# Abstract

# Outline

The thesis will begin with a review of the theoretical and empirical background to the project. It will discuss recent empirical research into word embeddings, focussing on two key studies published by Garg et al. (2018) and Kozlowski et al. (2019). A synthesis of the two approaches will be proposed, taking root in Bourdieu’s theory of the homology of the social space and its perception by ‘class sense’. With this described, it will describe a few sociological theories about the space of lifestyles and the structure of occupations that the project will seek to test with word embeddings: the homology of the space of lifestyles and occupations, the theories of embourgeoisement and omnivorism in cultural consumption, and the rise of the middle class professional occupations.

The methodology of the project will be treated next. Firstly, the Google Ngrams corpus used in the project will be described and discussed. The Word2Vec algorithm used will then be explained, with particular emphasis given to the exposition of the concept of “cultural dimensions”. Following this, the practical details of the implementation will be discussed. This includes the implementation fo the algorithm, the analyses with survey data and the analyses performed on the word embeddings vector space.

The results will then be outlined and discussed in detail. First, the results of the general evaluative techniques will be considered. Then the stability and validity of the cultural dimensions will be discussed. Once these evaluations have been discussed and summarised, the domains of focus will be discussed sequentially. Lifestyles will be treated first, firstly by correlating word embeddings projections with the Great British Class Survey and the General Social Survey. Then, the “space of lifestyles” will be visualised and described. A historical analysis of the shift in class connotations of the space will then be performed. Occupations will then be turned to, first by comparing the embeddings’ projections of occupations to data from the US census, both in detail with the 1990 census, and then through the decades from 1940 and onwards. Then, the “space of occupations” will visualised, with particular attention given to their correspondence to classification schema, as well as to the professions. The professions will be considered, both from their visual representation, and their historical trajectory. Finally, an extensive analysis of the shift in the image of the manager will be conducted.

A more general discussion of the results will ensue. Attention will be given to the biases inherent in the Google Ngrams corpus, as well as the “black box” nature of the algorithm, and the particular assumptions of language and cultural structure. The concept of “perceived homology” will be returned to, and proposed as an important organising principle of the use of word embeddings for sociological research.

# Introduction

## Class intro

"All societies are unequal; ... but they describe their own inequalities variously." (why did class)

Class is a word that feels old in the mouth now. It speaks of times gone by, of the war of worlds of capitalism and socialism, of men in flat caps and grubby attire attending to great machines, and suited gentlemen burring to each other on country estates. In contemporary Britain most people resists identifying with a class /cite{savage2015social} and British politicians (Margaret Thatcher, Tony Blair) have sought to distance themselves from the concept as irrelevant to our times /cite{cannadine2000class}. The US, a society whose dream of meritocracy almost a priori dispenses with such notions, seems even more distant from class.

The same for sociology, which has moved either towards fine grained statistical measurement of "stratification", or towards the analysis of individuals as identities lying on an intersection of culture, subculture, race, gender and otherwise. As Andrew Milner suggests, for many it has lost its "empirical significance to our culture" (milner, class).

But this perceived antiquatedness is at odds with recent memory, “in its post war heyday, class was the grandest and most masterly narrative available”. Whole nations were built on the eradication of the differences between people it entailed. Many political movements were based on the cultural identity it afforded. Many cultures and communities were formed under its brow.

Even more pertinently, differentiation of people from one another is an extremely prevalent feature of human life. It might be distinction on one’s family name, one's occupation, one's fame, accumulated wealth, it might be on the tastefulness of one’s attire, the accent of one’s speech or the colour of one’s skin. This differentiation does not need to be expressed in the language of class, it seems a more intuitive aspect of perception and lingual expression, closer to intuitions of “up” and “down” than to appraisals of the economic structure of society. A better word to use might be stratification, rather than social class.

Common representations of social stratification seem essential to understand culture historically. But beyond inferring from analysis of demographic composition of countries, it is very hard to investigate. The majority of work has been using meticulous historical research or close reading of cultural texts. But these are necessarily restricted in the texts they can consider and thus the breadth of their comparative gaze. As Moretti puts it, the spectre on the shoulder of cultural studies is that of "the great unread" (Moretti quote). The sheer amount that is produced in any slice of time or place overwhelms the finitude of the human capacity. And because of that, much goes unread, and much goes debated. The question is how this can be treated.

This thesis takes root in this problem area, attempting to expand the purview of experimental technologies to the domain of historical sociology of stratification. It builds upon previous research into class, bias and stereotypes using word embeddings, and seeks to engage with new areas of inquiry, as well as refine and synthesise techniques of analysis. Theories in the sociology of lifestyles and the sociology of occupations will be explored and tested. This will be supplemented with a theoretical engagement with the work of Bourdieu, who, I suggest, provides a comprehensive theoretical foundation to this methodology.

# Background

## Quantitative cultural analysis

Quantitative methods promise means by which the unreadable masses of historical text can be read - a form of "distant reading" as Moretti put it. Unlike the limited velocity of human reading, modern computers can zip through over a lifetime's reading in moments and return with an insight. The insight is only as insightful as the question that it answers, and formulating the right question is problem. It must accord to the rulebound logic of computational language, be written such that it not exceed computational limits, and, more importantly, provide an answer which may have meaningful interpretations despite these formal limitations. The promise is what Lee and Martin term "cultural cartography" - maps of the cultural terrain, simplified versions that "precisely because of their impoverishment... are useful" (Lee & martin 2014 p.12 from cult cart)

There are two elements of theoretical value that have made such distant reading more attractive to the humanities in recent years: Big data and modern natural language processing algorithms.

With respect to big data, corpora like Google Ngrams allow for quantitative analysis of cultural change, or "Culturomics", as the original authors dubbed it. The original authors used simple word counts over time (as a ratio to total corpus word count) to consider the coverage of dictionaries, the regularisation of irregular verbs, the duration of cultural memory, the trajectory of fame in various fields, the dates of influenza, changing paradigms in the academy and the fall of interest in God (quant analysis of essay). Beyond the original research, it has been used to track the shift from rural to urban settings in culture (changing psych), the concomitant rise of individualist values and fall of collectivist values (changing psych), the cognitive and behavioural psychology revolutions on the use of language (history of behaviour and mind), the rise and fall of psychoanalytic figures and their associated terminology (therapeutic hypnosis paper), the decreasing valence of language as a whole (birth of cool), as well as happy and unhappy periods of a culture (expression of emotions in 20thc lit).

The tools for aforementioned are relatively blunt, however, and can only track the prominence of a word or the concept it represents in consciousness - but little at all about the actual meanings of words. Here is where word embeddings provide a powerful new way to model language that approaches their semantics.

## Word embeddings

Word embeddings are continuous, dense high-dimensional vector spaces that can approximate the semantic relations between words. Initially used for solving NLP problems of analogies and word pair similarity, they quickly became appropriated for use in research in bias. They were found to accurately capture racial, ethnic and gender biases that were present in the texts they were trained on(Brunet et al., 2018; Caliskan et al., 2017; Lewis & Lupyan, 2020)¤copied - shift order and add. With that, they promise the possibility of automatically recognising hate speech, and potential avenues to correction ¤CIT (DEBIASING WORD EMBEDDINGS PAPER). But these same biases can be used to infer the culture that words are produced in. That is, culturally "boxing" may be stereotyped as a male sport and horseriding a female sport, but it may also be considered that culturally we associate them as such. They provide, as such a means by which to examine culture as an inherently biased, heuristic or schematic endeavour, all words being suffused with such associations.

This is a direction subsequent research has taken and applied in various domains of cultural research. Garg et. Al (2018) used Google Ngrams word embeddings to capture gender and ethnic biases of occupations through the twentieth century. Kozlowski et al. (2019) used Google Ngrams word embeddings to capture class biases in language and analysed how different dimensions of class related to one another through the twentieth century. More recently, Arseniev-Koehler and Foster (2020) trained word embeddings on a corpus of over one hundred thousand New York Times articles and were able to find significant biases regarding obesity and key cultural concepts such as socioeconomic status, gender, morality and health. Laura Nelson used word embeddings trained on abolitionist texts of the 19th century to map biases of an intersectional nature - towards black and white men and women – verifying these all in a close reading of the texts in question. I will focus on the studies by Garg et al. and Kozlowski et al., and describe how I propose to synthesize these approaches to investigate class in language from a new angle.

Garg et. Al’s approach used word embeddings trained on Google Ngrams by Hamilton et al. (2016) to map out gender and ethnic biases towards occupations in the US labour force. Training a regression algorithm on these projections, they were able to predict the actual gender and ethnic compositions of occupations to a high degree throughout the 20th century. They found that they could reproduce the discrete shifts towards the more balanced composition of the labour force after successive waves of feminism (as measured by a decrease in correlation between word embeddings occupation biases for the corresponding decades). They were also able to depict the prevailing stereotypes of each gender and ethnicity by listing the adjectives (within various domains such as professional competency, appearance, etc) most associated with an aggregate of the 5,000 most common names associated with the gender or ethnicity. The top 3 words associated with Asian Americans in 1910, for example, were “irresponsible”, “envious” and “barbaric”, but by 1990 this had shifted to “inhibited”, “passive”, “dissolute”. This demonstrated that word embeddings could be used to capture objective social relations as well as prevailing stereotypes, by virtue of the biases they incorporate.

The brilliant Geometry of Culture study (Kozlowski, 2019) extends this analysis to the study of class. This study uses word embeddings to consider change in the cultural perception of class in the 20th century. It considers 5 different dimensions of class according to leading theories in the domain - affluence, cultivation, ownership of capital vs. employment, education and status (as well as race, gender and morality) - and analyses the relationship between them over time. It does this mainly by analysing the similarity between dimensions (by virtue of cosine similarity), finding a relative stability between them throughout the 20th century, with the exception of education which becomes more closely related to affluence (following the great expansion of the education sector as a means for social mobility and distinction). Likewise, it established relative levels of drift of words with respect to each class dimension over time - words becoming, in general, drifting from their meanings over time. It validated these dimensions of culture by producing significant correlations between the cultural dimensions they created in their word embeddings space and i) an Amazon Mechanical Turk survey they fielded, which studied respondent ratings of a set of words on various scales of class, as well as ii) a large semantic differential study performed by Jenkins et al. in 1959 (An atlas of semantic profiles) where respondents rated words on 20 different scales (which the researchers took to be core dimensions of semantics within language).

GARG ALSO DID SUBEJCTIVE & OBJECTIVE

These studies complement each other intimately, but it is in their respective lacks that I think an important synthesis lies. Garg concentrated on validating biases in word embeddings by showing their mirroring of objective structures in society. But it is doubtful whether this means that word embeddings capture “biases” – it could just as well by a consequence of language discussing the world outside. Biases here may just be frequent co-occurrence of words that follow frequent co-occurrence of objects – female bias towards domestic worker occupations may just be due to a higher frequency of female domestic workers to talk about. Kozlowski, on the other hand, validated biases by showing how word embeddings word projections mirror human ratings of words – and thus validates them from an (inter)subjective perspective (in contrast to Garg’s objective approach). Though these are closer to validating that they capture biases, they i) face the problem that the human ratings may not be biases but considerations of their associations from an objective reality (cf. the previous example of domestic workers) – i.e. their distance from objective reality is not measured - and ii) they do not go in deep enough detail of detail of what the notion of class is that they are actually capturing with the word embeddings approach. Regarding the first point, I believe it is in the *discrepancy* between objective and subjective approaches of validation, that a meaningful concept of bias should be measured. I will return to this in the methodology section. Regarding the second point, I believe that what word embeddings can most meaningfully capture is the *perceived homology between the space of lifestyles and the structure of the economy.* That is, our intuitive sense of the “classedness” of things, their relative position in society – how we intuit the kind of things that rich people do, poor people drink, bourgeois people talk about, middle class people dress in. The language of “class”, antiquated as it feels, does not matter – it is about the sense of position of things. To unpack this, I will turn to Bourdieu, who provides the deepest theoretical explanation of it – considering his notion of “homology” first, followed by his notion of “class sense”.

## Bourdieu

### Structural homology of the social space

A central thesis of Bourdieu’s magnum opus, Distinction, is the structural homology of the social space. The intuition is simple: the space of culture is closely related to the structure of the economy. Taste in art, music or food, participation in sport, manners of speaking, gestures of the body – all of these align with an individual’s position in the economy. The direction of determination is not one-way, but the alignment is a one-to-one correspondence, or, “homology”. Individuals tend to engage with cultural practices that are appropriate to their position.

This homology means that both lifestyles and the economic division of the labour force can be modelled on the ordering metaphor of “space”. In Distinction, he seeks to map out “the space of lifestyles" (871) of France in the 1960's and how its accordance with the structure of labour. He does so by conducted a survey inquiring into various aspects of cultural engagement - taste in art and music, participation in sports, food, clothing and manners – and demographic background information on a large cross section of France (n = ?). Applying a novel technique in geometrical data analysis, multiple correspondence analysis he was able to visualize each of these domains of culture, as well as clusters of occupations, on a 3-dimensional space – as can be seen in figures 1,2,3.

The space was mapped out according to 3 parameters: "volume of capital”, "composition of capital", and to a lesser degree “trajectory of capital”. The volume of capital is as simple as it sounds - it is the amount of capital an individual has to their name, which aligns with our intuitions of the rich and poor but diverges with the Marxist conception of owner of and worker for capital. He later describes it as volume of accumulated labour, which can be exchanged or used to appropriate other people’s labour – in short, "pre-emptive rights over the future" (savage et al. 2013). The composition of capital is his original contribution here – it is a measure of the ratio between economic and cultural capital of an individual's capital. Cultural capital is a multifarious concept but at its core is a learned set of dispositions that manifest in one’s “taste”, as well as the capacity to create products in accordance with it. It is later defined in terms of three subcategories: "institutional" cultural capital (validation from institutions like the university), "objectified" (material cultural objects like works of art) and "embodied" (habits and capacities of the mind) capital – though the latter is the most integral to his thinking(243 forms). He also considers a third form of capital later on, social, (248 forms get some quotes!!)which refers to the power one has through one's network - the people one knows, the amount of them and their collective capacity. This latter one is downplayed as more relevant to the analysis of communistic society, but is still relevant. Each of these forms of capital can be exchanged for one another, and thus are theoretically integrated in the social space.

Classes can be distinguished in this space by volume of capital, but there can be radically different compositions of capital within a class - the classic example being "the curate with high status but low income and the bookmaker with low status but high income" (Runciman, 1972, p. 45). (69). Measuring simply on volume of wealth, or degree of ownership of the means of production, would obscure from our intuition that these two examples are much closer to one another than, say, a garbage collector. But it is important to note that Bourdieu refrains from theorizing classes, his stated goal being "not to propound a theory of social classes but rather . . . to uncover principles of differentiation capable of accounting . . . for the largest possible number of observed differences" (Bourdieu, 1990b, p. 117).(138). Rather than the “big classes” that we are familiar it is – it is better to consider it on this metaphor of space, within which certain clusters form, these clusters making possible the formation of distinct class consciousnesses .

