates" refer to specific operations in these scholars' economic models.

However, some uses of power-related words may carry more subtle meanings. In his interview Oliver E. Williamson, the Nobel laureate of economic study in 2009, said: "I owe enormous debts to my students who were persuaded on the merits of this approach". Williamson used "persuaded", a power-related word in LIWC analysis, to describe the acceptance of his theory, as if it was an outcome of a debate. In another example, Angus Deaton, the Nobel laureate of economic study in 2015, said: "I was very glad that, in the end, that the referendum did not make me forced to choose between being British and Scottish" when answering the question on his national identities. "Forced", a power-related word, was used to underpin the emotion of reluctance in choosing between being Scottish

and British. The use of power-related words is related to the "Need for Power" under the need theory (Maliszewski et. al, 2014), which indicates a desire to exercise influence or control over the environment or other people. The higher usage of Power-related words among economic sciences laureates may imply that economics, compared with natural sciences, is more preoccupied with the study of influence and dominance (Maliszewski et. al., 2014; Harrel & Stahl, 1981), either an implicit need for power for personal gains or an explicit need for power for common goods. Classical economics assumes that rational agents are motivated by self-interest and many economic models involve competition and domination over others for profit maximisation, which in line with the aims of implicit need for power. Economics also studies resources allocation and strategies for social efficiency and social profit maximisation, which are in lines with the socialised need for power. Natural scientists, however, especially the ones engaged in basic scientific research, are less involved in competitions, debates of point-of-views, and social issues.

Economists Use Work-related Words More Frequent

Table 8. Average percentage of work-related words. Laureates in economics have a significantly higher usage of work-related words than the laureates in natural sciences.

	Sample Size	Speech content mean (%)
Laureates in natural sciences	58	0.174
Laureates in economics	24	0.471

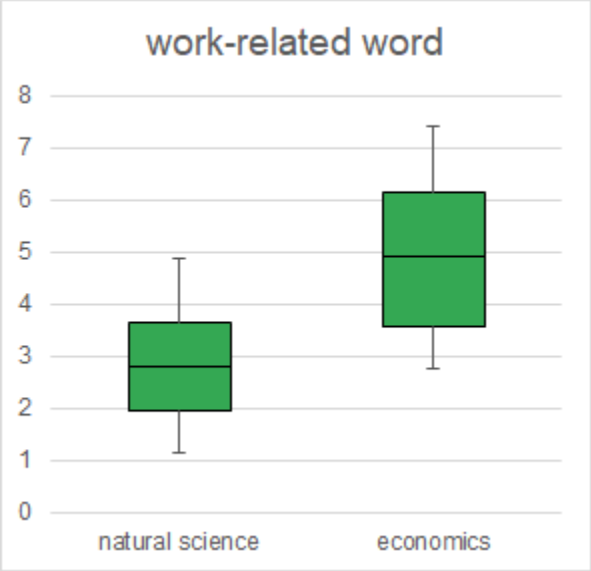

Figure 7. Box plot of average percentage of work-related words. The box represents the standard error of the samples. Standard errors are 0.174 for the laureates in natural sciences, and 0.471 for laureates in economics. The solid line in between the boxes are the means of the samples.

We also observed that economic laureates used work-related words more frequently (Table 8). We found that work-related vocabulary (261 words) accounts for 4.94% of the total word use in the interviews of the laureates of the economics sciences prize but only 2.79% of the words in the interviews of the laureates of the natural sciences prize. Work-words are mostly execution-based words such as do, fix, deal, work, wipe. There are two ways of using work-words in a conversation. First is to describe a mechanism. For example, Thomas Schelling, the 2005 laureate of the economic sciences prize, awarded for "having enhanced our understanding of conflict and cooperation through game-theory analysis", said, "Well, probably the most dramatic example in recent years was the various auctions that have been *used* for decentralization."

The second use of work-words is to describe the action of an investigation or research. Examples:

> "Well, I spent a long time *working* on the subject of nuclear weapons control. And I have *worked* some on the economics of crime and on studies of racial segregation, and I'm not sure just what it was that most attracted the Nobel Committee." - Thomas Schelling

> "I think there's two aspects to it. One is, I have **done work** on, what's called [inaudible] econometrics, which is statistics in economics and I did **work**, that I think of in a very simple way as trying to show how you can **do** [inaudible] without having to **do** everything. It's kind of a funny way to **put** it, but if you want to study a dynamic economic system, what you'd like to be able to **do** is focus on the linkages, say, between asset markets and the macro economy without having to model everything at the same time." - Lars Peter Hansen

We believe economists tend to communicate processes and actions in a manner of execution and to describe processes and actions, more often than scientists. Interestingly, in their analysis on Nobel banquet speeches, Bucchi, Loner & Fattorini (2019) noticed a wide usage of "work" words by Nobel laureates in the sciences (physics, chemistry, and medicine or physiology). However, they did not analyse the speeches of economic laureates. And the "work" words there are the narrowly defined word "work", which is different from the work-related word dictionary we use in our study.

Scientists Use Second-person Pronouns More Frequently

Table 9. Average percentage of second person pronoun (you). Laureates in natural sciences have a higher usage of second person pronoun than the laureates in economics.

