The Cultural Devaluation of Feminized Work: The Evolution of U.S. Occupational Prestige and Gender Typing in Linguistic Representations, 1900 to 2019

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Abstract

Previous research on occupational devaluation typically evaluates the potential wage declines associated with a significant inflow of women into an occupation; results have been mixed. Few studies, however, examine the cultural mechanism central to the thesis, where an occupation's symbolic value in multiple dimensions changes in response to the dynamics of its cultural association with women. This article proposes a new semantic approach to trace the devaluation process in U.S. culture, where occupation titles appear in scholarly and public discourses with varied semantic proximity to gender- and prestige-signaling phrases over time. Decade-specific occupation embedding (1900 to 2019) from 127 billion words of American English across genres and a novel fixed-effects estimator show a latent cultural bias against women's work, such that an occupation's general prestige and perceived potency (but not its moral standing) declines when it becomes increasingly stereotyped as female. The largest penalties are found in lower- and middle-wage occupations; most high-wage occupations, despite experiencing large increases in female share in recent years, are persistently stereotyped as male professions without a prestige loss. In total, the cultural mechanism of devaluation accounts for 22.4 to 25.9 percent of the observed negative link between occupations' female typing and hourly wages.

Keywords

occupational devaluation, work and occupations, gender inequality, natural language processing, culture

Not only do female-dominated occupations pay less than their male-dominated counterparts, but occupations that experience a disproportionate inflow of female workers—meaning they are objectively feminized—may decline in prestige and pay (Levanon, England, and Allison 2009).[1] Two major theories that differ in the extent to which economic systems are culturally embedded have
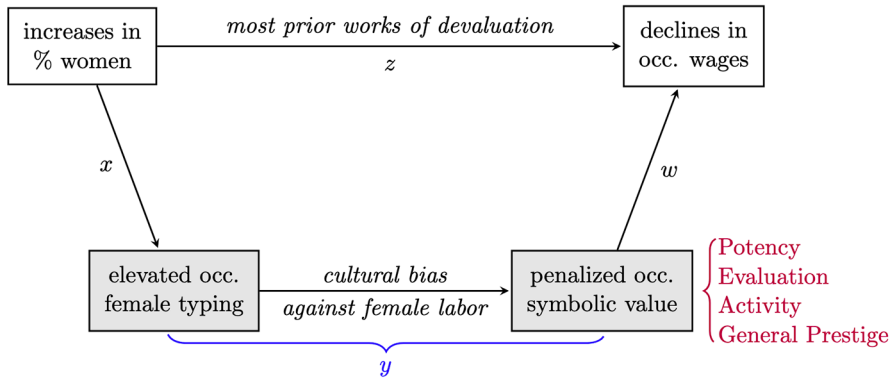
emerged to account for the association. First, the compensating differentials model from

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Figure 1. Cultural Mechanism of Occupational Devaluation in Response to Feminization

economics, which is essentially *acultural*, argues that female workers, who typically do most of the childcare, prefer shorter and more flexible working hours (Goldin 2014; Mas and Pallais 2017); an inflow of women that results from or causes the provision of family-friendly work amenities allows employers to set lower wages in exchange for nonpecuniary benefits. Second, the alternative devaluation framework from sociology, which bridges *cultural* and market dynamics, hypothesizes that skills involving nurture, care, and emotional sensitivity, which are typically associated with women, are perceived to deserve less reward and are seen as lower in status by society (England 1992); accordingly, occupations with an increasing female share and women-related characteristics incur penalties in prestige and wages (Levanon et al. 2009).

The devaluation of skills and occupations associated with women has been an important locus of sociological studies of the labor market due to the broad consequences for gender segregation and inequality in work. The theory makes no claims about whether occupational gender segregation arises initially from supply-side choices or demand-side discrimination (Levanon et al. 2009), but the biased valuation of women's work that it posits creates cultural and institutional incentives for men to maintain occupational closure

(Tomaskovic-Devey and Skaggs 2002), and discourages male workers from entering traditional female-typical work (England 2010; Pan 2015). The persistent gender segregation that results, coupled with the undervaluation of female labor and associated characteristics, keeps the gender pay gap from its final convergence (Blau and Kahn 2017). As Ridgeway and Correll (2004) theorized, this cultural belief in women's lower value and its resulting unequal distribution of economic resources constitute a gendered social structure, in which durable gender inequality is sustained (Valentino and Vaisey 2022).

Despite the theoretical importance of the devaluation framework, recent studies of devaluation that examine the wage changes associated with occupational feminization (path z in Figure 1) have had contradictory findings, raising concerns over its empirical validity. Some studies have found the predicted wage declines associated with women's increasing entry into occupations (Harris 2022; Levanon et al. 2009; Mandel 2013, 2018), whereas others have found no such patterns (England, Allison, and Wu 2007), or have found evidence that men may be peculiarly rewarded (Busch 2018). As Busch (2018) and Grönlund and Magnusson (2013) note, these mixed empirical findings reflect, in part, the mismatch between the devaluation theory and how it has been operationalized:

while devaluation entails a *cultural bias*, or a *value* judgment against subjectively assessed *stereotypical* women's work (path y in Figure 1), empirical studies have focused exclusively on the *wage* declines associated with objective, *compositional* change (path z), an association that does not necessarily stem from nor directly suggest a *cultural* devaluation of feminized occupations. This is not only due to the possibility that competing theories may account for the association (path z), but also to the potential mismatch between occupations' actual gender *composition* and their *stereotypical* association with women (path x) (Lueptow, Garovich-Szabo, and Lueptow 2001; White and White 2006), or between their actual *wage* and symbolic *value*—a construct that is likely to be multidimensional, reflecting judgments about an occupation's prestige, power, and moral standing beyond its pure material or economic situation (MacKinnon and Langford 1994; Valentino 2020). Without directly evaluating the cultural linkage between the changes in occupations' stereotypical femininity and symbolic value, the devaluation theory remains largely under-examined, despite the abundance of studies purporting to test the perspective.

This article highlights and formally evaluates devaluation as a *cultural process* in the collective understanding of occupations, where occupations' cultural associations with women (i.e., gender typing) are first formed in response to the changing actual proportion of women in the labor market (path x in Figure 1), *and* any such shifts in occupational gender typing change how the occupations are symbolically valued (path y in Figure 1). These symbolic values are likely to be multidimensional, encompassing perceived powerfulness (potency), moral standing (evaluation), and liveliness (or activity, assessed based on perceptual stimulation, such as whether an occupation is seen as noisy or quiet, fast- or slow-paced)—which together form the affective, micro-interactional basis of occupational prestige (MacKinnon and Langford 1994), alongside a residual component of general prestige not captured by these three.

These two underlying processes were identified by Busch (2018), yet no studies to my knowledge have evaluated these two pathways (path x and y) in the devaluation thesis, for at least two practical reasons. First, occupation-specific measures of subjective gender typing have been scarce, and the existing measures are mostly either cross-sectional (Williams and Best 1990) or focus on a small set of occupations as part of a word list (Jenkins, Russell, and Suci 1958). Most studies have assumed that occupations are seen as more female when they objectively feminize, despite the potential cultural inertia and mismatch in the update of gender beliefs (Lueptow et al. 2001; White and White 2006). Second, survey-based measures of occupational prestige are updated infrequently (Nakao and Treas 1994; Siegel 1971; Smith and Son 2014), partly because these measures are costly and are relatively stable over a short period of time (Treiman 1977). The relative lack of temporal variations in both occupational gender typing and prestige measures makes it difficult to trace the dynamics of these two cultural dimensions, which are central to the devaluation framework.

I address these two practical hurdles by leveraging the massive historical records of language that provide unparalleled temporal variations in the conceptions of gender typing and symbolic value of occupations since the dawn of the twentieth century. This analysis is enabled by recent advances in Natural Language Processing (NLP), which have shown promising potential in the understanding of collective framing and schemata in culture based on unstructured texts (Evans and Aceves 2016), including the way people construe social class (Kozlowski, Taddy, and Evans 2019) and social cleavages and relations (Charlesworth, Caliskan, and Banaji 2022; Garg et al. 2018). One prominent example of NLP techniques is the word embedding model: by mathematically learning the semantic relation between words, previous studies using the algorithm found that occupation titles in historical and contemporary

texts are embedded in a semantic network, in which their positions relative to other phrases can reflect important cultural properties, such as their social status (Kmetty, Koltai, and Rudas 2021) and gender biases (Bolukbasi et al. 2016). Using such embedding models, I construct a series of decade-specific (1900 to 2019), longitudinal measures of occupational gender typing and multiple dimensions of occupational prestige from 127 billion instances of American English words across a wide range of genres. These measures, based on each occupation's linguistic distance to gender- and prestige-signaling phrases in text, generally align with the actual labor market patterns (i.e., actual gender composition versus text-based gender typing in cross section) and with survey approaches to measuring occupational prestige.

Using these two novel cultural measures of occupational gender typing and prestige embedded in historical text, I find results broadly consistent with the devaluation hypothesis—although the process unfolds unevenly across the occupational spectrum and across different dimensions of symbolic value. I highlight two substantively new findings. First, while gender desegregation and women's growing workforce participation have occurred mainly in high-wage professional and managerial occupations in more recent years (Blau and Kahn 2017; England 2010), the *cultural* feminization of work has taken place primarily in low- and middle-wage occupations where women entered earlier. Many high-earning professional occupations remain stereotyped as male, partly because gender desegregation has occurred mostly in their lower tiers, and the more prestigious upper tiers—the prototypical images associated with occupational status—have changed much less. Second, once an occupation becomes culturally more associated with women, it tends to experience a decline in general prestige and perceived potency. This devaluation effect is *not* fully explained by changes in education, skill, or average experience of the occupation, nor is

it primarily driven by reverse causality, where feminization follows declining prestige. I find *no* or only *weak* evidence that increased cultural association with women affects occupations' moral evaluation or liveliness—two other affective bases of prestige. Overall, the cultural process of devaluation appears to be an important mechanism linking occupational gender typing to wages, highlighting the cultural embeddedness of the economic system theorized by cultural and economic sociologists (Zelizer 2000).