With respect to the space of lifestyles, it is important to note how cultural artefacts differ along the "composition of capital" axis: they run from the refined and rare to the vulgar and common, or, the legitimate and the illegitimate. The legitimate taste is where cultural capital concentrates. Here, taste values form over function, style over substance, manner over matter. In food, the rich have a highly ritualised procedure of dinner that emphasises aesthetic appeal, while the poor emphasis ideas of "honesty", "plenty" and "freedom". In clothing, the fashion and formality of dress contrasts with the functional clothing of the poor, where "value for money" and "durability" are the orders of the day. Cultivation has, of course, much in common with affluence; as he remarks, as one moves up the economic spectrum, lifestyles start becoming "the stylization of life". That is, one may make a free choice in what culture one pursues, while the poor are restricted by the necessities of life - "the choice of necessity" (73, atkinson). Tastes follows these contours much of the time, but also differs in important ways. Social classes like the nouveau riche have more in common culturally with the poor - their lifestyle remaining "very close to that of the working classes as regards economic and cultural consumption". The petit bourgeoisie, on the other hand, adopt the legitimate tastes of the bourgeoisie but are accompanied by awkwardness and embarrassment, in comparison to the bourgeoisie's "ease" (SEE THAT STUDY ON A BOARDING SCHOOL AND GCBS¤) of consumption and reflection - knowing that they constitute part of the subjectivity which determines legitimate taste, a native and not a foreigner to its land.

### Class sense

Beyond these notions of the objective dynamics of class relations in economy and culture, Bourdieu also considers the subjective element of it. We have an innate "class sense" (atkinson, 74) that senses these objective relations. Our class sense is the ability to naturally pinpoint in a snapshot where others stand in relationship to us, as well as we to them - "a sense of one's place" (466, distinction); who is top, who is bottom. As Atikinson put it, it is “a relational sense of difference and similarity, of antipathy and sympathy, of ‘one’s place’ and the place of others, and ultimately of distance and proximity in social space, based on the ‘reading’ of the signifiers of symbolic space borne and performed by bodies”. It is something that co-constructs the meaning of cultural objects, from the more obvious things like doing sport, enjoying art and music and having a job, to the "apparently most insignificant techniques of the body — ways of walking or blowing one’s nose, ways of eating or talking" (class/classif). No object is simply itself, it is inherently also a social object, and that aspect is constructed, or sensed, by this capacity within us.

Class sense is an aspect of Bourdieu’s more well known notion of “habitus”. The habitus is most frequently described as the "enduring set of dispositions" that make up our perceptions and actions. It is a cultural structure that shapes many of our beliefs, values and thoughts. Habitus has a dual function: "the capacity to produce classifiable practices and works, and the capacity to differentiate and appreciate these practices and products (taste)" - the dynamic relationship of these being how "the represented social world, i.e. the space of lifestyles, is constituted." (871). It determines both the outcome of our creative practices (understood broadly – down to the level of daily life), as well as how we appreciate the creative practices of others (our taste). This latter component is composed of a mass of "schemes", schemata that classify everything that come its way. These schemata both determine what kinds of things we like, but also allow us to understand where things are in relation to other things. As Bourdieu puts it, they are "a practical mastery of distributions which makes it possible to sense or intuit what is likely (or unlikely) to befall — and therefore to befit — an individual occupying a given position in social space." They classify objects in social space and therewith the individuals that are related to them. This is what the notion of “class sense” refers to, an ability to intuit objects position in the social space mapped out by Bourdieu in his study.

These "schemes of the habitus... function below the level of consciousness and language, beyond the reach of introspective scrutiny or control by the will." (Bourdieu, Marxists.org extract) This class sense thus doesn't have to be voiced in the conceptual language of class, or even voiced at all. Though the language of class was important in Western countries in the 20th century, class sense is just as intimately expressed in terms like rich, poor, good, bad, tasteful, tacky - or more poignantly in slang like "posh", "toff", "chav" or "waster". This class sense is not universally common, each individual only having imperfect access to the whole, nor does it necessarily pertain to the “big classes” of the lower, middle and upper – though these are often good approximations. It is perhaps best elucidated by comedy or humour more generally, which takes upon these underlying schematic understandings and brings them into the light. Making fun of people who are in some way reprehensible or lower, making caricatures which play upon prevalent stereotypes, pejorative names for people - these are all means by which people are made aware of what is socially lower, and require like schemata in the audience to be able to resonate. Lower, of course, is in this case not just determined by capital – but across many dimensions – race, gender, morality, personality – anything that could constitute a “type of guy”.

### Class sense & word embeddings

This notion of class sense is very useful when considering how stratification manifests in language. It implies that there is an inherent sense of where each object fits into the cultural landscape, which both patterns our interpretation of other people and the cultural objects they engage with, as well as our choices of objects that we engage with. This gets reflected in what language we choose to use and how we talk about the world.

This aligns importantly with word embeddings, since word embeddings seek to reproduce implicit biases we have by virtue of the language we use. The promise of word embeddings is the tapping into conscious or unconscious associations we have of cultural phenomena, by means of the algorithmic modelling of the word contexts of their corresponding words. There are certain words and certain kinds of words that fall naturally into the mind when thinking of particular cultural objects. If we are prompted "Trump" we might think president, old, businessman, money, tanning salon, American south and if we are prompted "glasses", we might think of cups, monocles, intelligence or eyes. These associations are things that come unprompted and resemble commonly available stereotypes, though are never quite fully aligned, dependent as they are to our cultural exposure. Pick up on which words commonly appear together, generalise in the frame of a language model, and a schematic understanding of the cultural multivalence of words and their signified phenomena can be built. If this were to be the utterances of one individual, this would hypothetically approximate their "societal sense" (class sense here being a subsection or angle of this sense), but in the case of large corpora, it may be hypothetically approximate a "general social sense" - the aggregated multiplicity of meanings across a society. As Koslowski [sic]¤ put it - the "shared understandings". We can imagine here to be the realm of stereotypes - hence why word embeddings found their first application in the field of bias research.

### Word embeddings complementariness to the notion of space

Likewise, the ordering metaphor of “space” aligns deeply with the capabilities of word embeddings. The concept of space as used by Bourdieu is continuous (as opposed to discrete or qualitative), linear and multidimensional. This aligns exactly with the dimension projecting method of word embeddings. As shown by Kozlowski et al. (2019), can be used to project words onto various dimensions of culture. These can be visualized to show the relationality of the cultural objects they refer to, and thus, the “lifestyle of space” that Bourdieu maps in distinction.

## Domains of analysis justification

Bourdieu is thus relevant to word embeddings research on stratification because of his conception of the objective mapping of the social landscape, as well as its subjective reproduction in the habitus of the individual. Word embeddings can, theoretically, reproduce the latter. But what might we expect of these word embeddings?

I will now investigate two domains of the social space: Occupations and lifestyles. The justification of the choice of lifestyles was outlined in the previous section - because of their being intimate expressions of class in culture and the centrality they play in research following Bourdieu. Furthermore, as Savage et al. note (class in 21st century 34), it seems to be that class markers in the domain of lifestyles are proliferating more in recent decades – over traditional markers like wealth and occupation. I will now consider why occupations are an interesting object of analysis.

**Occupations**

Occupations are interesting as a point of study for a few reasons: i) Their correspondence to particular positions in the distributions of wealth, status and culture, ii) the mechanisms that create internal homogeneity and external heterogeneity for occupations and iii) their suitability to word embeddings analysis.

**You are your job**

Regarding the first, one's occupation is very indicative of one's social standing. As John Goldthorpe has interpreted it (in Weberian terms), it is the most important determiner of ones life chances. If one has a high status job, one will most likely have better access to the things that commonly constitute "the good life". In Marxist terms, it defines one's relationship to the means of production - occupation often approximates one's position with respect to capital - employee or employer, and degree of capital available by virtue of income. It is hence "social classification in British sociology is almost synonymous with occupational classification" (53).

**Why you are your job**

Likewise, there are mechanisms that result in relative homogeneity within occupations. Grusky describes mechanisms that operate on the "supply side" and the "demand side" of occupations. On the supply side, occupations tend to imply certain dispositions, demographic and lifestyle reputations "that serve as self-fulfilling prophecies by selecting workers who find those reputations appropriate, attractive, or at least acceptable in light of their own traits and lifestyle". On the demand side, employers tend to filter out potential employees according to a similar criteria of traits - both when considering a potential employee's application or interview, but also because of recruitment based on referrals from current employees (likely to be similar).

While actually working a job, further mechanisms that guarantee internal homogeneity: training, interactional closure, interest formation, and learning generalization. I quote in full: "Training is the extended period of occupational-relevant education that solidifies attitudes and instills certain principles, interactional closure is the social exposure to an individual of a collection of like-minded people by virtue of physical proximity at their workplace, interest formation is the relative homogeneity of attitudes that arises from being subject to a relative homogeneity of working conditions, learning generalization is the application of principles and practices learnt on the job to situations outside of it" ¤(a new class map). Jobs determine to a high degree one's prior education, social network, interests, and way of thinking.

As to their suitability to word embeddings analysis, occupations have a few advantages. Occupations are relatively constant in their reference. The word "baker" refers to approximately the same role now as it did 100 years ago, the same for "shopkeeper", "scientist", or "dancer". Many occupations have died out in recent decades and many new occupations have come to replace them, but many of them are composites (CEO, CFO, CMO, customer success manager, life coach, etc) that are not within the range of this project.

**Occupational classifications and occupational prestige**

Furthermore, the field of occupational stratification has a wealth of theoretical research to engage with. For one, there are well established schema of occupational classification, the modern versions inspired mainly by John Goldthorpe and the Nuffield Social Mobility Research Program, that allow for analysis with word embeddings. Beyond that, there is also the tradition of research into occupational prestige. Early approaches simply got a sample of the population to rank professions in terms of their prestige - though with numerous iterations of this principle. The results of this research, however, was an extremely coherent picture of the relative status of occupations that was reproduced with very high correlation across the world (with an average correlation between pairs of countries of .81) as well as across population subgroups (e.g. class or ethnic groups) (Treiman, 234). These results would maintain in spite of difference in measurement procedures (e.g. asking of prestige, social status, or other synonyms) (Treiman, 233). Though criticized for the variation amongst individuals, the research showed an astonishing universality of the social landscape across individuals - in spite of difference in economic structure of society and position within it. This aligns with expectations from the Bourdieusian notion of class sense.

## Expectations

Firstly, it will be expected that the subjective representation of each of these domains will reproduce the objective distribution of them. Specific to occupations, those that require a high level of cultural capital will have a high connotation of education and cultivation, while those with a high level of economic capital will be associated with wealth, and the same for the lack of each. Specific to culture, there will be a spread of the cultural domain like the former, with the most important dimension of distinction being legitimate versus illegitimate culture. Secondly, it will be expected that subjective representations of each of these domains will shift in similar ways to known shifts in the objective distribution of them. Specific to lifestyle I will consider the "embourgeoisement" and closely related “omnivorism” hypotheses - that the rising disposable income of the working classes mean many adopt middle class lifestyle practices, while the upper and middle classes tend now to "graze widely" on objects of the traditionally legitimate as well as illegitimate or emerging cultural objects – where they used to restrict themselves to the legitimate. Specific to occupations, I will consider the expansion of the middle classes in the 20th century in the professional occupations, with specific emphasis on the managerial class.

### Lifestyles

EMBOURGEOISMENT

The notion of cultural capital as a differentiator of classes seems to be undergoing a transformation. With the postmodern turn and the explosion of consumer cultures, the polarity of high brow and low brow, the cultivated and uncultivated, is becoming less defined. Numerous surveys ¤cit have reported an inability to distinguish economic classes by virtue of their taste in culture. The upper and middle classes seem to be engaging with popular and trashy music, while the traditionally cultivated music is restricting itself to a small subpopulation that is not described by class, but perhaps best by age. This is evidenced further by the lack of consonance between the high, medium or low brow tastes, indicating that no one is engaging consistently with one "brow" of culture (bennett habitus clive).

Numerous theories have attempted to explain this movement. The theory of embourgeoisement is the notion that increasing affluence and living conditions, as well as the large expansion of mass produced consumer goods, has resulted in the political and economic assimilation of the working class into the middle class. The working class, by this perspective, are increasingly adopting middle class lifestyles and tastes. With that, lifestyles of the middle class and the working class have converged, to the extent that they are not meaningfully differentiable any more.

"Omnivorism", however, describes a complementary but opposite trajectory: that the tendency of middle- and upper-classes in contemporary society is to “graze widely” across the cultural spectrum of high- and low-brow, in distinction with the working class who remained with popular cultures. There is thus a mixing and consequential of the previously “legitimate” taste of these classes. British research has likewise shown in multiple significant studies (GBCS and CRESC) that class does not seem to reproduce itself in culture along the legitimate to illegitimate dimension, any more. Instead, it seems to stratify along the dimension of degree of \*engagement\* with culture and the dimension stretching highbrow to emerging culture (emerging displacing low-brow). Others in Norway still maintain the Bourdieusian notion of legitimate-illegitimate culture, and reproduce his results of a culture differentiated across the high- and low-brow.

Though these are distinct theories, their consequences are similar: a less distinctly stratified landscape of culture. It is this the that later analyses will attempt to test. Occupations will now be considered, where similar effects of the expansion of the middle classes will be considered.

### Occupations

"It is one of the cliches of history that the middle classes are always rising" (1, sociology of professions, eliot). That said, if there is a time in history that that cliche captured the truth, it would be the 20th century. The middle classes expanded in the 20th century by ¤DATA. By economic measures, many entered the middle class economically by the increased wages that blue collared factory work provided (social transformation). But many also entered it by virtue of education or training into specialised professions. With that came a concomitant expansion of luxuries - housing, education, domestic technology, and all the lifestyle activities that disposable incomes could enable.

The definition of middle class is by no means clear. Some define it by economic stratification (Piketty, ¤), others define it on economic relations of exploitation (Marx, Wright), some define it by occupational measures (Goldthorpe & co), others define it sociopolitically ("If the presence of police makes you feel safe rather than threatened, you are middle class" - Graeber, anthro and rise of PMC). To confuse the image further, popular understandings vary greatly, with rates of subjective identification differing from rates derived from any of the previous forms of evaluation - in contemporary America ¤% identify with the middle class, where only ¤% are by ¤ measures.

I will consider the transformation from two discrete angles: the expansion and consolidation of the professions, and the creation of the modern concept of the manager. (Two complementary sides of the "professional managerial class" concept)

### Professions

Of all occupational categories, it was the professions that bloomed in the 20th century. They bloomed in two manners: The increase in sheer amount in the labour force, and the consolidation of their status as professions.

The definitions vary on what constitutes a profession, Millerson cataloguing 21 different definitions by leading voices in the field (5 elliot), but there is a pool of overlapping characteristics: “a specialised skill and service, an intellectual and practical training, a high degree of professional autonomy and responsibility, a fiduciary relationship with the client, a sense of collective responsibility for the profession as a whole, an embargo on some methods of attracting business and an occupational organisation testing competence, regulating standards and maintaining discipline.” (5, eliot). But the definitions of the professions struggles to contain the sheer diversity of its field of reference. Since specialisation is an integral element in the landscape of modern professions, their spread is extremely diverse by definition.