	Sample Size	Speech content mean (%)
Laureates in natural sciences	58	1.88
Laureates in economics	24	1.45

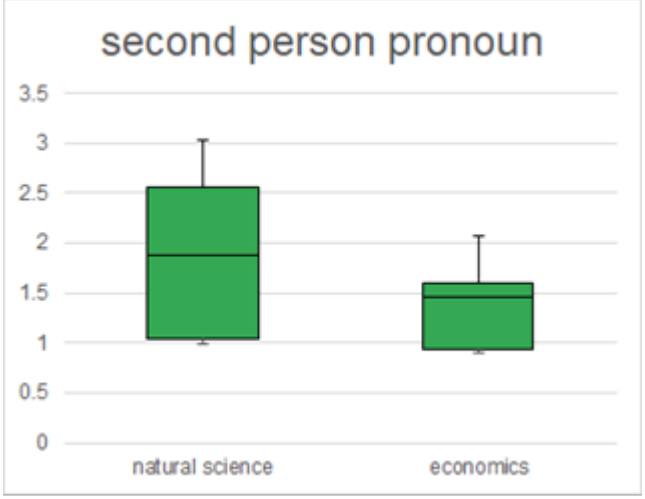

Figure 8. Box plot of average percentage of second person pronoun. The box represents the standard error of the samples. Standard errors are 0.137 for the laureates in natural sciences, and 0.170 for laureates in economics. The solid line in between the boxes are the means of the samples.

Our data show that science laureates used "you-words" more frequently than economics laureates (Table 9). This finding is consistent with a recent observation that scientists used more second-person pronouns in their tweets than economists (Giusta et al, 2020, Marina, 2021). Greater use of the personal pronoun, especially first- and second-person pronouns, is considered an indication of a more involved style, whereas a lesser use points to a more nominal and impersonal communication style. (Biber and Conrad, 2009). We identified the three main purposes of "you-words" in a conversation. (1) They used "you" or "your" to directly address the person whom they are talking to. Example: "So I learned just before *you* learned, I guess.", said the 2017 physics laureate Barry C. Barish. (2) The second-person pronouns were used for self-reference or addressing a general person, often when the speaker wanted to illustrate a situation or an analogy. Example: "It's something that *you* don't think will ever happen," said the 2020 medicine laureate Harvey J. Alter. (3) "You" can be used in courtesy sentences or as discourse markers (i.e. you know) (Rangraz, 2014). You-words are unavoidable when someone says "thank you" in their conversations.

Table 10-13. Distribution of usage of second person pronoun among laureates
Type 1 You as direct address to another person 1
Type 2 You as a general person and self-reference
Type 3 You as courtesy and filler words

Table 10. distribution of usage of second person pronoun among economics laureates

Economics Laureates	Frequency	
Type 1	28	15.70%
Type 2	78	43.80%
Type 3	72	40.40%
Total	178	

Table 11. distribution of usage of second person pronoun among physics laureates

Physics Laureates	Frequency	
Type 1	33	18.10%
Type 2	68	37.40%
Type 3	81	44.50%
Total	182	

Table 12. distribution of usage of second person pronoun among physiology and medicine laureates

Medicine Laureates	Frequency	
type1:	57	17.40%
type2:	95	29.00%
type3:	176	53.70%
Total	328	

Table 13. distribution of usage of second person pronoun among chemistry laureates

Chemistry Laureates	Frequencies	
Type 1	13	14.40%
Type 2	34	37.80%
Type 3	43	47.80%
Total	90	

We analysed the context in which each you-word was used and counted the frequencies of these three usages used by the laureates of each category. We observed that science laureates tend to use you-words for purpose 3 (as courtesy and discourse markers) more frequently, while economics laureates used them for purpose 2 (as reference to self or generalised person) more often (Table 10-13). We interpret this as an indication that scientists tend to be relatively more involved in their communicative style (Giusta, Jaworska, & Greetham, 2020). But this also implies that scientists exercise a higher level of caution, alertness, and precision in their conversations, as the use of "filler words" can buy the interviewees more time to think about how to answer questions (Ruth Umoh News, 2018), or to hold the floor so as to avoid people interrupting them (Shapira, 2019). For example, the laureate of the 2009 medicine or physiology prize, Elizabeth Blackburn, used "you know" 46 times in her around 14 minutes long interview. It is possible that, by using discourse markers/filler phrases, the interviewee was expressing their eagerness to answer questions, but was not being able to find the right word.

On the contrary, unlike laureates of natural sciences, laureates in economic sciences have a lower frequency of using the you-words. Economists tend to use you-words to address a general person, or as a self-reference. This device aids the telling of a story or the explanation of a concept. For example, the 2010 laureate Dale T. Mortensen, who was awarded the prize "for their analysis of markets with search frictions", said, "so *you* would expect people to spend some time unemployed before they find a job", described a situational story, using the you-word as a start. Similarly, Elinor Ostrom, the 2009 laureate, said, "But, what we've found is that people will, but it can be … people can escalate into, 'I'll punish *you*, *you* punish him, mamamamamma,' and it gets worse and worse."

Conclusion

In conclusion, the rapid expansion of archival materials on lectures, speeches, interviews and social media postings provide a large amount of publicly accessible data for the analysis of communication styles used by individuals from different academic disciplines. In our analysis of the interviews given by the Nobel laureates of economic sciences and natural science, we observed a different rate of usage in power-related words, work words and second-person pronouns. These results confirm the connection between academic disciplines and communication style. Our data are consistent with previous findings on the frequent use of second-person pronouns by scientists and the higher use of work-related words by economists (Marina, 2021).

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