I make three contributions to the current literature. Substantively, this study is, to my knowledge, the first to examine the cultural foundations of devaluation—linking shifts in an occupation's cultural association with femininity to changes in its symbolic value. In contrast to prior inconclusive findings on wage devaluation, I document consistent cultural biases against feminized work, particularly in lower- and middle-wage occupations, along the dimensions of potency and general prestige. These symbolic penalties may contribute to persistent gender inequality in the labor market, which is unlikely to diminish without broader cultural changes (Goldin 2014; Ridgeway and Correll 2004). Methodologically, I demonstrate the potential of text-based embedding models for studying labor market stratification, enabling researchers to evaluate core theories of gender inequality—specifically the devaluation perspective—using cultural data spanning more than a century. Importantly, these measures can be linked to occupation-level economic indicators such as gender composition and real wages, creating opportunities for scholars to bridge cultural and market dynamics in the analysis of social stratification. Finally, for scholars of U.S. cultural change, I make available word embedding vectors (1900 to 2019) by decade, which complement the *HistWords* project (Hamilton, Leskovec, and Jurafsky 2016) that did not include the Google Ngram corpora used in this article, partly due to their computational demands.

CHANGE OF OCCUPATION WAGES RELATIVE TO WOMEN'S ENTRY

In the early 1970s, the sharp division of the U.S. labor market into "men's occupations" and "women's occupations" started to unravel, and women increasingly joined occupations and other sectors traditionally dominated by men. A series of policy and technological changes contributed to the historical process, including passage of Title VII of the Civil Rights Act (1964) and Title IX of the Education Amendments (1972), which made explicit gender discrimination in education and employment illegal, the invention of and access to contraceptive technologies (Bailey 2006), and cultural shifts in attitudes about women's roles in the public sphere. Despite the slowed and incomplete desegregation of the workforce in recent years (England 2010), increased structural opportunities for women have significantly closed the gender gap in the share of employment and earnings (Blau and Kahn 2017).

Most studies seeking to test the devaluation perspective relative to the historical shift in women's labor force participation using longitudinal data assess whether *wages* change when an occupation's female share increases (i.e., feminizes), assuming that earnings are the most important dimension of occupational status to be penalized. Results are mixed.[2] On the one hand, drawing on data from 1960 to 2010, Levanon and colleagues (2009) showed that an increase in female share of an occupation in the prior decade was, on average, negatively associated with its median wage in the current decade for both men and women. Similarly, using a multilevel model that controls for both person- and occupation-specific characteristics, Mandel (2013, 2018) found that men's wages declined as their occupations feminized in a 10- and 20-year window, with the largest penalties found in recent years. Considering that the gender composition in these studies is hardly exogenous, thus making causal inference questionable, Harris (2022) constructed a shift-share instrument from education-induced changes of occupational gender composition and, analyzing data from 1960 to 2010, found that, on average during this period, an increase in female share in a typical occupation was associated with both male and female wage declines in the concurrent decade.[1]

By contrast, other studies examining whether within-occupation shifts in pay are associated with changes in gender composition have found weak or no evidence for devaluation. Busch (2018) found that the negative effect of occupational feminization on wages was suffered mostly by women in the bottom 80 percent of the wage distribution between 1960 and 1980, with no average effects between 1960 and 2010. In contrast to the male wage penalties suggested by Mandel (2018), Busch (2018) found that men receive wage rewards after occupational feminization, potentially as a result of the glass escalator effect, in which men are tokenized in a newly women-dominated environment. Using a dynamic panel model with a lagged dependent variable based on the data from 1950 to 2000, England and colleagues (2007) tested different lagging periods and found wage penalties associated with an increasing female share in less than half the models. The authors speculated the causal relationship between gender composition and wages in the early history of occupational changes was frozen by institutional inertia in subsequent years.

A final set of studies debates whether the wage penalties associated with objective feminization, if any, are heterogeneous across occupations. Drawing on data from 1960 to 2010, Busch (2018) found that occupations at the middle- and lower-end of the spectrum incur a lowering of their wage, whereas high-income professional and managerial occupations experienced wage growth on average with a rising female share. By contrast, Mandel (2013) found the largest wage declines in high-paying professional occupations over the full study period from 1970 to 2007, resonating with Goldin's (2014) hypothesis that

women's "pollution" of an occupation's perceived productivity and status will be greatest in prestigious high-income, male-typed professions. These contradictions pose an empirical puzzle for the devaluation hypothesis that has largely been overlooked. As Harris (2022) cautions, many high-paying professional occupations in law, medicine, and business—fields that have seen significant feminization since the 1970s (England, Levine, and Mishel 2020)—have also experienced steeper wage growth than the rest of the workforce, and arguably have not lost prestige. Yet scholars working within the devaluation framework often claim the opposite, without offering clear explanations or reconciliation.

Some ad hoc explanations have been offered to accommodate the contradictory results,[3] but scholars caution that the lack of studies that directly examine the causal mechanism of devaluation may underlie the inconsistencies (Busch 2018; Grönlund and Magnusson 2013).[4] Importantly, while devaluation is foremost a cultural conception that associates women's work with lower cultural status and valuation (England 1992), most current studies focus exclusively on changes in wages relative to changes in occupational gender composition, an association that does not necessarily arise from cultural devaluation (e.g., it could arise through compensating differentials that are noncultural), nor speak to other nonpecuniary dimensions of status that may respond to feminization. By using female share as the most important explanatory variable, research has also assumed that *objective* feminization naturally leads occupations to be seen as more female typed, offering an instant *cultural* basis for occupations to be evaluated on various dimensions of prestige. This simple assumption, as some prior studies have questioned and this article will show, does not always hold.

THE CULTURAL BASIS OF DEVALUATION

In contrast to the abundant discussions about the effect on wages of occupational feminization, few prior studies have directly evaluated devaluation as a cultural phenomenon (England 1992), where the symbolic value of the occupation beyond its material compensation changes as a result of the gender stereotypes newly associated with the occupation. This cultural phenomenon involves two necessary underlying cultural processes, which form the base of the devaluation theory (Busch 2018). First, any cultural evaluation implied by the devaluation hypothesis depends on an occupation's stereotypical association with women—a *symbolic* characteristic that largely originates from labor market demographics (i.e., process x in Figure 1). However, a shift in an occupation's cultural affinity with women as a result of demographic changes does not naturally occur nor necessarily hold in the short run, partly because the gender typing of occupations, once formed, may be stickier than the actual compositional changes.

For example, despite gender desegregation in various socioeconomic domains from 1974 to 1997, Lueptow and colleagues (2001:29) found that the ideals of femininity and the gender typing of occupations have remained largely stable, potentially due to inertia in the acquisition of new cultural norms. Similarly, despite women's movement into management roles, the gender typing of managers, and the stereotypes of female leaders being less agentic and task-oriented, remains resilient among male college students (Duehr and Bono 2006). Persistent gender stereotyping at the management level, according to Lawson and colleagues (2022), may partly stem from the continuing underrepresentation of women at the top levels of managerial leadership, including CEO positions and board memberships that are culturally most salient.

In other cases, even survey-based measures of subjective stereotyping may fail to measure the actual, implicit stereotypes people hold toward certain occupations (White and White 2006). One typical example is accounting: although survey respondents *explicitly* classified accountants as a gender-neutral occupation in the 1980s (Beggs and

Doolittle 1993) when women made up around half the industry, laboratory experiments show subjects *implicitly* link accounting with men's work, partly because male accountants once dominated the industry (White and White 2006).

The second core cultural process of devaluation links the change in gender typing with a shift in subjective valuation of occupations across multiple dimensions, prior to any possible later changes in pecuniary compensations (path y in Figure 1). However, few studies have examined this path due to the lack of systematic longitudinal data on occupational gender typing and symbolic valuation. Some of the best causal evidence comes from experimental studies that mixed the two processes x and y, where respondents were given different descriptions of the gender composition of the *same* occupation and were asked to rate its general social standing.[5] Touhey (1974), for example, found that an occupation's prestige and desirability decreases when respondents anticipate an increased proportion of female workers, and respondents have an increased sense of the occupation's passiveness, insecurity, and uselessness. Subsequent studies (Suchner 1979; White, Crino, and DeSanctis 1981), however, failed to find the same results, and the authors speculated that the findings of sexist biases against occupational feminization in Touhey (1974), if any, do not represent a continuing, generalizable bias in other populations.

OCCUPATIONAL PRESTIGE AND OCCUPATIONAL GENDER TYPING OR COMPOSITION

Recognizing that devaluation, as a cultural phenomenon, operates first through the symbolic value of an occupation rather than its wage, some studies shifted focus to occupational prestige—typically measured in social surveys as a unidimensional construct—and examined its relationship to an occupation's gender typing or actual gender composition. These studies are typically cross-sectional and yield mixed findings. The first strand of such studies found that people rate male-typed occupations as higher in prestige. In a study asking respondents to rate 25 occupations' gender typing and prestige, Oswald (2003) found that occupations regarded as male-typed are rated higher in prestige than their female counterparts. Similarly, Bose and Rossi (1983) found that female-typed occupations are rated lower in prestige, on average and among the most prestigious occupations. Similar results that suggest a monotonic relation between occupational gender typing and prestige were reported in Xu and Leffler (1992) and Touhey (1974).

Other studies, however, have found no significant differences in prestige by actual occupational gender composition (for an early review, see Warren, Sheridan, and Hauser 1998). Using the Hodge-Siegel-Rossi prestige scale with controls for occupational task complexity, education, and on-the-job training, England (1979) found that an occupation's female share does not predict prestige. Similarly, Treiman and Terrell (1975), Fox and Suschnigg (1989), and Suchner (1979) failed to find evidence for substantive differences in prestige between male- and female-typed occupations. The absence of a prestige gap alongside a persistent wage gap between male- and female-dominated occupations presents a paradox (Warren et al. 1998): even when women work in occupations with similar levels of prestige as those dominated by men, their occupations still receive lower compensation. This contradiction has led some devaluation theorists to argue that conventional prestige measures fail to capture gendered labor market inequality, even as female-dominated work continues to be devalued (England 1979).