By the measure of census data, they rose from constituting 4% of the labour force in 1910 to 23% in 2000 and becoming the dominant category of occupations. This is a characteristic of the increased specialisation of the modern division of labour - the requirement of specific expert knowledge at different points on the chain of production ¤modern not all labour division. This has been the so-called "knowledge economy" with its "knowledge workers", as well as the "service economy" - the former in distinction to the majority manual labour of industrial capitalism, and the latter in distinction to the productive logic of industrial capitalism.

Such expertise has required the development of the sociopolitical facets of professions to work: The practical and academic training, the legitimation of competence by certification and testing, and organisational exclusion of those that do not accord to its guidelines - all eventually enforced by legal recognition. This is the next element of the development of professions - the consolidation of each as an institution and sociopolitical power. It is this "occupational professionalism" which has been consolidated in the 20th century, it first emerging in the 19th century to displace the "status professionalism" that preceded it. Originally, the domain of the professions was "an appendage to the high-status groups of society at the time", restricted to those who did not have to work to secure an income (15) and was characterised by amateur enthusiasm that was wide-ranging and inconsistent - "specialised expertise was negligible or unrelated to the problems with which the profession professed to deal". The paradigmatic example is the doctor and the medicinal complex

### The Manager and the New Spirit of Capitalism

Beyond the shift of the structure of a labour force to a more specialised knowledge economy, there has been a concurrent shift in business ideology and practices. This transformation has been expressed in terms of a transformation in the "spirit of capitalism" by Boltanski and Chiapello. Following Weber, they consider it a necessary condition for the existence of capitalism that there be an ideology - a system of ideas and ethics - that "provides moral reasons" for engaging with it, as well as promising forms of security and prospects in life ¤quote. They argue that this spirit is not a timeless universal, but instead something that develops in tandem with the society around it. The 20th century thus bore witness to three successive spirits of capitalism, each one growing out of the previous, with the first corresponding to that which Weber had hypothesised. The development arises out of the dynamic interaction between capitalism and its critiques, each critique first undermining capitalism but then becoming incorporated in a modified spirit of capitalism. Relevant to this project is the crucial figure of the business manager, or "cadre", at the centre of it, in which is imagined different "heroic ideals" which the spirit projects as desired end.

The spirit of capitalism is best found in the texts written by the newly born field of business management. In the wake of the influential writings of the leaders of the new "management science", Frederick Taylor, Elton Mayo and Kurt Lewin, business became an academic field respected in its own right and institutionalised in the colleges. Out of this spawned an academic field whose output in textbooks and journals accelerated in the 1950's. It is the texts of this discipline which Boltanski and Chiapello took as the object of their analysis, being "ideological" in character - homogeneous in style, covering only select themes and highly normative in character. They compare key texts in the 1960's and 1990's to discern how the spirit of capitalism has changed by analysing a) what problems the authors pose, b) what solutions are proffered and c) what aspects of the situation they reject ¤what this mean. They characterise these spirits as a combination of "cities", distinct ethical realms that are summoned to model good and bad behaviour, desired structures of organisations, and ideal characters.

Likewise, the respective degree of the labour force that were managers dramatically bloomed, such that ¤quote. Like the domain of the professions, the managers became institutionalised and legitimated as a profession and became incorporated as a link in the great chain of specialisation.

They define the successive spirits in concrete detail:

- The first spirit of capitalism had its heroic ideal in the adventurous, risk-taking and innovative entrepreneur that pries himself out of poverty; the conquistador, the captain of industry, etc. It meant new economic practices as detailed in the Protestant Ethic - like parsimony and avarice, along with meticulous bookkeeping, calculation, prediction. It was combined with familial values, which modelled the company, an austere relationship towards family.

- The second spirit of capitalism had a more modest heroic ideal in the manager as a caring director of a large business that operated as a quasi socialist state. Instead was the ideal of the gigantic, centralized and bureaucratic corporation with a structured division of labour, with a series of managers responsible for managing the implementation of the executive director. Security was provided with lifetime career and development, and provision for housing and leisure of employees.

- The third spirit of capitalism is rooted in the metaphor of the network - connexionist in principle, decentralised in structure and informal and social in its mode of interaction. This is the recognisable trope of the lean, flexible and innovative start up of Silicon Valley, with its charismatic genius leader that wears a regular t-shirt and speaks in a charming relatable manager.

I will seek to test part of this theory by investigating how the various synonyms of "manager" change in their connotation throughout the period of these 3 different spirits. I expect to see a rise in association with education (due to the increasing institutionalisation of business management) as well as association with wealth (due to the increased wealth that this profession is remunerated with). Furthermore, I expect to see an increasing association with the linguistic field of this new connexionist spirit of capitalism, as well as association with the traits of the heroic ideal that pertains to it.

### Differences between America and Britain

Britain and America have long held opposite ends of the spectrum of class in the popular imagination (Devine 8).

Britain is the old class-bound society of aristocratic nobility and industrial working class. Its mention often conjures images of gentlemanly manners and accents, curious niche sports and formality of wear - as well as the diversity of accents of the regional working class, rock, mods, punk, and all the other cultural that took root in the grit of urban Britain exported itself around the world. Its politics is suffused with the upper class (Eton and Oxford determining most of the composition of the political elite) and its news media resounds to the sound of the upper class received pronunciation. The British seem furthermore to be intuitively conscious of their position in society - 90% identifying with a particular class in 1984 (11, milner, class). George Orwell was forthwith with his consideration of himself as "upper middle class", and described in his work [] how he was brought up to believe like other members of his class that the working class were 'stupid, coarse, crude, violent’ – and that they smelt." (class in britain, 2). All this made him remark that Britain was "the most classbound society under the sun".

Historically, it has had a long history of class politics. It has been the site for a long tradition of strong trade unions and working class solidarity, the 20th century witnessing a great series of revolts and strikes that only properly attenuated in the 1980's. E.P. Thompson noted the peculiarity of Britain in its early formation of working class solidarities. The enclosing acts from the 17th century and onwards created a new class of independent farmers that identified together as "freeborn Englishmen" and took a special pride in their role as craftsmen, forming the template of later working class movements. But this strong working class tradition broke up in the 1980's with Margaret Thatcher's breaking of the trade unions and "neoliberalisation" of the economy - the deregulation of the economy and the replacement of societal structures with "the individual, the community and the market" [quote] (class in britain). This was continued by Tony Blair and New Labour, who hoped to extinguish all intellectual Marxism as "out of touch with reality". Along with the general worldwide shifts in social stratification, this greatly attenuated class politics and identification in Britain, such that Devine et al. (2013) found an "ambivalence to identification with class" in contemporary Britain.

'gentlemanly capitalism' 10 21st century

the popular model being bi- or tri-partite, or infinite differentiation in a great chain of social being (class in britain)

United States, on the other hand, is the land of the free. It has always held a certain classlessness in the core of its national identity. The American Dream is the dream of radical meritocracy - that one's birth or upbringing plays no role in determining or denying the dreams of the individual. Everyone can have a slice of the cake if they put in the work for it. This "American exceptionalism" (Tocqueville), this rare quality of being open and mobile, has been what has distinguished it from European nations since its inception. These aspects of national identity have made class politics have been much less prominent in the US in comparison, with a relatively weak working class (Divine 8)and a relative lack of trade unions (Divine 189). The welfare state never met the power of those devised in Europe, and by now has been whittled down to very little.

Despite these remarks, however, closer inspection reveals much of America that is deeply classed. As is by now well known, America is a deeply unequal society, whose inequalities have greatly expanded since the economic restructuring of the 1980's (QUOTE FOR THIS?). It has a large underbelly of poor which remain poor. America's history has also been significantly affected by class. The book White Trash vows to document "the history of America as a classed society". Its inception was inherently classed, being seen by England simultaneously as a place to deposit the unruly poor and use them for cheap labour (much like Australia) and a place for great monetary gain, provided one had the capital to invest in risky ventures. Ownership of land was seen thus as a way to distinguish the upper and lower class, even when the titles of British nobility disappeared. This is not to speak of the history of slavery in the South, which has assured a strata of people who were kept below the white strata, by relationships of slavery, followed by segregation and discrimination, and eventually a persisting structural racism. In contemporary America, African Americans make up over an eight of the population, while Hispanic Americans over a tenth, and Asian Americans over \_\_ - making for a much larger ethnic diversity than Britain (25%+ against 5.5%) (12).

LAMONT and the the boudnary drawing aof americans

The classedness of Britain and America is thus much more complex than first meets the eye. This is reinforced by comparative sociological literature. Fiona Divine compared the data on each country and realised a great similarity between the two nations - perhaps more so than there were differences. Structurally, the composition of classes as investigated by the leading class researchers - Erik Wright (taking a more economic perspective) and Goldthorpe (taking a more occupational perspective) is more-or-less the same - pointing to a very similar economic structure in division of labour and money. Likewise, the trajectory of the economy has had a similar shape - a slightly earlier industrial in revolution was counteracted by an earlier expansion and dominance of large firms in the US (11). Each country experienced significant economic restructuring in the 80's under Regan and Thatcher, with the top 20% becoming richer and the bottom 20% becoming poor (107). Each country experienced a decline of manufacturing and expansion of the service industry, though manufacturing remaining more prevalent in the UK (11). Each country expansion of the field of highly skilled and specialized professions. That said, there are a few points of difference: The expansion of the class of managers and professions happened a little later in the UK - after the second world war as opposed to in the late 19th century in the US. Likewise, Britian has a high rate of unemployment, since the US has less regulated labour and thus many more badly paying jobs. Similarly, inequality in wealth and income is much more acute in the US (221) with poverty is much more endemic to the US, evident in its quantity of homeless and criminal (12). Lastly, Britain seems moderately more class conscious than America, though comparable on its identification and awareness (76).

As a consequence, I expect a slightly more acute differentiation on each dimension of class in the UK - especially in the early decades of the 20th century, as well as the immediate decade post war. Likewise, I expect to see a more accute differentiation on the dimension of race in the US. Furthermore, it is expected that different items connote upper and lower class membership, specific to their respective cultural landscapes (e.g. the relative prevalence of baseball and basketball in the US, and football and cricket in the UK).

# Hypotheses

* Homology in the space of lifestyles: it is hypothesized that projections lifestyle words on to cultural dimensions will correlate with the actual average corresponding capital of those that engage with the objects these words refer to.
* Homology in the space of occupations: Likewise, it is hypothesized that projections of occupation words on to cultural dimensions will correlate with the actual average corresponding capital of those that have these occupations
* Embourgeoisement of lifestyles: It is hypothesized that class connotations of the space of lifestyles will shift substantially through the 20th century and especially in its latter decades, in accordance with the increasing disposable income for the working classes and consequent move to “omnivorism” of the middle classes
* The rise of the professions: The professions can be shown to be relatively distinct from other occupational classes by virtue of their projections, and these projections will increase in connotation of status, affluence and education over the course of the 20th century
* The changing image of the manager: The manager profession will increase in connotations of status, affluence and education, and will be shown to move closer to the reticular terminology of the “new spirit” of capitalism

# Methodology

# Methodology theory

## Data

**Google ngrams**

The Google Ngrams corpus is the largest and most comprehensive historical corpus created to date. It is the collective effort of 40 libraries and their digital corpora. It contains 5,195,769 books (~4% of all ever published) and spans 361 billion words, 1,022,000 of which are unique (in 2000, excluding non-words). The corpus stretches from 1500-2000, though as to be expected, the latter years have are much larger (8 billion per year, compared to the 1.4 billion per year of 1900) (quant anal of culture)¤. It comes in 8 different languages, with a dedicated English fiction corpus and with the ability to use the data in 1 to 5-gram formats.

The Ngrams corpus is not an transparent window into the past, however, and comes with various issues. As (characterising the google corpus) noted, the corpus is more a "library of books", and it is not representative of i) all that was published at the time and more prominently ii) that which was read by people at the time.

To the first point, there has not been any mention as to which books from the libraries were selected for digitisation, nor how representative these libraries were of the entirety of publication. Furthermore, there is generally a lag in book publication (compared to newspapers and magazines), suggesting that it is less reliable for trends analysed on the short term.

There are many books that were published in obscurity, and of those that became popular, did not necessarily do so upon publishing, often times a while later. It is problematic, thus, to draw the inference that what can be gleaned from Google Ngrams is a reliable proxy to the general consciousness of people at a time. A good example of this is Upton Sinclair's Lanny Budd, " a fictional character was vaulted to the upper echelons of words affecting divergence (even surpassing Hitler) by virtue of appearing as the protagonist in 11 novels between 1940 and 1953" (characterising).

Furthermore, there is a systematic bias towards scientific literature in the latter decades of the corpus, corresponding to the exponential expansion of published scientific literature. Hence (characterising the google corpus) suggest the English Fiction corpus as a way of mitigating these bias.

Lastly, there are a myriad of technical issues present in the corpus. The digitisation of the corpus is reliant upon automated Optical Character Recognition (OCR) to convert images into to text. Though the algorithms are achieving high levels of accuracies in recent years, there are still a good degree of problems - distinguishing between the long "s" or "f" in older texts being a common one.

**COHA**

Beyond Google Ngrams, there is the Corpus for Historical American English (COHA). This is a genre balanced corpus of 475 million words that stretches from the 1820's-2010's (https://benjamins.com/catalog/cilt.325.11dav). It is notably smaller than Google Ngrams but with the potential balance between genres (though as mentioned in the discussion of Google Ngrams, genre balance does not mean a neutral window into the reading patterns of the English speaking public at the time - it merely corrects for some biases, such as the disproportionate amount of scientific texts.

## Word embeddings

Word embeddings are a technology developed out of Singular Value Decomposition (SVD) that model language by building continuous, dense high-dimensional vector spaces. These are "distributed" representations of words as numbers, as opposed to "discrete" representations where unique words are ascribed a position in vectors, such as one-hot encoding (cultcat 5). Compared with discrete representations, distributed representations the promise of summarizing co-occurrences of words in corpora - allowing for a more subtle representation of words.

They are trained through the optimisation of a neural network with one or more hidden layers of weights that are adjusted in the course of optimisation. Optimisation occurs by iterative prediction of a moving "window" of j words and adjustment of weights as a consequence. There are two means of doing so: i) predicting j-1 context words by the target word (Skip gram) or ii) predicting one target word by j-1 context words (Continuous Bag of Words (CBOW)).

The result of training is a m x n matrix, m representing the amount of words in the corpus, n representing the amount of dimensions of the space. This vector space is particularly useful because of the evidenced parallel between linear algebra operations and semantic relationships.

The idea that drives these models is in essence: "you shall know a word by the company it keeps!" (firth 6 CC). More formally, the "habitual collocations" (Harris) of a word can be used to model the meaning of words. Firth provides an insightful example in examining the sentences "Don't be such an ass!’, ‘You silly ass!’, ‘What an ass he is!’". In these examples the meaning of "ass" is closely related to its collocates: "the word ass is in familiar and habitual company, commonly collocated with you silly-, he is a silly-, don’t be such an-." This has been termed "distributional semantics" (distributional semantics paper) and allows for comparison of meaning on the logic of "difference of meaning correlates with difference of distribution".