A nuanced group of studies questions the linearity (or monotonicity) of the association, finding that gender-mixed or segregated occupations have particularly high prestige. Krueger, Ebner, and Rohrbach-Schmidt (2022) and Valentino (2020), for example, found a "segregation premium" in occupational prestige, where either male- or

female-dominated occupations are valued higher than mixed-gender occupations. The curvilinear relation may arise from the psychology of benevolent sexism, where women are venerated and symbolically rewarded for performing duties that are stereotypically feminine, such as household and care work, or reflecting feminine traits, such as beauty and fragility (Glick and Fiske 1996). Gender-integrated occupations, on the other hand, may create "status contradictions" (Hughes 1945), where any desegregation of occupations that were once male- or female-typed may create psychological tensions and be penalized in their symbolic worth. By contrast, Magnusson (2009) found that prestige is highest in gender-integrated occupations, and that women-typed care work does not have lower prestige than other tasks, although no theories are explicitly given to account for the reversed curvilinearity.

This series of studies has some limitations in advancing our understanding of the cultural mechanism underlying devaluation. First, while feminization and its symbolic consequences are inherently *dynamic*—with changes in female representation or gender typing reshaping an occupation's symbolic value—most prior studies evaluate stereotypes and prestige *statically*, at a single point in time. This creates a conceptual mismatch between the theory and the estimation strategy. Second, the sample sizes in many survey-based studies range from a few hundred to a few thousand, and some rely on data from a single college (Touhey 1974) or county (Bose and Rossi 1983), raising concerns about the generalizability of their findings (White et al. 1981).

Third, and more important from a theoretical perspective, the prestige measures used in these studies are predominantly drawn from surveys in which respondents rank occupations along a *single dimension*. This unidimensionality has been criticized for obscuring the multiple ways individuals perceive occupational status. Psychological research shows that people evaluate occupational prestige along *multiple dimensions*, each of which may

relate differently to gender typing (MacKinnon and Langford 1994). Notably, evaluation (moral worthiness) and potency (power and influence)—the two principal affective components of prestige—are culturally associated with femininity and masculinity, respectively (Freeland and Harnois 2020).[6] When aggregated into a single prestige score, opposing associations between gender typing and these dimensions may cancel out, producing a seemingly null relationship between gender composition and prestige (England 1979; Treiman and Terrell 1975). The relative weight of evaluation in determining overall prestige (Freeland and Hoey 2018; MacKinnon and Langford 1994) may also explain the higher prestige of some female-dominated occupations (e.g., flight attendants or occupational therapists) found in recent studies (Valentino 2020). Part E.3 of the online supplement explores how past mixed cross-sectional results may stem from treating occupational prestige as a unidimensional construct, an issue this article seeks to address.

A SEMANTIC APPROACH TO THE DEVALUATION PROCESS

Occupational stereotypes are seen not only through the surveys and experiments that many prior studies of devaluation relied on; recent studies have recognized that unstructured human expressions, such as languages (Caliskan, Bryson, and Narayanan 2017) and images (Guilbeault et al. 2024), also encode cultural frames, schema, and the collective understanding of social facts (DiMaggio 1997; Evans and Aceves 2016), including gender biases (Bolukbasi et al. 2016) and prestige of occupations (Kmetty et al. 2021). In the simplest form, the way language encodes social stereotypes can be seen in gendered occupation titles and descriptions. For example, previous studies have found that phrases like "he aims to become a venerated engineer" or "she is just an attendant" are more frequently used than "she is studying to become just an engineer" or "he is a prestigious attendant," underscoring the semantic

affinity between engineer (or attendant) and men (or women) and status (or relative unimportance) (Caliskan et al. 2017).

Some of these prejudices in language are pertinent to studies of devaluation, although little work by occupational stratification scholars has explored this issue. From a descriptive perspective, the English language contains more words that refer to men than to women (Maass and Arcuri 1996); of those that are associated with women, many have experienced derogation in status over time because of the cultural bias against women. For example, the term *governess*, which was once closely linked with a female political leader, has come to mean a woman responsible for the private education of children (Schulz 1975), losing its original power and potency. Similarly, *mistress* was once a feminine form of *master* and meant a woman with authority and control, but it now mostly refers to a woman who is in an extramarital sexual relationship and is financially supported by a married man. The linguistic context in which the word "mistress" frequently appears has shifted from one of prestige and authority to one of disgrace and economic dependence.

These changing semantics of social positions are not isolated cases. Scholars have noted that the cultural frames of social stratification are deeply embedded in language, shaping how a wide range of occupations and social roles are understood. For example, using word embedding models that represent meaning through semantic context (Harris 1954; Mikolov et al. 2013), Kmetty and colleagues (2021) analyzed the Common Crawl corpus (a large-scale collection of web page texts from 2011 to 2017) and found a strong correspondence between the occupational structure in semantic space and the actual stratification system. Latent factor analyses of occupation titles revealed underlying dimensions such as gender, proximity to healthcare and media, and prestige, with the prestige dimension closely aligning with the International Socio-Economic Index (ISEI), which is based on education and income. Similarly, Stoltz (2023) found that occupations

semantically associated with disembodiment, as well as proximity to the head and visual modality, were positively correlated with survey-based measures of occupational prestige.

Scholars have leveraged the semantic structure of occupations—where gender components are embedded—to examine the stereotypical association of common occupations with men and women. Pioneering work by Bolukbasi and colleagues (2016) and Caliskan and colleagues (2017), for example, found that gender typing in Google News articles across 50 occupations closely mirrors the patterns observed among human raters. Garg and colleagues (2018) further show that gender typing of occupations has become less pronounced over time, reflecting women's increasing labor force participation. Occupations are not the only domain where gender schemata are encoded: Kozlowski and colleagues (2019:923) found that femininity was culturally associated with wealth throughout the twentieth century, often through portrayals of wives and daughters as "vessels for men's vicarious consumption." In addition, Charlesworth and colleagues (2022) show that portrayals of men as competent and women as charming remained remarkably stable over 200 years, and Jones and colleagues (2020) found a decline in gender stereotypes related to family, career, science, and arts. These cultural framings of gender may interact with the stratification system and shape how people evaluate the status and gendered meanings of occupations.

The emergence of gender typing and prestige schemata encoded in unstructured text offers a unique opportunity to evaluate the devaluation theory while addressing some key limitations of prior survey-based designs. First, while earlier studies often relied on small samples (Touhey 1974; White et al. 1981), embedding models draw from corpora written by millions of authors across time and space—representing a scale of cultural input unmatched in traditional methods (Evans and Aceves 2016). The language patterns of these "respondents" often reflect *implicit* social biases embedded in cultural norms, without

being explicitly prompted, as in surveys. Second, whereas surveys typically elicit answers to *single* questions about cultural meanings, large corpora encode thousands of recurring concepts, allowing key occupation-specific cultural schemata—including multidimensional symbolic value (MacKinnon and Langford 1994)—to be inferred from the semantic network, or what some call the "geometry of cultural concepts" (Kozlowski et al. 2019). Finally, because many historical texts are preserved in digital or archival form, collective cultural schemata can be observed not just cross-sectionally but over long stretches of time (Charlesworth et al. 2022). This extensive *temporal variation* in occupations' gender typing and symbolic value is a critical strength of this article, enabling an evaluation of the cultural micro-foundation of devaluation as a temporally dynamic process (path y in Figure 1).

HYPOTHESES

To study the devaluation of feminized work as a cultural process, I construct a new set of longitudinal measures of occupational gender typing and symbolic value from textual data, and use them to evaluate a set of hypotheses grounded in prior literature. I begin by examining the stereotypical feminization of an occupation (path x in Figure 1) and its potential heterogeneity in response to changes in its objective gender composition—an essential cultural foundation for any subsequent devaluation to occur.

> *Hypothesis 1.1:* Over time, occupations at all wage levels that experienced a rising share of female workers will be increasingly stereotyped as female.

Most prior studies of devaluation assume that Hypothesis 1.1 holds naturally and universally, without accounting for the historical gender structure of occupations or the uneven gender desegregation that may occur *within* them. However, psychological research suggests that implicit gender associations are relatively persistent and often shaped by an

occupation's past gender composition (White and White 2006). Recent work also highlights the continued male dominance at upper levels of high-paying professional and managerial occupations—positions that are often culturally most visible (Lawson et al. 2022). Taken together, these findings suggest that cultural inertia in gender typing may be especially pronounced in traditionally male-dominated, high-income occupations where within-occupation segregation persists.

> *Hypothesis 1.2:* Over time, occupations that experienced a rising share of female workers will become more strongly stereotyped as female, except in the case of high-paying professional and managerial occupations, where this association is expected to be weaker or absent.

I proceed to a longitudinal evaluation of the two core cultural properties—gender typing and symbolic value—within the same occupation over time, which forms the main micro-foundation of devaluation (path y in Figure 1). The four interpretable dimensions of the normative content of occupational valuation, that is, potency, evaluation, activity, and remaining general prestige (MacKinnon and Langford 1994), are expected to change relative to the shift in gender typing.

> *Hypothesis 2.1:* Over time, occupations that come to be increasingly (decreasingly) stereotyped as female lose (gain) positive symbolic value in all their normative dimensions.

Some studies, however, have noted that moral evaluation—one of the four dimensions of prestige considered in this article—is culturally associated with femininity, such that occupations with increased female typing may be perceived as more morally virtuous or pure (Freeland and Harnois 2020). By contrast, potency and competence are typically associated with masculinity, and greater cultural feminization may reduce the extent to which occupations are perceived as powerful or competent. The relationship between

perceived liveliness and female typing is less clearly established in the literature.

> *Hypothesis 2.2:* Over time, occupations that come to be increasingly (decreasingly) stereotyped as female lose (gain) positive symbolic value in potency and general prestige, but not in moral standing or liveliness.

Finally, I evaluate whether cultural devaluation serves as the key mechanism linking an occupation's cultural association with women to its average wages—a relationship emphasized in prior studies of devaluation. This analysis is grounded in the premise that wages are shaped, in part, by the cultural valuation of occupations, as this valuation diffuses through society in response to feminization (Freeland and Harnois 2020).

> *Hypothesis 3:* Cultural devaluation significantly mediates the relationship between an occupation's gender typing and its objective hourly wage.

DATA

I draw on multiple textual data sources to study the shared understanding of occupations and to interrogate gender typing and prestige of occupations in multiple time points over a century. These data are processed in a neural-network language model, which measures each occupation title's semantic closeness to cultural concepts such as men and women (e.g., engineer is closer to men; attendant is closer to women). I then leverage other non-textual sources, such as Census-based measures of each occupation's gender composition and survey-based measures of occupation prestige, to validate the semantic measures of gender typing and symbolic value.

Word Embedding Data

I first leverage the second version of the Google Ngram corpus, which distills text from around 8 million books, or 6 percent of all books ever published across eight languages, from university libraries around the world (Lin et al. 2012; Michel et al. 2011). I focus on the American English corpus, which encompasses a wide range of genres, including novels, government documents, and scientific publications, enabling recovery of major as well as subtle linguistic frameworks that appear widely in the general discourse. Any sequence of n words that occurs more than 40 times over the entire corpus between 1500 and 2009, such as "the United States of America" ($n = 5$), appears in the collection of n-grams, along with the number of times it occurs each year. In light of copyright constraints (Michel et al. 2011), n is restricted to below 5 in the original release, and I use the 5-gram to maximize available semantic information in each sequence. I restrict the data to 1900 to 2009, as many modern occupations, such as professional sociologists, did not emerge until the late nineteenth century.

Despite being uniquely massive and powerful, Ngram data have been criticized for their potential bias in representing the total literary output and the general public. For example, Pechenick, Danforth, and Dodds (2015) caution that Ngram may overrepresent scientific works over other literature without adjusting for the scope and breadth of the document popularity. As scientific publications encode fewer social stereotypes than do non-scientific ones (Shi, Yan, and Xu 2021), the disproportionate share of scientific writings may underestimate typical gender stereotypes in the shared conception of occupations. Moreover, authors of government reports and academic articles are typically better-educated and socially more advantaged than the general public; their views on occupational prestige are likely to be more homogeneous (Lynn and Ellerbach 2017) and favor professions that require higher levels of human (education) and cultural capital (Valentino 2021).

In view of the Ngram's limitations, prior works suggest the use of alternative corpora in the same period to cross-validate Ngram-based analyses (Younes and Reips 2019). I

supplement the analyses with the Corpus of Historical American English (COHA, 1900 to 2009) and the Corpus of Contemporary American English (COCA, 1990 to 2019), the two largest structured corpora so far that include a wider range of sources of language (Davies 2010). Besides academic publications and fictions, COHA and COCA include scripts from U.S. TV shows and movies, as well as articles in newspapers and popular magazines throughout the period. To reflect the emergence of the internet in mass communication since the 1990s, COCA further samples paragraphs from blogs and other web pages. Notably, both corpora are balanced by genre (fiction versus magazine) and subgenre (poetry versus prose) by decade, ensuring the data reflect actual shifts in the public discourse instead of changes of composition. Given the substantive similarity of the two corpora, I merge the two text sources to form the Corpus of Contemporary and Historical American English (COCHA), which spans 120 years. Table S1 in the online supplement lists the total number of words that appears in each corpus by decade: Google Ngram includes more than 126 billion words over a century, and genre-balanced COHA and COCA combined consist of around another 1 billion words.

Validation Data

I validate the text-based measures of occupational schemata (i.e., gender typing and prestige) by a series of census- and survey-based data. First, while the *change* in some occupations' cultural association with women may be lagged and mismatched from the actual composition change, over the whole spectrum of occupations, I expect the *level* of gender typing to generally align with the actual gender composition, as found in prior studies (Bolukbasi et al. 2016). Accordingly, I draw on the Decennial Census for 1900 to 2000, where individual-level information on gender and occupation are available via IPUMS (Ruggles et al. 2025). I exclude individuals younger than 18, older than 65, or who are

not employed in the civilian labor force, and I harmonize occupations to the 1950 Census Occupation Code (COC) system. For validation, I compare the text-based gender typing with the person-weight-adjusted share of female workers in each occupation in each decade.

The text-based measure of occupational prestige is compared with a set of survey-based prestige measures, where a sample of respondents representative of the general public rate the general standing of occupations (Blau and Duncan 1967). The earliest measure for cross-validation comes from Siegel's (1971) prestige scores from a series of surveys conducted by the National Opinion Research Center in 1963 to 1965. Nakao and Treas (1994) subsequently updated the measures in the 1989 General Social Survey (GSS).[7] I harmonize each measure to the 1950 COC standard; in case multiple categories correspond to a single occupation in the 1950 system, I calculate the mean prestige score. To ensure comparability, I match the text- and survey-based prestige measures by decade. The Siegel's (1971) index, for example, is paired with publications in 1960 to 1969.

To benchmark the degree of alignment between text- and survey-based measures of occupational prestige, I supplement with several decade-specific benchmark indices measuring occupations' earnings or education, which are common regressors of prestige scores and are used to create measures of occupations' socioeconomic status (Treiman 1977). They include z-score standardized annual median income (ERSCOR50 in IPUMS) and the percentage of people with one or more years of college education (EDSCOR50), both compiled and standardized by IPUMS. I also include the Nam-Powers-Boyd occupational status score (NPBOSS50), which combines the measures of annual median income and median years of education with equal weights. The three measures that have been updated since 1950 are backward standardized to the 1950 COC system.

ANALYTIC STRATEGY

Word Embedding Model

I use the skip-gram with negative-sampling (SGNS), one of the most widely used word embedding algorithms (Kozlowski et al. 2019; Mikolov et al. 2013), to study the social schema of occupations embedded in text. Word embedding models represent the meaning of words by the *local semantic context* (i.e., surrounding words) in which they typically appear in a multidimensional vector space (Mikolov et al. 2013), where semantically similar words tend to share a closer vector space. For example, in the text of Google News, the words *men* and *doctor* appear more frequently with words such as *work*, *rewarding*, and *authority*, whereas the word *women* appears less commonly in this context (Caliskan et al. 2017). SGNS thus links *doctor* with *men* more than with *women* and places them closer in the vector space. Substantively, by learning the linguistic relations between words, word embedding models can reveal latent social schemata associated with occupation titles, including their stereotypical association with men or women (Bolukbasi et al. 2016) and with words that signal high or low symbolic value.

Under the standard SGNS framework, I vectorize the unique *single words* that appear in the three corpora using a shallow two-layered neural network with stochastic gradient descent and back-propagation for Ngram and COCHA data, respectively. The *local semantic context* is defined in a five-word window as per the 5-gram (Ngram) structure. For consistency, texts are trained by decade rather than by year (e.g., 2000 to 2009) to reduce random noise. I exclude words that appear fewer than 100 times in Ngram and 20 times in COCHA. Each 300-dimension embedding vector is normalized to have length 1. Part A.1 of the online supplement documents the mathematical foundations of the SGNS algorithm and the process of hyperparameter tuning.

To represent occupations in a semantic vector space and to ensure comparability over time, I harmonize occupation titles based on the 1950 Census Occupation Code (COC) and map multi-word occupations into single-word titles, with partial reference to the work of Garg and colleagues (2018). For example, *agricultural engineer* is summarized by the titles *agriculturalist*, *agronomist*, and *engineer*, and *professors and instructors in economics* is split into *economist*, *professor*, and *instructor*.[8] The majority of single-word occupation titles have a nontrivial presence in the three corpora: for example, the median number of occurrences of occupation titles in Ngram (2000 to 2009) is about 643,000, and 98.2 percent of titles appear over 100 times—the threshold for the word to be included in SGNS. In total, of the 255 occupations in 1950 COC, 238 occupations have at least one single-word title that exceeds the frequency threshold (100 for Ngram and 20 for COCHA) in at least one decade; when stacked into the decade-specific panel data, each occupation is observed 10.6 and 10.4 times, on average, for Ngram (1900 to 2009) and COCHA (1900 to 2019), respectively. I supplement the analyses when bi-gram occupation titles (e.g., *agricultural engineer* is trained as a single occupation) are trained in COCHA in Part C of the online supplement, where the substantive results remain almost identical.

Descriptively, occupations in different positions on the socioeconomic ladder and divisions of labor are stratified by the *local semantic context* they are embedded in. Figure S2 in the online supplement presents the semantic representation of occupations, where each 300-dimension occupation vector (Ngram, 2000 to 2009) is mapped onto a two-dimensional space through *t*-Distributed Stochastic Neighbor Embedding. Professional and managerial occupations are grouped in a unique position in the semantic space, with a discernible linguistic boundary with craftsmen (Panel A of Figure S2) and with the rest of the workforce (Panel B, where the lower-left corner of Panel A is enlarged). Their distinct linguistic context may stem from their uniquely high-level position in the stratification system by education

and income, as well as by the cultural products their incumbents consume (Bourdieu 1986). Non-professional and non-managerial occupations, on the other hand, share a largely overlapped semantic continuum distant from professional and managerial occupations, although occupations from the same category may form their own clusters in the higher-order space beyond two dimensions.

Measures

Occupational gender typing. To measure an occupation's cultural association with women, I represent the gender subspace in text by a set of antonym words associated with gender compiled from prior works (Garg et al. 2018; Kozlowski et al. 2019) based on multiple thesauri, such as *he-she* and *father-mother* pairs. Occupations that are closer to the word *she* than to *he* in the vector space are semantically linked with women more than with men. To construct a single dimension that encodes gender schema from the list of antonym words, I use the centroid of normalized word vectors that represent female and male, and create the difference of the two antonym centroids (Kozlowski et al. 2019). The resulting difference vector forms the basis for the gender dimension.

Gender typing is measured by the cosine similarity between the occupation title and the dimension of gender schema (Kozlowski et al. 2019), averaged over n single-word occupation names. As word vectors are normalized, cosine similarity between vector $\overrightarrow{w_1}$ and $\overrightarrow{w_2}$ is given by their dot product $\overrightarrow{w_1} \cdot \overrightarrow{w_2}$. Gender typing of *chemical engineer*, for example, averages the cosine similarity between the gender dimension and the vector of words *chemist* and *engineer*. By construction, a positive cosine similarity indicates the occupation is culturally stereotyped as female more than male.