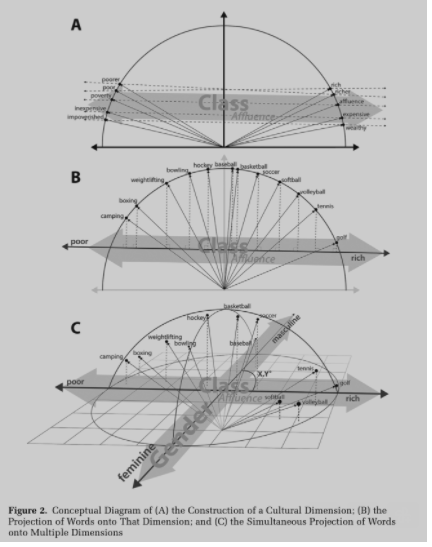
Cosine similarity or the Euclidian normal between two vectors can be used to compare meanings by virtue of their "similarity". The two capture functionally the same meaning, as evidenced by the high correlations (>0.95) between their outputs on word pairs (¤garg, but als o another). The similarity they depict at its ground level is similarity in likelihood of being predicted given the same context of a single target word (skip-gram) or surrounding words (Continuous bag of words, or, CBOW). At a higher level, it is the degree of shared context (GOC 910) - not to be confused with strict co-occurrence, since the heuristic optimisation of the neural network means that, theoretically, words that do not co-occur together can be near neighbours in the space as long as they share the same \*kind\* of context. At its highest, most desirable level, it is the syntactic or semantic difference. Words of a similar sphere, e.g. car, road, wheel, drive are relatively close to one another, as are words that play a similar grammatical function, e.g. yes, no, indeed, absolutely. That is, semantic relations between words can be modelled geometrically (distributional semantic sand linguistic theory).

Arithmetic can also be performed with embeddings vectors. Mikolov et al. (2013) showed that analogy problems can be solved using word embeddings arithmetic. "Man is to woman as king is to... " can be solved by the arithmetic "King - man + woman = ". Theoretically, subtracting the vector man from king subtracts all the male aspects of the concept king, while adding the vector woman adds femininity. This is easier understood visually, as can be seen in figure ¤. This works for semantic relations as well as syntactic relations, as seen in figure ¤.

## Cultural dimensions

This same arithmetic logic can be applied to the creation of conceptual "dimensions". Man and woman, like other antonyms, are very close in the vector space, and thus not so useful to analyse the masculinity and femininity of things. They contain lots of syntactic information, the shared semantic concept of gender, as well as various other "semantic noise". We can, however, analyse the difference between the two poles, just as in the analogy calculation: subtract man and add woman (- man + woman) is the same as adding + (women - man). The latter element (women - man) can be interpreted as the "semantic direction (CC), or the "cultural dimension", a more purified concept of “femininity” we can understand other words in relation to. This cultural dimension has been shown to correlate with human ratings of the same words on a corresponding scale, and that using more pairs of antonyms creates a more valid dimension (Kozlowski et al, 2019¤).

![[Pasted image 20220331103931.png]]



As is compare the words in an embeddings space to this cultural dimension, the matrix of word embeddings can be projected onto this conceptual dimension by multiplication with it (m x n) x (n x 1). This results in an (m x 1) vector which contains the projections of each of the words in the vocabulary on the dimension of femininity. These projections can thus be interpreted as the degree to which they are associated with femininity - words with a female undertone result in positive projections and words with a male undertone result in negative projections. The way to express this association is not clear - association, connotation, valence, sense, bias are all valid interpretations of it.

This creation of a cultural dimension and the projection words onto it is visualised in the diagram ¤. I will use the same pairs antonyms created by Kozlowski et al., due to their usage of historical thesauruses to create historically robust dimensions, and their validation with human ratings from a semantic differential research conducted by Jenkins et a. (1959).

/includegraphics{dimensions\_diagram.jpg}

## Relationship to Bourdieu

There is an intimate relationship between the projections possible with this method. Bourdieu considered stratification to occur due to three forms of capital: social, economic and cultural. Each of these can be approximated with creating a dimension in word embeddings. Likewise, Bourdieu's mapping of the space of lifestyles in Distinction are visually similar to the visualisation of projections of words in word embeddings. Bourdieu evaluates each occupation and aspect of lifestyle with the metrics of "volume of capital" and "composition of capital". These are related intimately to the measures of economic capital and cultural capital. If we take volume of capital as the simple addition of the capitals, and composition as the percentage of the capital which is economic (assuming the scales are the same, or some scale transformation is performed), then each capital could be found by either division or multiplication of the volume of capital by the composition of capital, i.e. a linear transformation of the Bourdieusian space.

Important to note, as was noted in the introduction: Word embeddings theoretically map the \*perceived\* space, not the objective space, though it is often that there is a great correspondence between the two. This is in contradistinction to Bourdieu, who attempted to measure the objective space of lifestyles and their correspondence to the structure of the economy.

# Practicalities

## Data Collection

The google 5-gram files were downloaded using the script ¤pull\_ngrams.ipynb. Download links for each ngrams collection were generated through list comprehension, and then iteratively downloaded using the library requests¤. The resultant collection sizes can be found in the appendix.

Each collection was composed of a series of alphabetically ordered gzip compressed files that contained tab-separated lines of the form: ngram TAB year TAB match\_count TAB volume\_count NEWLINE.

One file, “-th” in the ENG\\_GB collection, was corrupt from approximately two thirds away through despite repeated downloads. Everything prior to that point was included, and the rest discarded.

Inspiration was taken from the Geometry of Code Github ¤link for the first iterations of code for training the Word2Vec model. This involved a function to turn the compressed gzip files into a generator object for the input of the Word2Vec function, as well as the code to initialise the word2vec training. ¤later at training section?

## Partitioning

It became immediately clear, however, that there were significant computational limitations that necessitated different solutions. To ease the computational load, I wrote a script to partition the data by decade ¤Ngram\_partitioner\_by\_decade. This created 10 separate decade files, and then iterated through each collection and wrote each line to its corresponding decade file in the form: ngrab TAB match\_count, leaving out the irrelevant volume\_count and year. It skipped any lines which had punctuation in them (since punctuation were not involved in training, these would become less than 5-grams.

This reduced the time taken to train the data approximately 50 fold - the file size of each decade being over 10 times smaller - this advantage being multiplied fivefold due to word2vec involving 5 iterations through the data. The time taken to partition ENG\\_GB was, and for us\_12.¤size? & time

## Training

Embedings were trained for each decade of the 20th century (1900-1909, 1910-1919, etc) were trained using the Gensim Word2vec library with the parameters recommended by Radim Řehůřekwith an added minimum word count of 25 [link](https://radimrehurek.com/gensim/models/word2vec.html). Training took ¤ . The skip-gram model was used, due to the relative superiority found in comparative studies ¤cit. The resultant embeddings had a vocabulary size of ¤, each a vector of 300 dimensions.

![[Pasted image 20220331103721.png]]

Due to persistent errors in the training of the us\_12 embeddings, it was only possible to train embeddings on the ENG\\_GB data.

To supplement the lacking American embeddings, as well as to provide extra corpora to test hypotheses with, embeddings trained by Jurafsky et al. were also used for the ENG\\_ALL, eng\_fic and COHA collections. ¤paramaters descrip Pretrained Google News embeddings that are available in Gensim’s Word2Vec package were used as a benchmark to compare the other embeddings against.

## Dimensions

Creation

Choice (Bourdieu as main ones, rest of GoC, lamont + intersectional theorists as justifications)

## Validation

\*\*General\*\*

\*\*Function word stability\*\*

To evaluate the stability of the word embeddings through time, I compared the stability of function words through time. I first collected function words using the stopwords collection from NLTK, as well as sampled 5,000 words by using Numpy's random number generator to generate 5,000 indices, whose key was retrieved from the word embeddings space. For each group, the mean Euclidian distance (and confidence interval) of each word with every other word was calculated. This was done for each embedding, and the increase in distance of time for each group was compared.

\*\*Word pair similarity\*\*

To evaluate the validity of the semantic relations of words in the embeddings, I used Gensim's evaluate\_word\_pairs function. This correlates the distance between pairs of words in the word embeddings space with human judgments on their similarity.

\*\*Analogy tests\*\*

To evaluate the reliability of the semantic relations logic of the word embeddings space, I used Gensim's evaluate\_word\_analogies function. This computes the performance of word embeddings on a series of analogy tasks, e.g. man is to woman as king is to \_\_\_ .

\*\*Dimensions\*\*

\*\*Dimension stability\*\*

To assess the stability of the dimensions through time, I utilise the method of Kozlowski et al. (2019) of comparing the correlations of the projections the top 10,000 most frequent words in the English language across the word embeddings. That is, I first took the top 10,000 most frequent words (retrieved from https://www.kaggle.com/datasets/rtatman/english-word-frequency?resource=download) and extracted those that were present in all word embeddings models. I then projected these words on each cultural dimension for each decade's word embeddings, and then correlate this projection with the projections of each subsequent decade (see figure ¤ for visualisation of this). The stability of each dimension can thus be compared.

\*\*Dimension validity\*\*

Data from the Amazon Mechanical Turk survey fielded to 398 respondents in 2016-2017 by Kozlowski et al. (2019) was used to validate the cultural dimensions. 59 words in 7 different categories (occupations, clothing, sports, music genres, vehicles, food, first names) were rated on 3 scales corresponding to gender (male-female), race (white-black) and affluence (rich-poor). The mean aggregates of the human respondent ratings on each of these scales were correlated with the projection of the same words projected on corresponding dimensions in the word embedding space.

## Surveys

\*\*Correlation with demographic data and cultural engagement surveys\*\*

We will use multiple surveys to evaluate the validity of the resultant word embeddings. For each survey, demographic questions were chosen that could act as "proxies" for each type of capital for the respondent, e.g. income would act as a proxy for economic capital. Questions about participation in cultural activities or taste in cultural objects were then chosen.

The first is the General Social Survey, which is a nationally representative survey of adults in the United States that has been conducted since 1972. (Retrieved from: https://gss.norc.org/About-The-GSS) It consists of questions that inquire into respondents' opinions attitudes and behaviours, with a set of core questions that are kept constant, and a set of questions that vary from year to year. Of interest to this project are the questions that i) ask about participation in leisure activities such as visiting art galleries, going to see sport and going to see theatre (years ¤) and ii) ask about taste in music genres (years 19¤). Proxies used for capital were: respondent's income for economic capital, years in education for educational or cultural capital and occupational prestige for social capital. The questions used are including in the appendix

The second is the Great British Class Survey, which was a survey of social class from a Bourdieusian perspective conducted by Mike Savage et al. in 2011 on a sample of over 325,000. (Retrieved from:ukdataservice.ac.uk/) The survey covered a few different domains, but relevant to this study are the questions about the respondent's taste in music genres with Likert scale responses, and the questions about the respondent's frequency of engagement with various leisure activities like going to the pub or going to a gig or making art. For educational capital, a ranking of 1-7 of education level provided by the researchers was used. For economic capital, the respondent's income bracket was used. For cultural capital, a composite variable created by the researchers representing taste in "high culture" was use.¤justify!!

The third is micro data from the decennial US census, as collated by the University of Minnesota in their Integrated Public Use Microdata Series. Extracts were created for each decade from 1900-2000, with microdata samples available for between 1 and 5% of the entire population. Relevant to this study were occupation titles (the 1950 occupational mapping was used to keep consistency in analyses) and

demographic information on income level (a proxy for economic capital), level of education (a proxy for educational/cultural capital) and occupational prestige (a proxy for social capital). Information on income level and level of education was lacking for the decades of 1900-1940, so analyses were restricted to this period.

In each survey, steps were taken to remove missing or erroneous data (missing data was not substantial in any of the cases, so imputation was not considered), align data types and other basic data cleaning steps. SPSS was used to transform the US census data into data readable by python. Being a sample of the full survey, individual responses in the US census data had to be multiplied by a corresponding "person weight" that indicated how many people in the population the individual was representative of.

\*\*Evaluate\*\*

Improving Distributional Similarity with Lessons Learned from Word Embeddings

Evaluating word embeddings

word embeddings have been shown to be unable in effectively capturing different meanings of a word, even when these meanings occur in the underlying training corpus (Yaghoobzadeh & Sch¨utze, 2016). (dist semantics)

ALso lack of historical surveys to validate with, especially if with respect to a specific domain of analysis (garg)

Survey correlations

The logic of analysis for the surveys was simple: Correlate projections of words (occupation, leisure activities, music genres) on various dimensions of class with the average of the respective capital of individuals that "engaged" with that "object" (that had that occupation, engaged with that leisure activity, liked that music genre). To do so, for each object of analysis (e.g. occupation, leisure activities, music genres), a mean average for each capital proxy was calculated, such that an average profile of the person that engages with that object was created. For occupations, this was simple - filter out every other occupation and calculate the mean average. The questions concerning leisure activities and music genre taste had a Likert scale response, so "Like" and "Like a lot" were parametrised as positive engagement, as well as "sometimes" or "often" for questions on frequency. These mean averages of capital per "object" were then correlated with their projection on the corresponding class dimension (e.g. x = average income of individual liking bluegrass, y = projection of "bluegrass" on rich-poor dimension).

## Analysis

Mapping the space of lifestyles

To map the space of lifestyles, I took categories and subcategories of objects stored in CSV files and sequentially projected them onto the created cultural dimensions. I then sequentially graphed each of these subcategories, according to their constituent words’ projections onto select cultural dimension, and gave each its unique colour.

Silhouette

To evaluate the resultant mappings of cultural domains, I utilized the silhouette method, commonly used to evaluate clustering algorithm. The idea is simple – measure the independence of each of the clusters from one another. This is done by iterating through each element of a cluster and calculating the average distance between it and i) objects of the same cluster and ii) objects of other clusters. The results are averaged, and the ratio is taken between the average distances to objects external to the cluster and the average distance to objects internal to the cluster. A high resultant number would imply a relatively distinct cluster, while a low resultant number would imply the converse.

To calculate the stability of cultural domains through time, the same method as described in the “dimension stability” section is used. Instead of taking the top 5,000 most frequent words, the words contained in the cultural domain are used.

# Results

Outline

The results section is structured into three subsections. I first report the results of evaluations of the various word embeddings I used on function word stability tests, analogy tasks, word pair similarity tests, and cultural dimension analysis. I summarise the consequences of these results. I then move to the domain of lifestyles. I report the results of correlational analyses of the word embeddings with respect to the GSS and GBCS surveys and discuss the implications of this for word embeddings capturing homology in this domain. I then proceed to visualize the “space of lifestyles” that can be generated from these results, and discuss whether they align with expectations, and whether they can be considered reliable. I proceed to do the same for the occupations – first correlating the projections of occupation words onto cultural dimensions with measures of capital in the US census data. I discuss the implications of these results, with special attention given to the problem of outliers. I then extend this to historical census data, reproducing these results in most cases. Following this, I then go onto visualize the “space of occupations” and consider how well it maps onto prevailing occupation classification systems. I then go on to evaluate hypotheses in the professional occupations, with special attention given to the managerial occupations. Finally, I summarise the results section, with special attention given to the question of the homology of the social space.