Occupational prestige. Instead of measuring prestige as a single-dimension construct as gender, I create *four* dimensions

of prestige people leverage to evaluate the symbolic value of occupations. Psychological studies unpacking the normative content of occupational prestige have found that the affective, micro-interactional basis of prestige is typically multidimensional, consisting of (at least) three interpretable cognitive components: evaluation (or moral worthiness), potency (or powerfulness and competence), and activity (or liveliness) (MacKinnon and Langford 1994). Recent studies have found that these cultural dimensions are similarly encoded in text, and embedding models are able to represent each dimension by antonym word pairs associated with these concepts (Van Loon and Freese 2023). I follow Van Loon and Freese's (2023) practice and measure an occupation's moral worthiness by word pairs such as *honest-dishonest* and *fair-unfair*; potency by *strong-weak* and *powerful-powerless*; and liveliness by *fast-slow* and *active-inactive*. I consider the remaining *general prestige* of occupations encoded in text that does not directly speak to any of the three components as the fourth dimension. I use word pairs such as *esteemed-lowly* and *honorable-dishonorable* that signal *general* status, as used in Kozlowski and colleagues (2019) (for a complete list of words and thesauri, see Part B.1 of the online supplement). Similar to the measure of gender typing, the cultural affinity of occupations to each prestige dimension is measured by their cosine similarity in the vector space.

While these dimensions are, not surprisingly, correlated with each other (see Table 1), they each measure an important component of symbolic value that may be orthogonal or opposite for each individual occupation. The left panel of Figure 2 presents the relative position of five selected occupations on the three affective dimensions from COCHA, 2010 to 2019. For example, demonstrators and agents are described positively in their work potency, but their moral standing, according to their cosine similarity with the evaluation dimension, are negative. Tailors and nurses, in contrast, are seen as morally justified, yet are not viewed as powerful or competent professions.

Table 1. Association between Survey-Based Occupational Prestige and Four Dimensions of Text-Based Prestige, 1960 and 1990

(1)	Dependent Variable: Survey (GSS) Prestige					
	(2)	(3)	(4)	(5)	(6)	(7)
General prestige	1.379*** (.062)					1.398*** (.075)
Evaluation		.492*** (.102)			.343*** (.099)	.299*** (.083)
Potency			.854*** (.079)		.831*** (.083)	.077 (.085)
Activity				.542*** (.114)	−.066 (.123)	−.350*** (.104)
Observations	822	822	822	822	822	822
R^2	.435	.117	.204	.116	.216	.449

Note: Occupations are weighted by the relative size of their workforce. Corpus and decade fixed effects are included in all models.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ (two-tailed tests).

With the addition of the gender subspace, Figure 3 positions the six selected occupations in the three-dimensional space as structured by the gender and *general prestige* dimensions (5-gram, 1990 to 1999). Two clusters of occupations appear. On the side of male-typed occupations lies *engineers* and *architects*, which are some of the most esteemed occupations in the semantic space; *attendants* and *cleaners*, by contrast, are most closely associated with women and lower prestige. Figure 3 presents a *static* representation of occupation schema in a certain decade, but the devaluation of culturally feminized work, as a *dynamic* process, predicts an average movement of occupation vectors along the dimension *D* over time. Substantively, an occupation's stereotypical shift toward femininity (masculinity) is expected to be associated with a decrease (increase) in general prestige and in other prestige dimensions, such as potency and moral worthiness (Hypothesis 2.1).

Controls

Several text-based measures of occupation characteristics that may be associated with occupational gender typing and prestige are included as covariates in the main analyses. I first control for an occupation's proximity to the phrases that signal cultivation and education, as the pursuit of

abstract knowledge provides an important source of an occupation's esteem and legitimacy (Bourdieu 1986). Typical word pairs for the education/cultivation dimension include *knowledgeable-ignorant*, *educated-uneducated*, and *schooled-unschooled*. Second, I consider an occupation's affinity to descriptions of affluence and wealth (e.g., *rich-poor*, *affluent-destitute*, and *wealthy-impoverished*), which typically affects a position's desirability. Together with the cultural measures of education, they form the basis for the most common measures of occupational socioeconomic status and prestige (Treiman 1977) (for a complete list of words that construct the controlled dimensions, see Part B.1 of the online supplement). According to the right panel of Figure 2 (COCHA, 2010 to 2019), occupations such as nurses (or pharmacists and teachers) are considered cultivated with a positive general prestige yet relatively poor, whereas tailors (or entertainers and auctioneers) are viewed as relatively affluent but less educated.

In robustness checks, I expand the list of controls and include measures from the actual labor market based on the Decennial Census (1940 to 2010), including an occupation's racial composition, mean hourly wages (CPI-adjusted), mean years of education, mean working hours per week, and potential years of experience. As occupations with different degrees of feminization may have unequal
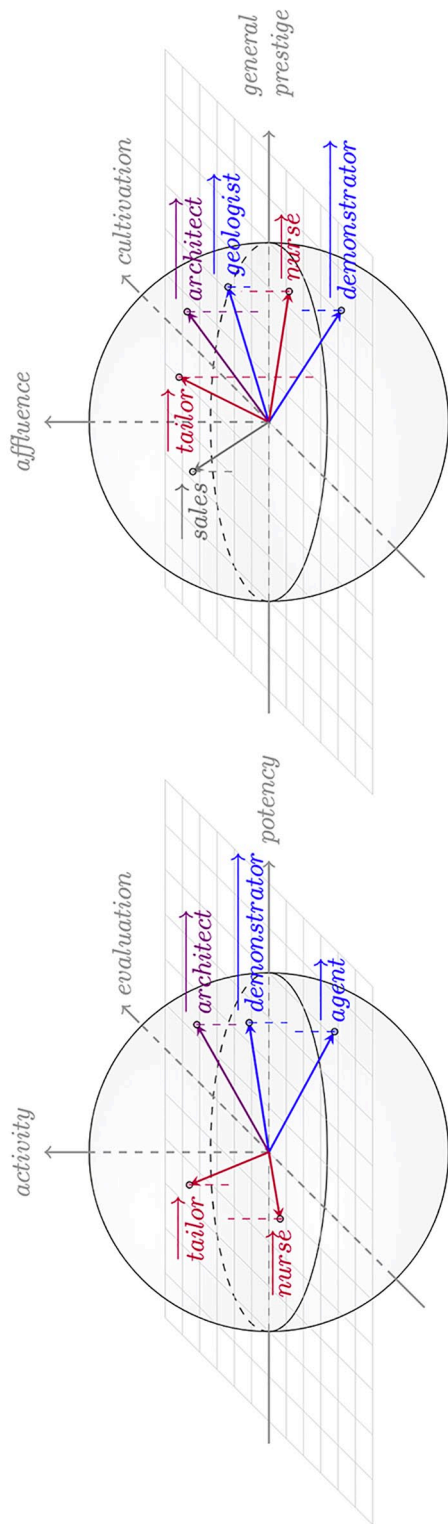
Figure 2. Relative Positions of Occupations on the Four Dimensions of Symbolic Value (Potency, Evaluation, Activity, and General Prestige) (Left Panel); and On the Two Dimensions of Covariates (Cultivation and Affluence) (Right Panel); COCHA, 2010 to 2019
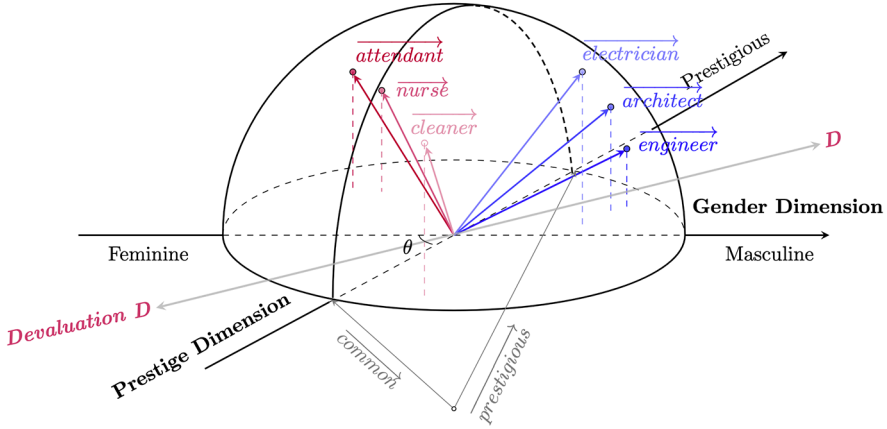
Figure 3. Three-Dimensional Vector Representation of Occupations on the Gender and General Prestige Dimensions, American English Ngram, 1990 to 1999
Note: The prestige and gender dimension is constructed by the difference between the centroids of the two sets of antonym words. Full names of single-word occupations are *engineer:* industrial-engineer; *electrician:* electrical-engineer; *architect:* architect; *attendant:* attendant, hospital and other institution; *nurse:* practical nurse; *cleaner:* laundry and dry cleaning operative.

exposures to technological change and associated rises and declines in their sectorial size and returns to education, I also control for the change in an occupation's share in the labor force during the past two decades and the current returns to years of schooling. The main results with the above *basic labor market* controls remain robust. These covariates are not controlled in the main analyses, as most of these measures are not available prior to 1940.

Finally, to disentangle the intersection of occupational feminization and the shift in required skills in the decades 1960, 1970, and 1990, I control for a set of important skill requirements found in prior literature (Autor, Levy, and Murnane 2003). I first use measures of numerical, routine-cognitive, and human interactive skills (*basic skill controls*) and then include *full controls* of General Educational Development (GED) measures of reasoning, mathematical, and language capacities, and required levels of intelligence, verbal ability, spatial perception, form perception, clerical perception, motor coordination, finger dexterity, manual dexterity,

eye-hand-foot coordination, and color discrimination skills, based on three editions (1965, 1977, and 1991) of the *Dictionary of Occupational Titles*. As skill requirements typically change slowly, I impute the 1980 and 2000 measure for each occupation using linear inter- or extrapolation to form a continuous skill measure for five decades. Part E.6.2 of the online supplement documents how I construct the skill measures from newly transcribed historical materials.

Statistical Model

To model the temporal dynamics of gender typing and prestige *within* occupations, the majority of the longitudinal analyses leverage the classic two-way fixed-effects model (TWFE) as in typical studies of devaluation (Busch 2018):

$$Y_{it} = \beta^D D_{it} + W'_{it} \beta^W + \alpha_i + \gamma_t + \epsilon_{it} \quad (1)$$

where Y_{it} and D_{it} are the embedding-based occupational prestige and cultural association

with women. W_{it} is a vector of time-varying covariates, including measures of affluence and cultivation as described above. The unit-specific fixed-effects, α_i, control for all unmeasured, time-invariant characteristics of an occupation, differencing out constant heterogeneity between occupations. The estimate therefore only uses variations *within* each occupation over the study period. γ_t represents the decade-specific effect, controlling for potential biases internal to the corpus or the embedding model that homogeneously affect occupations of a certain decade. The unit of analysis is occupation-decade. Panel robust standard errors are used to correct for serial correlation.