TLDR:

* The word embeddings were evidence to both capture objective relations as well as subjective representations – their discrepancy is what may show an even more meaningful conception of bias, but analyzing stray of subjective relations from objective relations
* This can be considered from the theoretical viewpoint of the homology social space and economic structure
* This is only present in some domains, however: music genre’s relation to economic capital, certain kinds of activities, and most of all, occupations – which had statistically significant correlations for all measures of capital, which is reproduced back to 1940 (with some exceptions).
* Investigations of resultant graphs of the space of lifestyles was interesting, and allowed us to explore some hypotheses, maybe to think things with, but could not be used to conform or disprove hypotheses
* Some hypotheses were confirmed in: the manager’s increasing relationship to education, its association with the word space outlined by the New Spirit of Capitalism, and the relatively intuitive graphs of the space of lifestyles and the occupations
* But on the whole, the relations between objects seemed unstable and unreliable for closer analysis
* But despite the unreliability, I hope to emphasise the validity of a bourdieusian perspective for word embedddings analysis, that key theories like his homology of the social space are evidence in word embeddings models, as well as interesting directions to use when approaching word embeddings that call for deeper, more meticulous investigations, especially if collaborating with domain experts.

## Evaluations

In this section I will describe the results of each of the evaluative procedures used to test the word embeddings. I will begin with the general NLP task evaluations – function word stability, word pair similarity, and analogy task solving – and follow with evaluation of the validity of the cultural dimensions

### General

Stability of function words

TABLE

Comparing the variability of distance between pairs of function words through time with 500 randomly selected pairs of words, I found that the embeddings were remarkably stable. As can be seen by table ¤ (tables for the other word embeddings are found in the appendix), the average distance increased by 0.031 (0.030, 0.031) going from 1900 to 1910, up to a maximum of 0.080 (0.078, 0.082) by 1990. In comparison, the average distance for randomly selected word pairs increased to 0.113 (0.111, 0.115) by 1910 up to 0.424 (0.421, 0.426) by 1990. This much smaller shift in distance aligns with expectations that function words shift less in meaning than other words over time. This provides initial evidence for the integrity of the semantic relations captured by the word embeddings, and that these semantic relations can be compared across word embeddings corresponding to time periods.

Analogy tasks

TABLE

All embeddings were able to solve some of the analogy tasks, and considering the probability of randomly choosing the correct answer is very low, it points to a degree of integrity in the embeddings. That said, they performed significantly worse than the state-of-the-art word embeddings - ranging from 0.408 in the 1990 ENG\\_ALL word embeddings, down to 0.09 in the COHA 1900 word embeddings. ENG\\_ALL performed best, followed by ENG\\_GB, followed by COHA. This is compared with the state-of-the-art Google News embeddings which scored 0.74 - almost double the best of my embeddings.

Some of this is due to their distance in time to the analogy formulations - language has changed substantially since 1900. But the semantic relations asked of in analogy tasks are relatively stable over time - London is to England as Paris is to France and will likely remain constant for a very long period of time. This is also clear in the results - the difference in performance from 1900 to 1990 are minor - 0.13 in ENG\\_ALL and 0.08 in COHA, and no increase in ENG\\_GB or ENG\_FIC. Performance, instead, seems to correlate with sheer size of the corpus, with the rank in analogy performance matching the rank in corpus size. This would also explain why the state-of-the-art embeddings are achieving higher performance - they are much larger than the corpora used in this study.

This comparative lack of performance may bear consequences, since the ability to solve analogy tasks is what the logic of word embeddings semantic analysis is built upon; geometric relations mirror semantic relations. Granted, analogical reasoning is only a subsection of all semantic relations, but it is an important proxy.

Word pairs

TABLE

Word pair similarity tests faired better. Correlations scored a high 0.64 in the 1990 ENG\\_ALL embeddings, though they stretched down to 0.15 in the 1900 ENG\_FIC embeddings. The order was approximately the same in performance, though with ENG\_FIC and COHA approximately the same. This is comparable to the Google News embeddings which scored 0.624 - ENG\\_ALL even achieving slightly higher with the 1990 word embeddings.

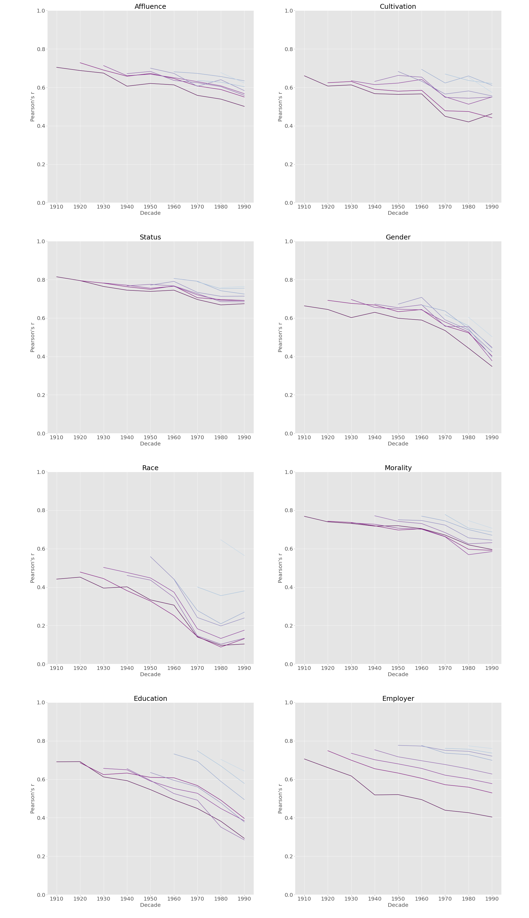
TABLE

The ranking in performance points to size being the most important determiner of ability to match human rated word senses. Interestingly, however, time is a much more important factor here, with all embeddings but ENG\\_GB experiencing a dramatic increase in performance over the century - 0.47-0.7 for ENG\\_ALL, 0.15-0.44 for ENG\_FIC, and 0.19-0.41 for COHA. This implies that intuitions of word similarity change much more than analogical relations, which perhaps remain more constant because of their more fundamental relations of meaning.

This is positive for our study for two reasons. First, the relatively good performance of these word embeddings implies that they can capture these more subtle relations of meaning, which is exactly what is hoped for with an analysis of class connotation. Secondly, their increase in performance implies that subtle relations of meaning change a substantial amount over time, indicating that word embeddings have something to model. The latter conclusion may have to be tempered, since the drop of the performance may be ue to the relative smallness of the early decade corpora. But considering the relatively large increase in performance compared to the analogy over the same decades, as well as the relatively small difference in size of the 1900 to 1990 corpora, the conclusion still seems to hold.

### Dimensions

Stability of Dimensions



\begin{figure}[h]

\centerline{\includegraphics[scale=.5]{dimension\_stability.jpg}}

\caption{Correlation plots of projections of the top 10,000 most frequent words on each cultural dimension, of each decade with each subsequent decade.}

\label{dimensionstability}

\end{figure}

As can be seen by figure ¤, status is the most stable domain, followed by affluence, morality and cultivation. Gender, education, and employment show significant changes through the 20th century, while race seems unstable from the beginning (which accord with expectations from the Amazon Mechanical Turk survey correlations).

The large fall in correlation for educaiton could be attributed to the changing status of education in the 20th century. At the beginning, many less went through a protracted period of education - university being restricted to the very few. But as universal education got extended into later and later years, as well as university educations becoming a necessary step to a significant portion of jobs (i.e. the professions), education has played a role. Consequently, one can imagine that it has attained a different connotation over time.

Employment, likewise, was something that gradually became necessary for the upper class over the 20th century. At the inception of the century, most of the upper class could and would avoid employment, living off of their accumulated capital and rent. But gradually, it became necessary, as well as the norm, to be employed. Hence the list of the world's richest being now populated by working men (who also commonly preach the values of hard work).

Gender aligns with expectations from the historical record. While it remains relatively stable in the initial decades, it begins to drop precipitously in correlational value in the 1960's. This aligns directly with when the feminist movement picked up momentum and transformed cultural expectations of women.

That status remained constant is surprising. With the cult of celebrity that came with popular media in the latter decades, one would expect that high status would have different connotations. It may also be that the difference between words included in that antonym list like "famous" and "respected" shows that difference, but this gets tempered in the procedure of aggregation. It is also surprising that cultivation remains quite stable - theories of omnivorism have suggested that distinction according to cultivation is becoming more subtle in recent decades. One could imagine, however, that words like "cultivation" are not being used to describe the new way of having good taste - words like "hip" or "cool" or "fresh" displacing that and cultivation remaining ossified and tied to an old ideal. That affluence remains similar is perhaps more understandable - although one might expect that the increasing prevalence of the concept of the "new rich" in contradistinction to old aristocratic wealth might change that.

\*\*Validity of dimensions\*\*

TABLE

MENTION JENKINS STUDY¤

We now evaluate the cultural dimensions by comparing word projections onto them with human scale ratings recorded in Geometry of Culture's Mechanical Turk Survey.

All word embeddings performed best in gender - each hitting 0.7 in at least one decade. Interestingly, both ENG\\_ALL and ENG\\_GB fell quite dramatically (from 0.71 to 0.38 and 0.66 to 0.53, respectively), while in ENG\_FIC it rose moderately. COHA seemed (as a genre-balanced corpus) to balance out these differing trends, hovering at 0.7 through the century. This is only slightly under what was found in the original study (0.76), as well as the Google News embeddings (0.804). ¤decimalsss

All word embeddings performed poorly with respect to race. Most had a low correlation and were very inconsistent (between -0.26 and 0.39 for COHA, -0.38 and 0.31 for ENG\\_ALL, -0.25 and 0.28 for ENG\_FIC). The Google News registered a negative correlation of -0.520, strangely – indicating a reverse pattern. This instability and generally low correlations corroborate the findings of Kozlowski et al. (correlation of 0.27), and is very likely due to the polysemy of words such as "black" and "white" with the colours they also denote.

Performance on affluence associations seemed to land between gender and race. COHA was an important outlier, performing poor consistently (-0.09 to 0.1 in all with one outlier of 0.24). ENGFIC was quite inconsistent, moving between -0.14 and 0.29, though it seemed to become moderately reliable by 1980 and 1990 embeddings (0.43 and 0.48). ENG\\_GB and ENGALL seemed to both fall in their performance over the century, dropping from 0.4 to 0.28 and 0.36 to 0.25, respectively (though the decrease was not linear.

class = 0.53, gender = 0.76, race = 0.27 for goc

The survey correlations show a competence in the cultural dimensions capturing connotations of words. Gender seems to remain a benchmark, while affluence and race trail behind. As discussed, race can be discounted because of its polysemy. Affluence, however, may have fallen due to a lesser prevalence of class markers by affluence - meaning a greater variability amongst individuals' associations with wealth (and thus declining ability of embeddings of match associations). This is corroborated by the average variance for the respondent ratings for affluence which, at 314.438, is higher than race (313.264) and gender (284.038). Gender is surprising, however, as one would expect a fall in correlation with gender associations, consider how feminism has opened up more variability in women's lives and thus greater variability in bias and representation. This may point to enduring biases in that domain.

\*\*Caveats to further analysis\*\*

The aforementioned analyses have shown that the embeddings have an unevenly distributed reliability. ENG\\_ALL is the most reliable of them on all accounts, followed by ENG\\_GB, ENG\_FIC and then COHA. They seem to perform reasonably on both analogy and word pair similarity tests, but are far from perfectly representative of human semantic relations. Affluence and gender connotations seem reliably captured, but all considerations of race will have to be discounted because of the inconsistency of the correlation evaluation results. Their reliability is harder to verify the further back in time we go, as there is a lack in historical surveys to test them on. We can assume, however, that a significant amount is captured – both because of the relative performance of the earlier word embeddings, but also because of the validation that Kozlowski et al. performed with the 1950’s semantic differential research.

## Lifestyles

\*\*Validation of the perceived homology of lifestyles\*\*

The correlations with the Great British Class Survey and General Social Survey provided some interesting detail to the capabilities of word embeddings in mapping culture. Correlations of the 1990 ENG\\_ALL word embeddings with the Great British Class Survey provided an array of significant correlations, while the General Social Survey only in one area. The 1990 ENG\\_GB word embeddings had insignificant results for correlational analysis for every domain of culture and for every dimension in the Great British Class Survey. This was surprising because one would assume that a British language corpus would capture the correspondence of class and taste in a British context better. The best explanation seems to be the relative size of the corpus trained on, as a similar drop in accuracy was noticed in the previous rounds of analysis. Because of the relatively poorness in performance of embeddings in the initial evaluations, it was decided that they were not robust enough for the fine quantitative analysis that the subsequent analyses required.

GBCS:

Leisure

TABLE

Correlations with the data on participation in leisure activities in the General Social Survey provided no statistically significant results, as shown in table ¤, all with relatively high p-values. This may be because of the polysemy of many of the words (does "art" refer to making, visiting, or discussing art? Does "sport" refer to playing sport or watching sport? Could connotations be more relevant to artists or sportsmen than their consumers?). It may also be due to the lack of specificity of the activities. As cultural capital researchers ¤have argued, too broad a category like "sport" is not enough to map distribution of taste - type of sport, or even choice of sports team are more relevant to differentiation on taste.

TABLE

Correlations of activity participation in the Great British Class Survey provided much more promising results. There was a high correlation with affluence (0.82, p-value < 0.01) and a high correlation with education (0.70, p-value < 0.05), though insignificant results for cultivation. This is confusing, since there doesn't seem to be a great degree of recognisable difference between the two collections of words. It may be because of the Great British Class Survey being conducted in the UK, where actual class practices are more distinct than in America, where there is more fluidity in practices and less distinct boundaries for each class. ¤BUT WHAT ABOUT ENG\\_GB??

Music

Interestingly, correlation with music genres in the General Social Survey provided more fruitful results. Though the correlations with education and status provided insignificant results with high p-numbers, the correlation with affluence provided a statistically significant (p<0.05) high correlation of 0.65. This implies that connotations of affluence with music in the word embeddings reflect actual connections of music taste with affluence.

The Great British Class survey also exhibited high correlations with affluence (0.97, p-value < 0.05), but insignificant results for the latter two dimensions. These must be taken with a certain degree of caution, since only 4 words were retrievable from the word embeddings after filtering out the very polysemous genre words (e.g. country, rock and metal)

\begin{figure}[h]

\centerline{\includegraphics[scale=.5]{music\_income\_correlations.jpg}}

\caption{Correlation plots of the projections of music genres and the corresponding average income of survey respondents}

\label{music\_income\_corr}

\end{figure}

The fact that word embeddings can replicate real world associations between affluence and music taste is interesting. This would indicate that music is still a type of cultural consumption that is inherently classed. Collectively, there seems to be an awareness which music genres are engaged listened to by the rich and which by the poor. This aligns with Bennet's (¤culture, class distinction) findings in his survey on cultural capital and social exclusion, where music found to be the type of cultural consumption which differentiated people most (above book genres, film genres and art genres).

There seems less of an association with cultivation and status, however. Cultivation perhaps, is less relevant a means of differentiating people's music taste - this would align with the omnivorousness hypothesis of the upper and middle classes being less confined to high culture and instead listening widely. It may also be that cultivation and associated terms are used less to describe music taste, with their connotations of the old, universal humanist notions of Bildung.

Status seems inherently problematic because of the words used. One can imagine that words like "respected" and "famous" are much more likely to refer to the artists that produce works in these genres, than the types of people that listen to them.

The correlational analysis is not without its flaws, however. Income is not a perfect proxy of one's socioeconomic status. Especially when moving up the higher ranks of socioeconomic status, wealth is increasingly determined by one's accumulated capital and less by income. Because of this, the correlations face a potential mismatch of scale - the upper end of the survey values referring to the wage earning upper middle class and the upper end of projections referring to either the upper middle classes or the traditional upper classes (each holding a distinct position in the cultural space). Likewise, the measure of education is not linear, as the ranking code implies. Perhaps years of education would have been a better way of linearising, or a simple university versus non-university binary.

Furthermore, taking the mean distracts from the variance there may be in each sample. If the variance is high, it would be hard to assert there is a good mapping, since only few values of the sample would genuinely accord with the values.

¤CHECK VARIANCE OF EACH MEAN VALUE CALCULATED

- Evals of both: polysemy, participation vs taste, the problem of averaging and not considering variance

### The Space of lifestyles

\*\*Transformations in the lifestyle domains\*\*

Now we take the list of leisure activities present in the GBCS and GSS surveys and combine it with three further lists - places of entertainment, sport and clothing (music was discarded for having too many recently established genres), and analyse how these domains transformed in their class connotations through time. We use the same correlation-of-projections method used earlier in the validation of cultural dimensions on each of the domains, correlating the projections of the 1900 word embeddings and the projections of the 1990 word embeddings.

We can interpret high statistically significant correlations as measuring the consistency of a domain's space through time. A high, statistically significant correlation implies, then, that the relations between the objects of the domain remain stable with respect to one another, in terms of each of the cultural dimensions.

GRAPH FOR ONE DIMENSION, TABLE

We find that out of these domains of lifestyle, sport has the largest amount of statistically significant high correlations (5) followed by clothing (4), leisure (2) and then places of entertainment (2). Interestingly, no domains have a statistically significant correlation for the dimensions of education and race. Inspecting their graphs (see appendix), it does not seem to be because of a dramatic change in the space - the correlations are very low from year to year to begin with - which implies that i) they are not relevant in the consideration of sports, or ii) they are not particularly meaningful dimensions. Considering the relative performance of each dimension in the dimension stability tests, it seems to be that the first applies for education, and the latter applies for race.

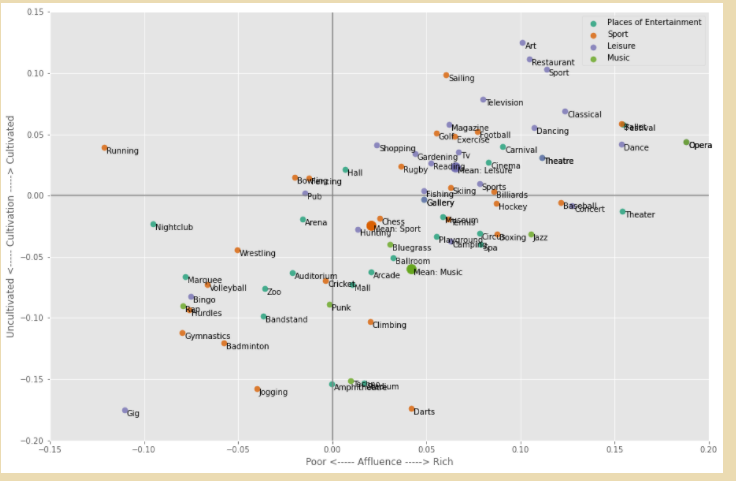
Sport seems to be remarkably consistent throughout the 20th century. This implies that the class connotations of each object seem to not change, which is surprising considering the opening up of many sports to the working classes because of increasing disposable income. Clothing also seems remarkably consistent - which one would not expect because of the decreasing distinctiveness of clothes worn by each class over time (tokido). Though its lowest correlation is in the dimension of affluence (0.463), implying that there has been some mixing up of the space. The domain of leisure seems to have transformed widely - except for gender and affluence, which seems to accord with expectations, since many activities of leisure are prohibitively expensive (opera, restaurants) or tastes that are more-or-less exclusive to the rich (classical music, theater). Places of entertainment seem to display a great divergence over the century, which again may be due to the increased disposable income available to most people, and the consequent intermingling of people at places of entertainment.

Comparing these correlations with those of the top 10,000 most frequent words seems further confirm this picture. The top 10,000 most frequent words show a statistically significant correlation in all dimensions (albeit very low in race and education, as seen in the other domains). This indicates that there is a general stability, from which the domains can diverge – the insignificant correlations indicating, then, a divergence from this general stability.

It is hard to justify interpreting too much, from this mode of analysis, however. The argument I have been making - instability in a particular domain compared with a greater stability generally implying a transformation of that domain’s space - may have other explanations. Small sample of words from the domain may mean a higher risk of insignificant correlations. Likewise, speculating reasons for these changes is also risky, however, as multiple narratives could fit the same result. Deeper engagement from a domain expert would greatly contribute in providing contextual depth.

\*\*The space of lifestyles\*\*

We can now explore how the word embeddings by mapping the space of culture. I will begin by visualising how the space can be visualised along the different dimensions of class. I will then analyse their degree of correspondence to survey data of actual patterns of cultural consumption. I will then take the examples of boxing, sport and the avant garde as examples that can be explored in greater detail.



\begin{figure}[h]

\centerline{\includegraphics[scale=.5]{lifestyle\_space\_all.jpg}}

\caption{Projections of words pertaining to the domains of ¤¤ on the dimensions of affluence, cultivation and status}

\label{lifestyle\_space}

\end{figure}

Looking at figure ¤, we see the projections of music genres, places of entertainment, leisure activities and types of sport on the dimensions of affluence and cultivation in the 1990 word embeddings. The first thing that strikes the eye is the seeming correlation of the two sets of projections. Correlational analysis of all the sets of points reveals a statistically significant correlation of 0.489 (p<0.001). This correlation is found in each of the separate domains apart from "places of entertainment". The domain of music has a very high correlation (0.864, p<0.05), sport a strong one (0.586, p<0.01), and leisure moderate (0.420, p<0.05). This all implies that for the space of lifestyles, activities for rich people are generally activities for cultivated people - and vice versa.

Furthermore, it is noticeable that, beyond the high variance displayed by each of the domains (with a lot of overlap between categories), each of the domains seem to occupy relatively discrete places.

Music seems to occupy a spot mid-way on the scale of affluence and relatively low on cultivation. It is the most popular of the art forms, and thus most prevalent across classes. This is evident in the relative stretch of the space, from rap at the bottom of cultivation and affluence, up to opera and classical music at the top of each.

Sports seem to be more associated with cultivation, strangely, but lowest on the dimension of affluence. Traditional sports of the upper class like skiing, rugby, golf and sailing all seem to score high on affluence and cultivation - but others like fencing and cricket score relatively low on affluence and cultivation, respectively (though fencing is polysemous with the job of putting up fences). The theory of working classes greater engagement with the physical, combative sports ¤bourdieu quote is badly reproduced – wrestling scores comparatively low on both cultivation and affluence, but boxing scores high on the affluence dimension (though this may also be due to the comparative remuneration of the celebrity boxers of the 1990's). Football, the most popular sport for the working classes of Britain (though, of course, polysemous with American Football), scores very high on affluence and cultivation dimensions. On the whole, sports do not seem to be particularly well captured by the projections - but unfortunately no datasets were available to test their performance on.

Leisure scores the highest of all the groupings on both dimensions by quite a way. This aligns with expectations, as leisure is traditionally most associated with the middle classes (¤tomiko). It is also the grouping that is most prohibitively expensive. It captures a lot of intuitions about leisure: pub, gig, and bingo receive the lowest projections, while art, dancing, and restaurant are relatively high up. Important exceptions include television, which is remarkably high - though the slang word "TV" is lower. Hunting and fishing - traditionally upper class activates - are only mid way in the ranking of projections.

Places of entertainment seem to align with expectation, with the theatre, carnival, museum and gallery high on the scale of affluence and cultivation. Popular venues such as the nightclub, zoo, arcade and mall are comparatively low in connotation of affluence. There are many outliers, however, as cinema is high on the affluence scale, despite being a popular place of entertainment, while amphitheatre is very low on the scale of cultivation and only moderate on the scale of affluence - despite being places of entertainment predominantly for the rich. Festivals are surprisingly the highest associated with affluence and cultivation, but this may be because of connotations with high culture festivals such as the Vienna Biennale.

In sum, it seems that the space of music genres is best captured by the word embeddings, followed by leisure and then sports, and finally places of entertainment. What is evident, however, is that in many of the domains, they seem to be right in \*most cases\*, as evidenced by their relative mean positions, but are not particularly useful for analysis of individual objects. If we were to learn about the elative position of each of the lifestyle domains only from these graphs, we would have a quite warped understanding of society.

\begin{figure}[h]

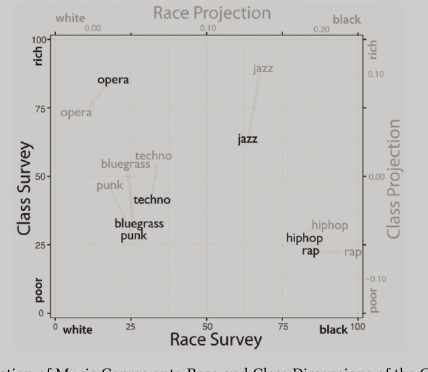
\centerline{\includegraphics[scale=.5]{music projs vs survey.jpg}}

\caption{Comparison of projections of music genres onto the dimensions of race and affluence with the ratings of music genres with respect to these dimensions }

\label{music\_corr}

\end{figure}

¤



## Occupations

Analysing the space of occupations had a similar structure of approach to analysing the space of lifestyles. I will begin by comparing the projections of the occupation space on the 1990 data from the US census with a correlational analysis. I will then consider how to interpret these correlations, with special attention given to outliers. Following this, I will examine this for previous decades. I will then proceed to visualise the space through projections onto cultural dimensions. I will compare these visualisations with visualisations of projections from principal component analysis. I will then consider how different occupational categorisation schemas perform in capturing popular conception using silhouette analysis. I will finally examine the individual cases of the manager and professions, as examples of more in depth study using this methodology.

Validation of the space of occupations

\input{census\_correlations.tex}

The correlations with census data suggest word embeddings reflect the objective layout of occupations in the 1990's. All 3 dimensions are statistically significant with status having the highest correlation of 0.58, followed by education with 0.52, and affluence with 0.35. This a good to moderate concordance. This is all the more surprising, considering the amount of data points that are correlated and the diversity of contexts implied.

Interestingly, replacing the dimension of "education" with "cultivation" produced very insignificant results, with a p-number of 0.32 - cultivation being a by-product of education and in relative semantic proximity ("educated" being a moderate synonym of "cultivated"). This suggests an independence of the dimensions of education and cultivation, at least with respect to the realm of dimensions. It may also be the effect of education having a more practical function as training for employment in the late 20th century - rather than the humanistic education that was the privilege of the elites before.

(INVESTIGATE THIS?)

Outliers

\begin{figure}[h]

\centerline{\includegraphics[scale=.5]{occupation\_aff\_outliers.jpg}}

\caption{Scatter plot comparing the projections of occupations onto the dimension of affluence with average income of respondent working in that occupation}

\label{occupation\_aff\_outliers}

\end{figure}

¤





Care was taken to remove outliers from the dataset - as Pearson's correlation is extremely sensitive to outliers and thus assumes a dataset without them. ¤REPOSITION AS AN EXAMPLE AREA TO GO INTO

Prior to removal of outliers, affluence was not statistically significant, but after removing a significant amount that diverged greatly, it became significant. These were predominantly those in the artistic domain - dancers, designers, painters, authors, athletes and photographers. These were all projected much higher on affluence than were actually compensated. One can imagine that these occupations are naturally more associated with affluence because of the celebrity of their most prominent representatives. Likewise, dentists, physicians, surgeons, policemen, lawyers, judges, pilots, veterinarian and stock and bond salesmen were removed. These were all represented as much poorer than they actually were recompensed. It is unclear as to why that may be the case, but for some like dentists, pilots and veterinarians, their compensation is arguably much less represented by the media and consequently less associated with wealth. Others like lawyers, judges and policemen often are associated with criminals because of the nature of their work. Criminals tending to be poorer, it would seem reasonable to assume that these words often neighbour words describing criminals, and therefore associated.

For education, there were no prominent visible outliers, so it was left as it was found.

\begin{figure}[h]

\centerline{\includegraphics[scale=.5]{occupation\_status\_outliers.jpg}}

\caption{Scatter plot comparing the projections of occupations onto the dimension of status with average occupational prestige of respondent working in that occupation}

\label{occupation\_status\_outliers}

\end{figure}

¤

Status had a few prominent outliers, however. Members of the armed forces and painters were much higher projected than were ranked as prestigious. Tool makers, die makers and setters were projected substantially lower, however. This divergence cannot be attributed to difference in public perception like the previous because the rankings are themselves subjective. It may be attributed to difference in the perception of those writing in the public domain to that to the public perception, but that also has to be discounted, as occupational prestige has been demonstrated, as mentioned previously, to be consistent across demographic subgroups. It would most likely be due to statistical noise specific to these words - but further, qualitative research or a domain expert's opinion would be needed to judge whether this is the case.

Whether outliers should be removed in this case is debatable. These could arguably be due to deficiency in the measuring instrument (in this case the shortsightedness of the algorithm). They could also be capturing actual popular perceptions of occupations. It may be the case that deviations represent actual deviations of popular conceptions from reality. It may well be the case that the common person considers artists to be rich, with the majority of media exposure being of the well known and accomplished and less of the starving artist trope. These speculations can only go so far, and it would require further inspection by a domain expert - perhaps a cultural theorist or historian - that could assess reasons for divergence. This points to how word embeddings could be used as an exploratory tool, whose outliers can prompt investigation into prominent stereotypes.

General

That there was a high correlation between the embeddings and status is very promising. Unlike the proxies for education, cultivation and affluence, the values for status were aggregates derived from subjective rankings by occupational prestige research. This suggests that not only are word embeddings competent at capturing objective relations or properties of the world, they are even better capturing subjective impressions of cultural objects than objective properties or relations of the world. This discrepancy is important, as it implies that word embeddings can, in fact, be used to evidence stereotypes or biases, considered as unrealistic representations of the world.