While the embedding-based measures of gender typing D_{it} are hardly exogenous due to the relational nature of word embedding models, for a transparent interpretation of the estimate $\hat{\beta}^{D}_{FE}$ that is ideally going to be causal, two of the underlying assumptions warrant notice. First, D_{it} is not reversely determined by Y_{it} at the current or prior period; in other words, a drop in prestige of occupations is not the precursor of their semantic associations with women. In the robustness checks, I evaluate the sensitivity of the estimation against the potential reversed process. Second, an unbiased estimate of β^D assumes a parallel trend, which substantively requires the prestige of never-feminized occupations and to-be-feminized occupations, had their association with women never changed, would grow or decline at the same rate over the study period.

The extent to which the parallel trend is credible for causal inference depends on the time span of the analysis. The assumption is typically more plausible in a shorter period of time: the prestige trajectories of occupations such as *mechanical engineers* and *cooks*, had their cultural links with femininity never changed, may not be identical over a century window, whereas the assumption for a 10- or 20-year gap may be more reasonable. To reflect the estimation sensitivity against potential violations of the parallel trend, I mechanically decompose $\hat{\beta}^{D}_{FE}$, which

Ishimaru's (2024) pioneering work showed to be equivalent to a weighted sum of all possible first-difference (FD) model estimates, including short- and long-term effects, plus a bias term $\hat{B}$, for a balanced panel:

$$\hat{\beta}^{D}_{FE} = \sum_{k=1}^{T-1} \hat{w}^{D}_{k} \hat{\beta}^{D}_{FD,k} + \hat{B} \qquad (2)$$

$$\hat{w}^{D}_{k} = \left[\sum_{i=1}^{N} \sum_{t=1}^{T-k} \left(\Delta_k \tilde{D}_{it} - \Delta_k \tilde{W}'_{it} \hat{\delta}^{W}_{FE} \right)^2 \right]$$
$$\left[\sum_{\ell=1}^{T-1} \sum_{i=1}^{N} \sum_{t=1}^{T-\ell} \left(\Delta_k \tilde{D}_{it} - \Delta_k \tilde{W}'_{it} \hat{\delta}^{W}_{FE} \right)^2 \right]^{-1} (3)$$

where k represents the year gap of the FD model, including in this case 10-, 20-, and up to 100-year intervals of temporal changes. $\Delta_k D_{it}$ represents the change of D_{it} in k years subject to $\Delta_k D_{it} := D_{it+k} - D_{it}$ and $\Delta_k \tilde{D}_{it}$ captures the demeaned female typing given by $\Delta_k \tilde{D}_{it} = \Delta_k D_{it} - \frac{1}{N} \sum_{i=1}^{N} \Delta_k D_{it}$ in decade t. $\Delta_k \tilde{W}_{it}$ is defined in a similar way. $\hat{\delta}^{W}_{FE}$ is the coefficient from a regression of $\Delta_k \tilde{D}_{it}$ on $\Delta_k \tilde{W}_{it}$ pooled for all $k = 1, ..., T-1$. The weights $\hat{w}^{D}_{k}$ are positively defined, upward weighting the FD estimates in periods with a larger total between-occupation variation of gender typing changes that is unexplained by time-varying covariates.

When controls are present, the TWFE-to-FD decomposition is "contaminated" by the controls as summarized by $\hat{B}$:

$$\hat{B} = \left[\sum_{k=1}^{T-1} \sum_{i=1}^{N} \sum_{t=1}^{T-k} \left(\Delta_k \tilde{D}_{it} - \Delta_k \tilde{W}'_{it} \hat{\delta}^{W}_{FE} \right)^2 \right]^{-1}$$
$$\times \left[\sum_{k=1}^{T-1} \sum_{i=1}^{N} \sum_{t=1}^{T-k} \left(\hat{\delta}^{W}_{FD,k} - \hat{\delta}^{W}_{FE} \right) \left(\Delta_k \tilde{W}_{it} \Delta_k \tilde{W}'_{it} \right) \right] (4)$$
$$\left(\hat{\beta}^{W}_{FD,k} - \hat{\beta}^{W}_{FE} \right)$$

where $\hat{\delta}^{W}_{FD,k}$ is the coefficient from a regression of $\Delta_k \tilde{D}_{it}$ on $\Delta_k \tilde{W}_{it}$ independently performed for each $k = 1,...,T-1$. Overall, $\hat{B}$ measures the relative strength of covariance between the controls and the treatment and between the controls and the outcome variable across possible FD periods. It is not hard to see $\hat{B} = 0$ when no controls are included.

In the main analyses, I use a robust fixed-effects estimator that combines *shorter*-term FD estimates with normalized weights and report:

$$\hat{B}^{robust}_{FE} = \left(\sum_{k=1}^{\ell} \hat{w}^{D}_{k} \hat{\beta}^{D}_{FD,k} \right) \left(\sum_{k=1}^{\ell} \hat{w}^{D}_{k} \right)^{-1} + \hat{B} \quad (5)$$

where the value of ℓ depends on the time span where parallel trend assumption is potentially plausible (i.e., FD periods, k, used in estimation range from 1 to ℓ). I present the results using ℓ consecutively from one to four decades to present the sensitivity of the results. Indeed, the magnitude of $\hat{B}$ is trivial compared with the TWFE and FD estimates, such that whether controls are included or not, or included in the numerator or outside the fraction in Equation 5, does not significantly affect the results. Part E.1 of the online supplement presents the values of $\hat{B}$, $\hat{w}^{D}_{k}$, $\hat{B}^{D}_{FE}$, and $\hat{B}^{D}_{FD,k}$ for each corpus in detail. Standard errors are derived under the assumption that stochastic errors are independent across different FD periods and are calculated using the corresponding finite-sample formula.

In the final part of the analyses, I leverage Baron and Kenny's (1986) mediation analysis and link actual occupation hourly wages with the cultural process of devaluation, with the premise that occupation's symbolic value—as a function of its cultural association with women—may intervene in the formation of new wages (see Freeland and Harnois 2020; Harris 2022). Specifically, I use a Structural Equation Model (SEM) and decompose the total negative association between (lagged) occupational female typing and occupation's hourly wages (log) in Figure 1 into (1) the indirect effect where gender typing affects an occupation's symbolic value, and gendered evaluation of symbolic value partly shapes actual wages, and (2) the remaining "direct" effect of female-typing on wage. I experiment with different lagging strategies, from no lag to two-decade lags of female typing. *Full controls* including skill measures as described above are included in the model; they are allowed to co-vary with occupational prestige and wages. The cultural process highlighted in this article is expected to partly account for the original negative link, and the "direct" covariance may arise from other noncultural mechanisms, such as compensating differentials (Mas and Pallais 2017). For an easier interpretation of the mediation effect, I synthesize the four dimensions of prestige using the first principal component from Principal Component Analysis (PCA) and pool the three decades where full controls are available. Standard errors are derived from bootstrapping the sample 1,000 times. Part E.5 of the online supplement presents the full SEM model specification.

RESULTS

Validation of Text-Based Measures

Before presenting the main estimates on the cultural feminization of occupations and their associated devaluation, I assess the validity of the text-based measures of occupational gender typing and prestige that underlie the statistical analyses. While the *change* in some occupations' cultural association with women may lag behind actual shifts in workforce composition, prior studies show a general alignment *at a single point in time*: occupations with higher proportions of women (or men) tend to be similarly gender-typed in language (Bolukbasi et al. 2016; Garg et al. 2018). Figure 4 shows consistent patterns, where the two measures are highly correlated ($r > 0.7$) among professional and service occupations (similar patterns for other occupations are omitted). For example, *nurses*, *dancers*, and *attendants*—female-dominated
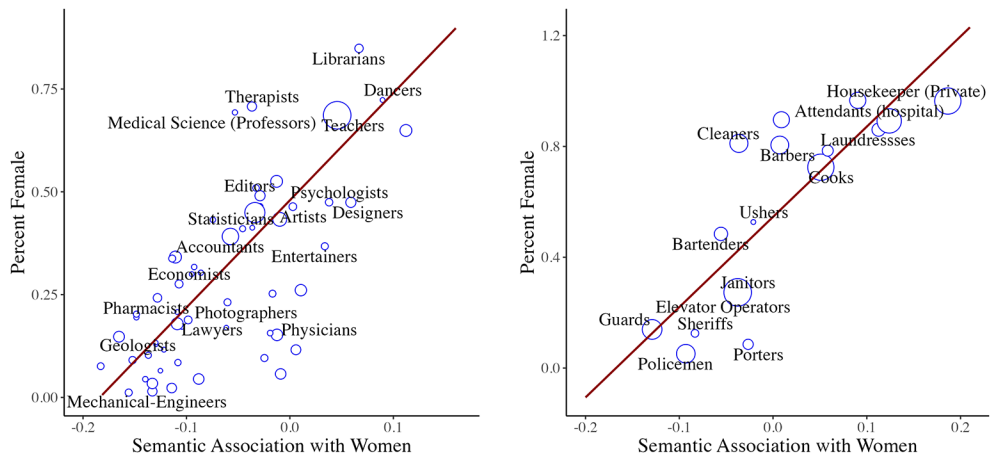
Figure 4. Gender Typing in Text and Actual Female Share in Occupations, COCHA, 1980 to 1989, Professional and Technical Occupations (Left Panel) and Service Occupations (Right Panel)
Note: Circle sizes are scaled to reflect the relative employment size of each occupation in the year shown.

in 1980—are also stereotyped as female in COCHA embeddings in the 1980s; *geologists*, *mechanical engineers*, and *police* are male-dominated and male-typed. Notably, whereas Beggs and Doolittle (1993) identified *accountants* as gender-neutral in surveys, the embedding results suggest they were still perceived as male in the 1980s, aligning with findings from laboratory experiments on implicit bias in gender typing (White and White 2006).