\*

### Historical correlations

\input{census\_correlations\_historical.tex}

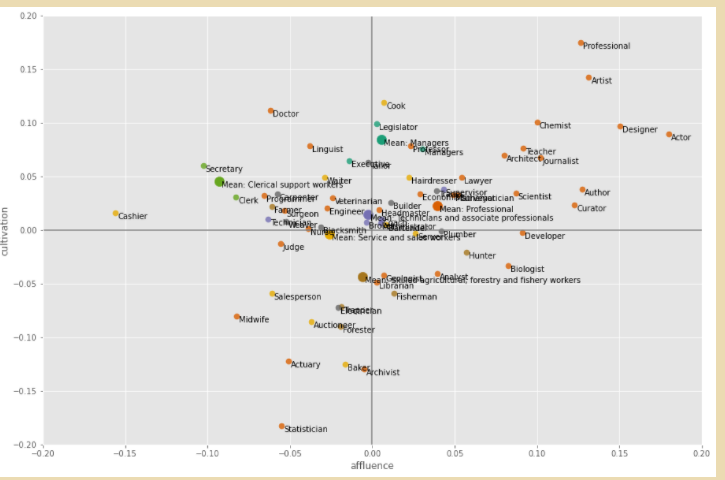
\begin{figure}[h]

\centerline{\includegraphics[scale=.5]{occupations\_space\_all.jpg}}

\caption{Projections of words pertaining to the ISO classification of occupations on the dimensions of affluence, cultivation and status}

\label{occupations\_space}

\end{figure}



### Space of occupations

With the projections partially validated, I will now proceed to examine how the projections of the occupations distribute across the different class dimensions. As to be seen in fig ¤, I assigned each occupation to a class or category, following the International Standard Classification of Occuaptions, and coloured them accordingly. The words are far from one-to-one, with some being belonging equally to different groups, and many being left out, due to the restriction of being able to use only one word. The visualisations make it clear a high degree of overlapping between groups. Nevertheless, it seems that there is some degree of distinction. Professions are heavily weighted towards high status, cultivation and high affluence, but with a substantial portion considered somewhat less cultivated and affluent. Technicians and administrative professionals both clustered very closely to the centre of the professionals, which aligns with the associations of a lot of the modern technical, white collar professions.

The elementary professions seem to be considered as relatively affluent and cultivated, which strikes one as quite strange. The same is the case for the elementary service professions. It may well be the case that many of these, (e.g. cook, bartender, cleaner, waiter) are associated wealth and cultivation because of the wealthy, cultivated people that they tend to serve or be employed by.

Notable are those professions that pertain to the artistic dimension. In every dimension of class they are a very distinct group, occupying the high end of the spectrum. As aforementioned, some of this may be due to the bias of celebrity that these domains tend to accumulate to themselves. If we consider them from the perspective of perceived social position, they seem to occupy a distinct position in the social space. This accords more with Bourdieu's multidimensional conception of the distributions of occupations of social space. In contrast to the traditional reliance on economic capital, the Bourdieusian system asserts cultural capital and social capital (as imperfect a proxy "status" is for social capital) also to be important differentiators of the space of occupations.

\*\*Silhouette evauation\*\*

\*\*PCA\*\*

Projection onto 2 principal components does little to clarify matters. On 3 principal components it seems to separate out according to the defined clusters, but it is not clear how to interpret the dimensions of principal components. Principal components promise the possibility of differentiating high-dimensional data points on simplified composite variables, but unless they are readily interpretable, they are not useful for this investigation.

### The Professions

To investigate the domain of professions, we first consider how well this domain correlates with the census data. Correlating projections of each occupation on the 3 dimensions of affluence, status and education with the mean average of income, occupational prestige and level of education, we get surprisingly unconvincing results. There seems to be insignificant results for most of the dimensions for every decade. The only exception is affluence – which hovers around the statistical significance level, going under the threshold in 1960 and 1990. What is confusing, however, is how these are uniformly *negative* correlation values. This implies that professions have an opposite representation in the cultural imagination – such that more remunerative professions are perceived as less affluent, and the opposite for less remunerative professions. This is hard to interpret the meaning of. At the very least, it implies that word embeddings are relatively unstable when considering smaller subsections of a whole.

GRAPH TO DO

We turn to consider how the image of professions has changed through time. We create for each decade a composite vector by calculating the mean average of all of the vectors corresponding to the professions. We verify that this composite is meaningful by looking at the most similar vectors (by virtue of cosine similarity) and seeing whether they were related to the professions. We then project each decade’s composite vector onto each of the cultural dimensions, and plot each of the dimension projections through time as separate lines.

As can be seen in graph¤, the domains are remarkably stable through time. According to this visualization, professions are high status, highly educated, somewhat cultivated and somewhat moral and marginally affluent – and they remain so throughout the 20th century. The only change seen is gender – which seems to gradually fall from the 1920’s and onwards, dropping precipitously from the 1960’s. This aligns with what was observed in the most frequent words projection in figure ¤ - gender biases seem to shift quite dramatically in the 1960’s and onwards. Here it is evident that the professions gradually become more biased towards female, which aligns with Garg et al.’s conclusions on female biases in the occupations.

We now look at the space of professions by projecting them onto the cultural dimensions of the 1990 word embeddings. As was noticed in the space of occupations, culture producing professions lie on the pole of each of the domains. Interestingly, it seems to be that profession related to academia also cluster together, somewhat below the culture producing professions – with the exception of statistician. The more “practical” professions, like doctor, surgeon, nurse, judge, veterinarian and midwife also seem to cluster together on the bottom pole of the affluence scale – perhaps because their more practical nature meaning they are less associated with high education and status. We group the professions according to these intuitions and, as, can be seen in graph ¤, this seems to capture the division well. This division is only really visible on the dimension of “affluence”, however. If we consider the projections on the dimensions of cultivation, education and status by restricting vision to the y-axis, there is a significant overlap between all the groups.

This indicates that affluence seems to be the axis upon which professions differentiate – and it seems to be that this is due to the type of work that is involved – intellectual, practical or artistic. This is, of course, a relatively crude method of evaluating this space and further research would be required with the knowledge of a domain expert to parse the data in a more meticulous manner.

Contraction over time

Distance between professions and some word

### The Manager

We now take to task the New Spirit of Capitalism's assertion of the transformation of the spirit of capitalism by analysing the image of the manager in word embeddings. We hypothesise that the word "manager" and its synonyms become greater associated with education, because of the institutionalisation of business management in the universities. We hypothesise also that it becomes more associated with affluence and status, as managers become increasingly well remunerated (especially with respect to the role of CEO) and are accordingly provided status. Likewise, we hypothesise an increasing association of the word with the word space described for the new spirit of capitalism (connectionist words like network, projects, team, flexibility, lean, and so on - full list provided in the appendix ¤).

As an occupational class

\input{census\_manager\_corr}

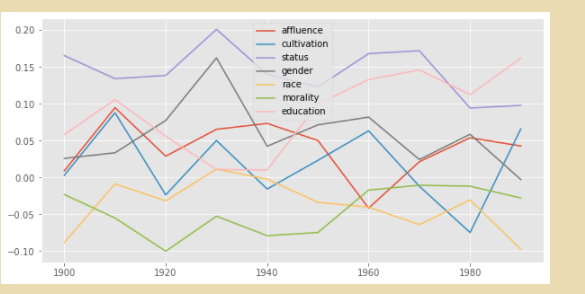
\begin{figure}[h]

\centerline{\includegraphics[scale=.5]{comp\_manager\_line\_graph.jpg}}

\caption{Projections of "manager" composite on 7 dimensions of class}

\label{comp\_manager\_line\_graph}

\end{figur



When projecting the composite of the manager words onto the seven class dimensions, we see a relatively clear, consistent image of the manager (figure¤). The manager is relatively neutral in race, affluence, morality and to some degree cultivation. It seems to be perceived as a high status and relatively male profession, though this gender bias seems to milden after an initial peak in the 30's. This may well be due to the rising equality of gender distribution in the profession (the rise in the early decades notwithstanding).

Education seems more ambiguous, however. The profession seems relatively consistently associated with education, but there is a notable trough in the 1930's to 40's, a peak in the 60's, and then a fall again by 2000. This does not accord with the relatively constant rise of business management as a discipline and education, especially since the 1960’s and does not align with our hypothesis.

\begin{figure}[h]

\centerline{\includegraphics[scale=.5]{manager\_line\_graph.jpg}}

\caption{Projections of "manager" on 7 dimensions of class}

\label{manager\_line\_graph}

\end{figur

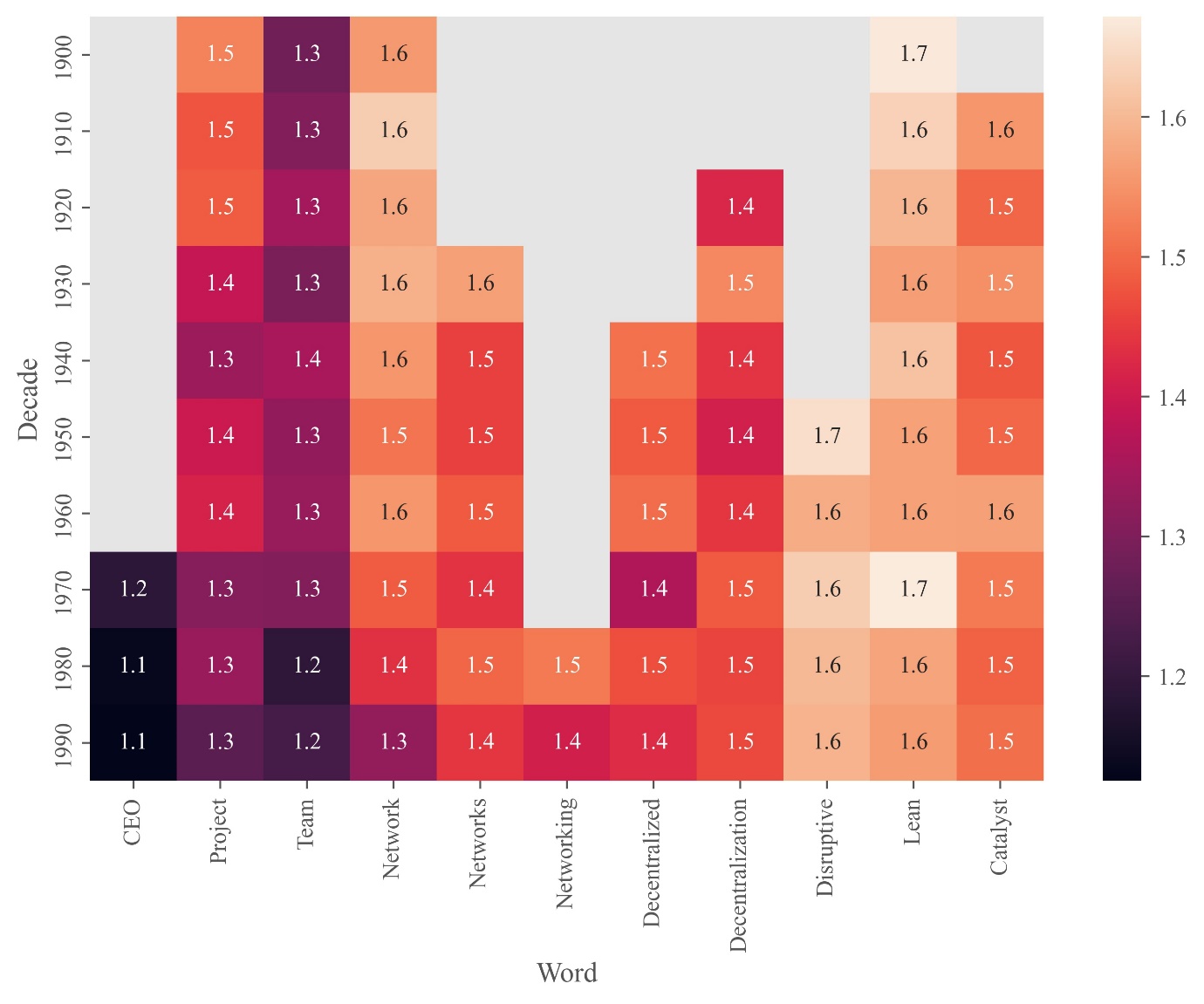
When we look at the word "manager" (figure), however, we see a different picture. We see a more unstable distribution between the dimensions of class, which reflects the ranking of the composite but with a few key differences. Status seems to gradually decline mildly over the course of the century, after a peak in 1930. Education seems to increase dramatically increase in association after 1940, which aligns with our expectations. Cultivation seems to fall dramatically between the 60's and 80's, but shoots up again by the 90's. Affluence is initially associated with the profession but gradually falls down to a rough in the 60's, only to bound back. This aligns to expectations for the latter decades but, considering the decades prior to that, seems unreliable.

This implies that the word “manager” captures the changes in the profession over time. The other words in the composite vector – foreman, supervisor, superintendent – these became perhaps more obsolete over time. Being displaced by manager, they likely did not change as much in connotation over the period concerned. For the ensuing analyses, we therefore restrict our focus to the word “manager”.

SCREENIE OF G NGRAMS VIEwER

**Managers of the New Spirit**

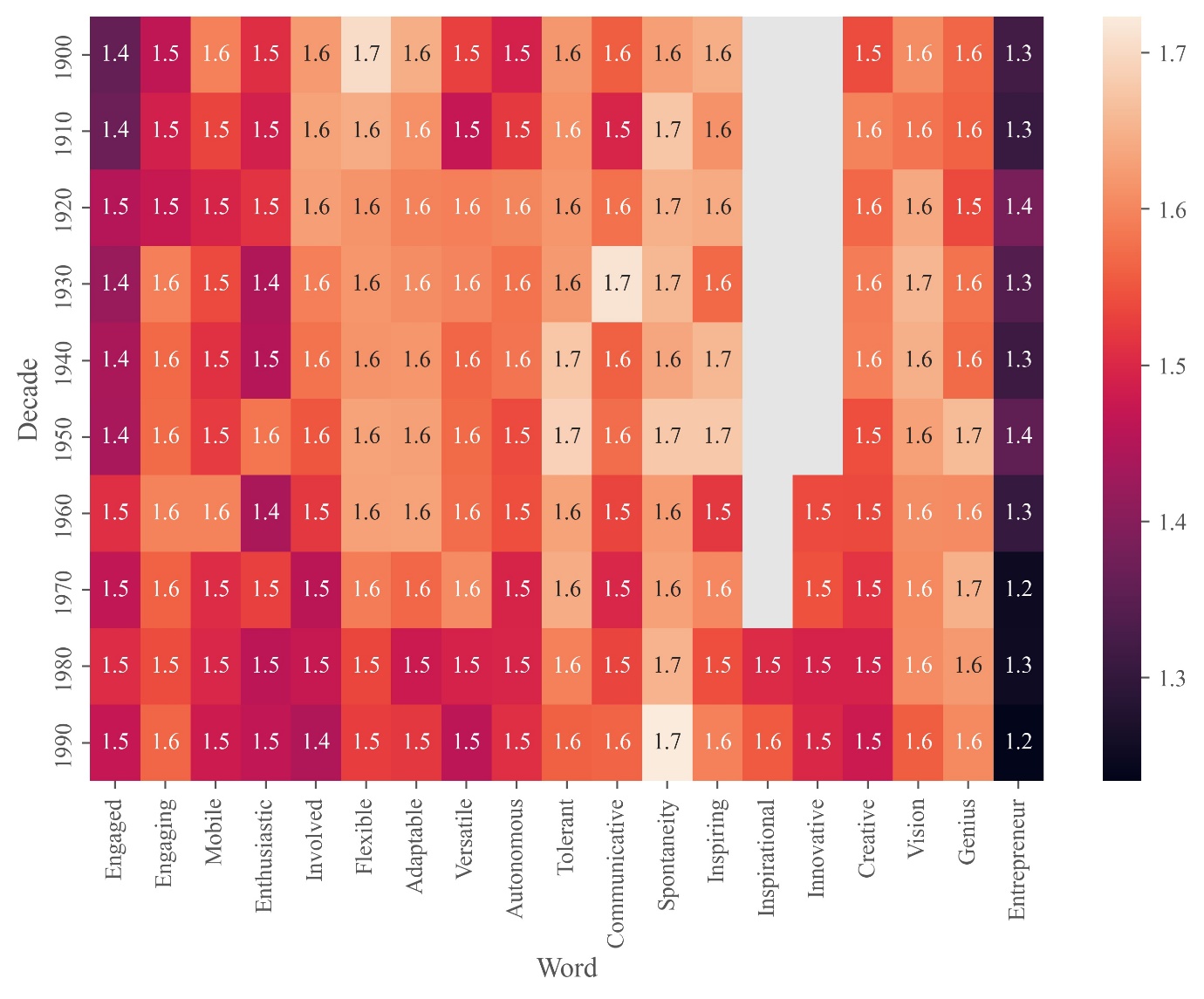
TABLE



Looking at the values of similarity between the term "manager" and terms associated with the new spirit, we see a clear tendency towards tighter association.

Terms associated with the new reticular philosophy of businesses - "network", "networks", "networking", "decentralised, "decentralised", "project", and "team" all moving discernibly closer to the word "manager". This is not seen for terms such as the more antiquated "foreman", which is to a much lesser degree associated with these practices. This failed to hold for other, related terms, such as "catalyst", "disruptive" and "lean", perhaps because these are more peripheral to this word space. The latter two are perhaps only becoming more prevalent in the latter part of the 90's and 00's.

TABLE



With respect to the "heroic ideal" conceived by Boltanski & Chiapello, we observe a closing distance on words such as "versatile", "mobile", "involved", "flexible", "adaptable", "tolerant", "inspiring", "innovative", "creative", "vision", and "entrepreneur", while seeing relative consistency for "engaged", "engaging", "autonomous", "communicative", "spontaneity" and "genius". Thus we see a clear trend in some areas of the heroic ideal but less so in others. This may mean that not all words mentioned in the New Spirit were relevant to the New Spirit, or at least were not taken up as relevant ideal practices. It may also indicate that only certain characteristics were perceived by the public and not others.

We can see a likewise progression of the word "network" into this lingual space, with a greater number of words within the space appearing in the top 5,000 related terms. Notions like "decentralisation" come into proximity starting from 1950, suggesting a spreading of this metaphor beyond the scientific field. Words like "project" and "innovation" or "innovative" come into proximity in the 1960's, indicating the movement of the word into the business sphere, as Boltanski and Chiapello noted.

Discuss about the difference between New Spirit’s study of business management texts and my study of public texts .ideological core of business, but can this be witnessed on a wider scale?

# Discussion

There are a few broad remarks that affect the integrity which must also be discussed. Firstly, I will discuss the words used, then the corpus, the algorithm Word2vec and finally the issue of the representation as a “space”.

## Words

This project suffers the limitation of utilising sets of words that are not adjusted through time. One set of antonyms were used for each dimension of culture. One set of words was used for occupations (albeit from 1950). One set of words was used for each domain of lifestyles. To the benefit of the study, the majority of these words are invariant through time. The word "baker" refers to approximately the same role now as it did 100 years ago, the same for "shopkeeper", "scientist", or "dancer". Many occupations have died out in recent decades and many new occupations have come to replace them, but many of them are composites (CEO, CFO, CMO, customer success manager, life coach, etc) that are not within the range of this project. Likewise for the space of lifestyles - many have remained precisely the same, albeit with many new coming into the space (especially genres of music). The salient outlier is the set of words used for antonyms - being adjectives, and thus not as specific in their reference, they have both shifted meaning more and been replaced by synonyms. These were created using contemporary and historical thesauruses, however, so they do correspond to usage to a degree, but more desirable methods could be imagined.

To further methodological completeness, it would be a fruitful avenue of research to investigate how words used for word embeddings analysis could be adjusted to align with historical usage. This could be by consulting thesaurus at certain interpolations through a time period. It could also be by weighting synonyms according to their ngram usage through time (provided this is not usage with respect to another, irrelevant meaning of the word in question).

## Ngrams

The Google ngrams corpus is not a transparent window into the past. As (characterising the google corpus) noted, the corpus is more a "library of books", and it is not representative of i) all that was published at the time and more prominently ii) that which was read by people at the time.

To the first point, there has not been any mention as to which books were selected for digitization to create the corpus, nor how representative these libraries were of the entirety of publication. The COHA corpus promised potential in remedying this, but its poor performance in the initial stages of evaluation indicate that it is not large enough to be used.

There are many books that were published in obscurity, and of those that became popular, did not necessarily do so upon publishing, often times a while later. It is problematic, thus, to draw the inference that what can be gleaned from Google Ngrams is a reliable proxy to the general consciousness of people at a time. A good example of this is Upton Sinclair's Lanny Budd, " a fictional character was vaulted to the upper echelons of words affecting divergence (even surpassing Hitler) by virtue of appearing as the protagonist in 11 novels between 1940 and 1953" (characterising).

Furthermore, there is a systematic bias towards scientific literature in the latter decades of the corpus, corresponding to the exponential expansion of published scientific literature. Hence (characterising the google corpus) suggest the English Fiction corpus as a way of mitigating these bias – though, again, the performance of this corpus in initial evaluation suggest that it is not yet useable.

But it is not only that it is not representative of what people read at the time - it is questionable what embeddings trained on it actually represent. Since word embeddings capture a single representation of the word space, it is a single view point onto language and its relations. It thus refers to no individual in particular, and instead refers to the perspective of a vague subject-less aggregate. Such an aggregate does not exist, and it is questionable how useful it could be. Bakers may be considered by a majority as vaguely uncultivated and quite modest in earning. But beyond that there may be a cultural movement that cultivates an image of the humble craftsman as a spiritual endeavour that seeks mastery and cultivation of spirit, the deepest of all pursuits. There may be a trope considering philosophy majors as a shy, distant, intellectual figure, but another one sees them as tattooed part time café server bohemians. The details are not important - what's more important is that every word and every concept that infuses it is in contest. Words are multivalent, and much of their depth lies in the concrete ways they can be used in reference to their surrounding cultural and lingual space. An aggregate paints this multidirectional interaction of people a flat grey that may obscure rather than clarify the situation.

Lastly, there are a myriad of technical issues present in the corpus. The digitisation of the corpus is reliant upon automated Optical Character Recognition (OCR) to convert images into to text. Though the algorithms are achieving high levels of accuracies in recent years, there are still a good degree of problems - distinguishing between the long "s" or "f" in older texts being a common one.

## Word2Vec

As regards Word2Vec as method, It is still unsure as to what word embeddings actually capture. They are conceived, variously, as capturing biases, stereotypes, meaning, association, and connotations. They could, however, just be representing habitual collocations and nothing more. Take the somewhat conceited example of a newspaper article discussing harmful stereotypes about ethnic minorities. If we were to train an embeddings model on that, it is highly conceivable that it would result in embeddings that would encode these stereotypes. The same would go for a newspaper article that reported a crime committed by an ethnic minority.

Likewise, one can imagine the situation of words habitually collocating with distinctly different words. Mentions of policemen or judges are likely to be found in the vicinity of words to do with criminality. It is likely, then, that these words will be in vicinity of each other, despite pertaining to quite different spheres of society and different sorts of individuals. This extends to the project’s discussion of lifestyles – how can we know that the connotation of a lifestyle practice with respect to a cultural dimension refers to the consumers or the producers of that practice. Take the example of rap music – is it more likely to be the musicians, or the consumers of the music, that are captured by the context around the word? Disregarding the similarity there may be between fans and artist, it seems more likely that artists are discussed more than their fan, and thus connotation corresponds to them.

This issue is very much related to the problem of the “black box”edness of artificial intelligence. If something doesn’t align with expectations, there is no way to reverse engineer the result to understand why that is the case. It may be possible on much smaller scales, say, at the level of document, but at the level of big data – like Google Ngrams – it is impossible, or would require a vast amount of smaller targeted case studies, to be possible.

Furthermore, there is the problem of the lack of differentiation between semantic and syntactic relations encoded in the word embeddings space. The most similar words to a word are often those that can be “substituted” in place of that word, both semantically – but very much also syntactically. If we look at the top 10 most similar words to “romanticism”, we get 5 -isms, even if they don’t seem extremely close semantically: “freudianism”, “modernism”, “realism”, “humanism”, “postmodernism”. While many of the methods used here (e.g. the creation of cultural dimensions) do well to avoid this noise, it is still a significant factor to consider.

## The embeddings space

The linearity of space should not be taken for granted, either. Though semantic differential theory and other distributive theories of language (as well as the success of word embeddings) provide evidence for the linear combinability of meaning, there is a sense of absurdity lurking behind it. How hot or cold is a brick, essentially? How male or female is it? It is illustrative to consider the projection in fig ¤. Though arguments could be made for implicit connotations in these words, the graph is essentially absurd. There is no useful meaning to be derived from it, or not without a very deep investigation at the least.

With respect to the concept of class this is even more pertinent. Class has through its concept been considered as dividing society in a few discrete categories or groups of people - the working class, the middle class, the upper class, the proletariat and the bourgeoisie, or numerous other ways of categorising. But these groups, defined by boundaries, cannot be meaningfully represented here. We can only consider continuous relations of scale, upon which we can artificially impose boundaries to cut up the space. But there is a fundamental disconnection from the lived experience of class and sense of position of oneself with respect to the world. What is captured here is perhaps better understood as a sense of "stratification", a vague general societal schema of the relative position of people, devoid of the relationality that groups necessarily imply.

This has its uses. It's radically empirical, for one, and does not have to artificially draw lines to separate areas by virtue of statistical homogeneity or heterogeneity. It's also better for understanding more general senses of things, instead of the concrete historically interwoven class consciousness.

## The specific domains

Occupation classification schema public/private, industry, industrialists/intellectuals

## Overall - homology

# Conclusion

Despite the doubts risen in the discussion, it seems that the main conclusion of the project stands: word embeddings can capture the common “class sense” of the social space – our sense of how the social world is hierarchically differentiated. This capturing of the sense is shown by validation on subjective and objective data. For the objective, the correlation between projections of words on cultural dimensions in the word embeddings space, with objective data on the profiles of individuals pertaining to that word. For the subjective, the correlation between projections of words on cultural dimensions in the word embeddings space, with data on human ranking of these words on scales (or by ranking, with respect to occupational prestige). That the subjective ratings are captured implies that they can approximate human opinion. That the objective structures are captured implies that they capture the homology of the social space with the economic structure (via associations). That there is a relatively better performance on subjective rankings, implies that word embeddings do not just capture habitual collocations of words describing the objective relations of the world, but also associations which diverge from them; biases, or stereotypes. This seems to stand strong in spite of the caveats raised in the discussion – statistically significant correlations do not come for free (unless there is significant hypothesis-free data munging to find them).

The evidence for capturing the homology of the social space was uneven, however. Amongst lifestyles, there was strong evidence for embeddings capturing the relationship between affluence and taste in music genre. Amongst activities, there was also strong evidence, but only in one survey – the other provided insignificant results. Whether this was because of the sample, the style of questioning, or problems with the embeddings, was not clear.

The evidence was strongest in the domain of occupations. Here, significant correlations were found in all dimensions. This was found to extend back through the 20th century as well, though to a lesser degree of efficacy.

Visualising this, however, showed a good degree of discrepancy between expectations and results. There were significant outliers, such as the domain of art producers and the professions that deal with criminals, which seemed to be because of issues specific to their respective domains. The visualisations did capture expectations of the aggregates of each domain. The International Standard Classification of Occupations seemed to do reasonably well in mapping out the space – but only with respect to the dimension of affluence. This classification seemed to be improved with the additional subdivision of the professions into “cultural”, “academic”, and “practical” subgroups – but again, only with respect to the dimension of affluence.

With respect to the hypothesis of embourgeoisement – that lifestyle practices were becoming less “classed” due to the greater disposable income of the working classes – mixed results were found. It was found that the connection between music and affluence remained strong in the survey correlations, indicating that music taste is still related to economic position and perceived as such. Leisure activities also seem to strongly relate to classes, though this was restricted to the UK. When considering the historical trajectory, it seemed that sports and clothing remained most consistent in class connotations, but places of entertainment and leisure seemed to experience the most change. This would indicate that places of entertainment and leisure seem to have experienced the consequences of embourgeoisment, but less so clothing and sports. This was hard to verify without verifying with a deeper reading of the history of lifestyles.

With respect to the hypotheses regarding the professions, it seems that we can midlly confirm their distinctness as a cluster (while suggesting that better subclassification could be used), and not confirm the rise in status, education and affluence. They had the most variance out of the occupational classes, and it seemed that the cultural perception was better subdivided into cultural, practical and academic professions. Their projections onto each of the domains remained relatively stable across the 20th century – against expectations.

The manager occupation bore the most fruit out of the close studies. It seemed that managers increased in connotation of education along the same trajectory as the expansion of business management as a discipline. They also seemed to move discernibly into the lingual space that Boltanski and Chiapello described in *the New Spirit of Capitalism* – but more with respect to the business terminology, than the traits of the “heroic ideal” described. This was surprising, as a large discrepancy between the space of general discourse and business management texts could be imagined.

In summary, it seems that word embeddings provide fruitful potential for analysis. I argue that they are very valuable for researching the perceived homology of lifestyles and economic structure. This is evidenced by their strong correlation with cultural surveys. They can also be used to investigate hypotheses in the field of sociology like embourgeoisement in the space of lifestyles and transformations in the structure of the labour force – but the more detailed one goes with analyses, the more risk there is for error and flippant speculation.

Word embeddings are an experiment. Research is young, and applied research even more so. With that, much work with it feels like fumbling in the dark (of a black box). Initially, nothing is visible, but you depend on your memory of what others told you the layout was. Gradually, you can feel the contours of the room, many of them matching what they told you, but many of them feel completely different – perhaps because they were wrong, or perhaps because you misheard. Gradually, you get a knack of the space, something of an awareness, but always mistier and more heuristic than that which your eyes can do. Describing it to others is another task – how would you draw that space you felt only with your hands and body? Most artificial intelligence has justified itself because it *worked*. It performed well at some specified task. But when we ask questions and seek its answer, it is hard to know how to listen to the answer, or whether we should at all. Word embeddings seem to promise a window into past cultures on a scale that isn’t found elsewhere, but it is hard to know how to look through it, or whether we trust what it sees. Methods are developing for validating them and the picture seems clearer, but throughout working with them on this project there was a prevailing sense of doubt. Some has been allayed, but much of it remains, and there remains to be established a greater body of knowledge that can help quash this doubt.

# Future Work

# Appendix

The resultant collections were of the following sizes:

- English One Million: 31.98 gig

- ENG\\_ALL\_12: 3.67 gb

- us12: 160gb

- gb12: 52.6gb

- eng\_fic12: 23.4gb