The comparability between survey-based occupational prestige and the multiple affective dimensions of text-based prestige remains underexplored, with the exception of Kmetty and colleagues (2021), who found a general similarity between the International Socio-Economic Index (ISEI)—a derivative of education and income—and prestige measures derived from Common Crawl embeddings. To validate the prestige constructs captured in text, I regress the four affective dimensions of occupational prestige from two corpora on survey-based prestige scores from corresponding decades (with corpus and decade fixed effects), as shown in Table 1 (Siegel 1971; Smith and Son 2014). Regressions

are presented individually (Columns 2 to 5) and jointly (Columns 6 and 7). Two consistent patterns emerge. First, when evaluated jointly (Column 6), the *directions* of correlation align with prior literature (MacKinnon and Langford 1994): competence (potency) and moral worth (evaluation) are positively associated with survey-based prestige, and liveliness (activity) is negatively associated—possibly reflecting the sedentary nature of high-status white-collar occupations. Second, the relative *magnitude* of these associations similarly mirrors prior findings (Column 6): potency contributes more strongly to GSS-derived prestige than evaluation, suggesting power may matter more than moral standing in the structure of occupational valuation (but see Freeland and Hoey 2018). Overall, the three affective dimensions explain 22 percent of the variance in survey-based occupational prestige, with potency accounting for the largest share (Column 4).

Together with the fourth dimension—semantic affinity to phrases signaling general prestige—the four text-derived dimensions account for nearly half the variation in survey-based occupational prestige across

Table 2. Comparison between Embedding-Based Prestige and Survey-Based Prestige (Four Dimensions of Symbolic Value) of Occupations, 1950 COC system

| Outcome	Predictor	Corr. (s.e.)	R^2	Decade
Siegel (1971)	COCHA Prestige		.55	1960
Siegel (1971)	Ngram Prestige		.40	1960
Siegel (1971)	ERSCOR50 (IPUMS)	.66 (.05)	.43	1960
Siegel (1971)	EDSCOR50 (IPUMS)	.82 (.04)	.68	1960
Siegel (1971)	NPBOSS50 (IPUMS)	.82 (.04)	.67	1960
Nakao-Treas (1994)	COCHA Prestige		.40	1990
Nakao-Treas (1994)	Ngram Prestige		.48	1990
Nakao-Treas (1994)	ERSCOR50 (IPUMS)	.73 (.05)	.53	1990
Nakao-Treas (1994)	EDSCOR50 (IPUMS)	.83 (.04)	.69	1990
Nakao-Treas (1994)	NPBOSS50 (IPUMS)	.84 (.04)	.71	1990

the two corpora and decades (Column 7). Notably, the explanatory power of general prestige alone (Column 2) approaches the R^2 from the full model, suggesting it may serve as a synthetic proxy for the three affective dimensions. Additionally, to benchmark the validity of these text-based measures, Table 2 disaggregates R^2 values by corpus and decade. The combined explanatory power of the four dimensions is slightly lower than that of educational attainment (EDSCOR50), but comparable to occupational income (ERSCOR50). These R^2 levels are also consistent with those reported in MacKinnon and Langford (1994), who used survey-based affective dimensions to predict GSS prestige scores of occupations—largely supporting the general viability of embedding-based prestige estimates when jointly evaluated.

To further consolidate the validity of the text-based measures of prestige and gender typing, I supplement the occupation-specific one-on-one comparison of the two measures and several additional evaluations, including the test of stickiness of occupational prestige over time (Treiman 1977) and the *3CosAdd* test (Mikolov et al. 2013) that evaluates common-sense word relations from the embedding space (see Part D of the online supplement). Results from these text-based measures are largely consistent with academic and common-sense understandings of occupational relations and prestige.

Occupational Feminization in Cultural Conception

Cultural devaluation builds on an occupation's increasing stereotypical association with women (path *x* in Figure 1), which depends on, but does not necessarily occur alongside, an objective increase in women's share in the occupation. To show the link between compositional change in female share (with 0- to 3-decade lags) and occupations' cultural feminization embedded in text, as well as its potential heterogeneity over the wage distribution, I present the TWFE estimates of the association for occupations in each wage quintile (defined using post-1990 mean CPI-adjusted hourly wages) in Panels A to D in Figure 5. Consistent with prior studies (Garg et al. 2018), I find an overall positive association between changes in female share and female typing (also see the rising mean female typing of the workforce in Figure S6 of the online supplement). Yet, the extent to which occupations become culturally more feminine varies by wage, where statistically significant changes happen mostly in lower- and middle-income occupations. By contrast, effects on the highest-earning occupations
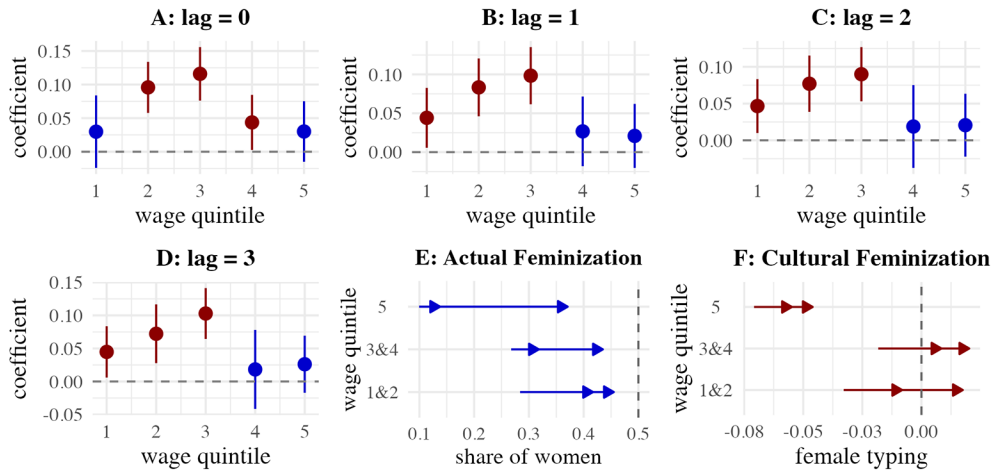
Figure 5. Association between the Change of Occupation's Female Typing and Actual Female Share with Different Lags in Decades (Panels A to D), 1900 to 2019; and the Mean Value of the Actual Female Share and Female Typing from 1900 to 1959, 1970 to 1979, and 2010 to 2019 (Panels E and F), Pooled COCHA and Ngram
Note: Error bars represent the 95 percent confidence interval. Occupations are weighted proportional to their average size across the years in Panels E and F.

are close to zero whether female share is measured in the same decade or lagged for up to three decades (the results remain similar when four- or five-decade lags are used).

Panels E and F of Figure 5 further unpack the potential cultural inertia in occupational gender typing relative to women's actual entry into those occupations. I compare changes in the *actual* mean female share and the workforce's mean *cultural* association with women across three periods—1900 to 1959, 1970 to 1979, and 2010 to 2019—grouped by wage quintiles (quintiles 1–2 and 3–4 are combined for visualization). I highlight two distinct stages of women's workforce participation and cultural change. First, before the Civil Rights Act, most feminization occurred in lower-wage occupations (e.g., bank tellers, cashiers, bookkeepers, and certain textile or agricultural roles); these occupations were increasingly perceived as feminine (see Figure S11 in the online supplement). Many of these occupations reached near gender neutrality in cultural perception (female typing = 0). Second, beginning in the 1970s,

rising female educational attainment led to increased entry into high-paying professional occupations, and objective feminization slowed in lower-wage roles. However, these high-status occupations did *not* exhibit comparable cultural feminization. Occupations such as architects and engineers remained predominantly male in public conception, and by 2010 to 2019, their average female typing still lagged behind that of lower- and middle-wage occupations in earlier decades. Occupations that did undergo significant cultural shifts continued to cluster in the lower and middle wage tiers (e.g., clerks and librarians) (see Part E.2 of the online supplement). Taken together, the results support Hypothesis 1.2, showing that occupations with a rising share of female workers tend to be increasingly stereotyped as female—except in the case of high-paying professional and managerial occupations.

There are two possible explanations for the slow or absent update in gender typing for the highest-earning occupations—and their unrealized cultural devaluation. First, despite

substantial gains in female representation in recent decades, these occupations remain—and have historically been—more persistently male-dominated than those in lower-wage groups (see Panel E of Figure 5). For example, the female share of architects rose from 9.5 percent in 1980 to 28.2 percent in 2010, making it one of the most feminized occupations by raw or relative change. Yet with nearly three-quarters of architects still being men, public perceptions may continue to associate the occupation with male characteristics. Indeed, architects' cultural association with women slightly declined—from –0.09 in the 1990s to –0.12 in the 2010s (COCHA)—likely reflecting people's tendency to rely on familiar and prototypical representations when perceiving social categories (Guilbeault et al. 2024; Winkielman et al. 2006). Moreover, psychological research suggests that once prototypical representations are formed, they tend to be resistant to change. For example, medical science professors and instructors were still culturally typed as male in the 1980s, even though over 70 percent were women by then; in 1950 and 1960, the female share had been just 10.7 and 24.6 percent, respectively.

Second, gender desegregation in high-paying professional occupations has largely occurred at the lower end of these occupations, yet gendered cultural conceptions may be disproportionately shaped by the top tiers, which remain male-dominated. Research shows that women in high-status professions such as medicine and law often face a "glass ceiling," limiting their advancement within occupational hierarchies (Cotter et al. 2001). In law, for example, Hull and Nelson (2000) document that women remain overrepresented in less prestigious, lower-paying legal positions and underrepresented in law-firm partnerships due to persistent cultural and institutional barriers. As women enter male-dominated fields, dominant-group members may maintain advantage by creating new, fine-grained job titles and reinforcing within-occupation hierarchies (Martin-Caughey 2021). These strategies are especially prevalent in high-paying professions, which exhibit the most diverse titles and greatest wage dispersion (Lemieux 2008; Martin-Caughey 2021). Because cultural stereotypes are often formed around the most salient and visible exemplars (Guilbeault et al. 2024), elite professional occupations may remain strongly and persistently associated with men in public culture.

Devaluation of Culturally Feminized Occupations in Multiple Dimensions

Overall, occupations that become more culturally associated with women tend to experience penalties in symbolic value, although the occurrence and magnitude of these effects vary by dimension of valuation. According to Figure 6, which presents TWFE estimates ($\hat{\beta}_{FE}^{D}$) from the full model, an occupation's stereotypical association with women is negatively associated with its perceived potency (competence) and general prestige—the two dimensions most strongly correlated with survey-based prestige ratings (see Table 1)—at the $P = 0.05$ level across both corpora. These effects are substantively nontrivial: in COCHA, a one-standard-deviation (SD = 0.04) increase in female typing is associated with a 0.01-unit (potency) or 0.007-unit (general prestige) decline, which amounts to roughly 28 percent of the total SD in each outcome (0.036 and 0.037, respectively). The two effects are slightly smaller but remain statistically significant in Ngram, where academic texts are overrepresented. By contrast, I find no evidence that changes in female typing affect perceived moral evaluation or liveliness, despite prior findings that evaluation is culturally associated with femininity in cross-sectional data (Freeland and Harnois 2020). I supplement the analysis with cross-sectional estimates by decade, including tests of curvilinearity (Krueger et al. 2022; Valentino 2020) for the association between gender typing and each dimension of occupational symbolic value, as well as a curvilinearity test in the longitudinal framework (see Parts E.3 and E.4 of the online supplement).

Ngram, 1900-2009
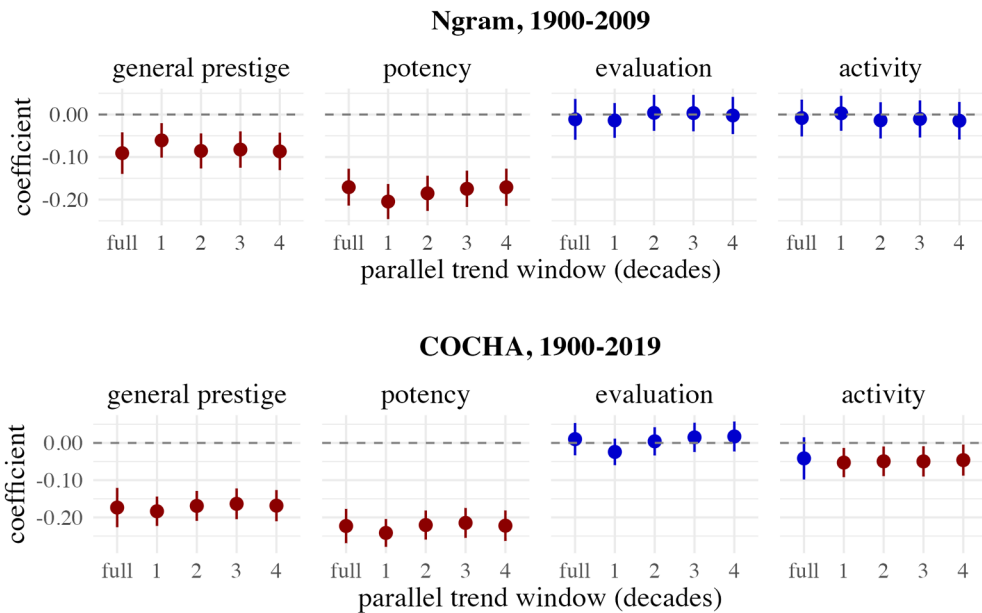
COCHA, 1900-2019

Figure 6. Generalized Robust TWFE Estimates Using Ngram and COCHA, 1900 to 2019
Note: Error bars represent the 95 percent confidence interval.

The cultural devaluation observed in the potency and general prestige dimensions remains robust under the generalized robust fixed-effects estimation, which limits the parallel trends assumption to shorter temporal windows for more plausible causal identification. As shown in Figure 6, the penalties in general prestige and perceived powerfulness associated with cultural feminization persist under this stricter identification strategy, with effect sizes comparable to the main estimates. For example, using only 10-year variation in COCHA, a one-standard-deviation increase in female typing is associated with a 0.28 standard deviation decline in occupational potency. Part E.1 of the online supplement reports estimates across all possible parallel trend windows, demonstrating that the devaluation effects for these two dimensions are consistently present and surprisingly stable over both short and long durations. Indeed, prestige penalties have remained salient over the past 30 years (see Figure S10 in the online supplement, which evaluates potential

temporal heterogeneity in the devaluation effect), with no signs of gendered cultural beliefs or valuation processes that contribute to occupational devaluation disappearing (England et al. 2020).

Occupational liveliness appears uncorrelated with gender typing in the full model (Figure 6), but results using 10- to 40-year variations in the panel suggest that perceived activity levels may also be penalized, at least in COCHA. However, the implications of changes in liveliness for overall occupational prestige remain ambiguous. As shown in Table 1, activity positively predicts prestige when entered alone (Column 5), but the association turns negative when evaluated alongside other dimensions (Columns 6 and 7). Because these cultural valuations are likely intertwined in practice—analogous to a multivariate framework—declines in liveliness associated with feminization may ultimately enhance prestige when controlling for other dimensions of valuation. It is important to note, however, that these effects are limited to COCHA and are much smaller than those
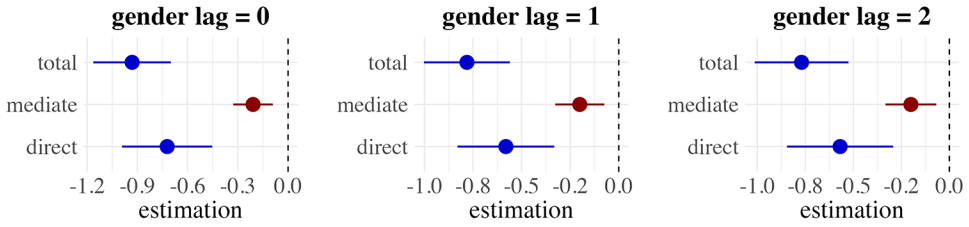
Figure 7. Mediation Analysis, 1960 to 1999
Note: The 95 percent confidence intervals are derived from 1,000 bootstrapped samples. Ngram and COCHA are pooled together with corpus fixed effects in estimation.

associated with changes in potency or general prestige—the two dimensions that explain the most variation in survey-based prestige. By contrast, the effect of gender typing on moral evaluation remains trivial and statistically insignificant in both corpora. Together, these findings are more consistent with Hypothesis 2.2.

### Cultural Devaluation as a Mediator for Wage Decline

As the final component of the main analysis, I link the *cultural* process of devaluation with occupation wage in the *actual* economic system by evaluating whether occupation symbolic value, as a function of gender typing, partly mediates the relationship between an occupation's stereotypical association with women and hourly wages in the current or subsequent decades. Depending on the lag structure (0- to 2-decade lags), during which new average wages may form in response to the updated occupation prestige—a normative valuation diffused through public discourse and potentially informing wage-setting decisions net of human capital controls (Freeland and Harnois 2020)—the cultural devaluation process accounts for 22.4 to 25.9 percent of the total association between gender typing and future occupational wages (see Figure 7). While the direct effect of gender typing on wages is attenuated by the mediation process, it remains statistically significant, suggesting that other noncultural mechanisms (e.g.,

compensating differentials [Mas and Pallais 2017]) may also contribute to the observed wage penalty. Overall, the results support Hypothesis 3, indicating that cultural devaluation significantly mediates the link between gender typing and wage outcomes.

Robustness Checks

I present two main robustness checks to further support the cultural interpretation of devaluation. First, prior research on the wage penalties associated with occupational feminization has proposed a queuing process as an alternative to the devaluation framework—arguing that declining wages lead men to leave certain occupations, which subsequently become feminized (Reskin and Roos 1990). By analogy, the negative association between an occupation's stereotypical association with women and its prestige, as shown above, may reflect a reversed process in which prestige decline precedes cultural feminization. It is important to note, however, that devaluation and queuing are not mutually exclusive; they may operate jointly and reinforce one another, ultimately slowing progress toward occupational desegregation and the closure of gender pay and prestige gaps (England et al. 2007).

To assess whether the main results are driven by a reversed queuing process, I estimate two separate fixed-effects models: one with prestige as the dependent variable, as in the main analysis (devaluation), and the

Ngram, 1960-1990

COCHA, 1960-1990
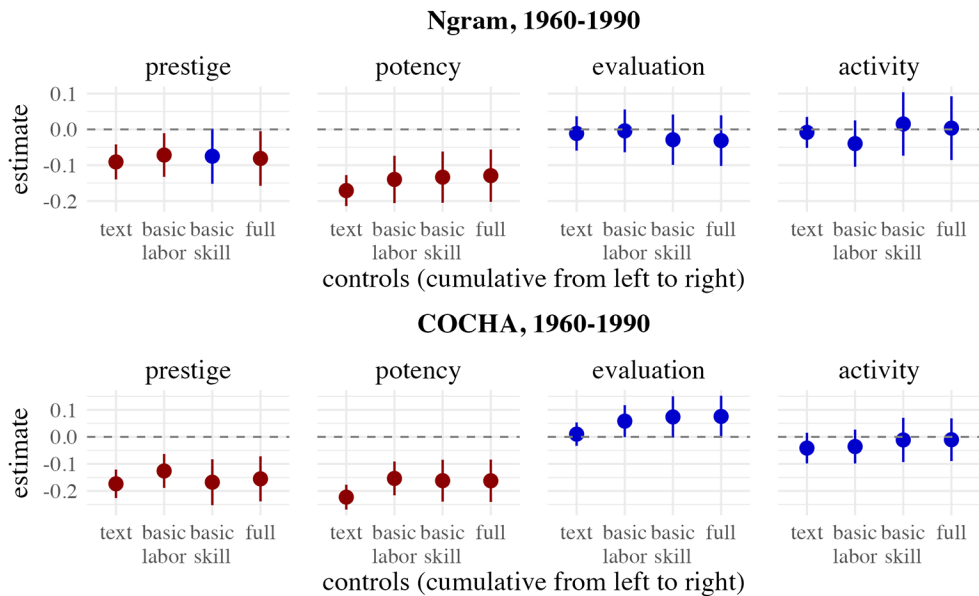
Figure 8. Effects of Female Typing on Occupational Prestige with Additional Controls
Note: Error bars represent the 95 percent confidence interval.

other with stereotypical association with women as the dependent variable (queuing). To address potential reverse causality, both models include a temporally lagged dependent variable and are estimated within a Structural Equation Modeling (SEM) framework (England et al. 2007; Levanon et al. 2009) (for methodological details, see Part E.6.1 of the online supplement). Results are summarized in Figure S15 in the online supplement. I find robust evidence for cultural devaluation even after accounting for the reverse process in both the Ngram and COCHA data. By contrast, the queuing effect is statistically significant only in COCHA and with a smaller effect size.

Second, the observed relationship between female typing and the cultural valuation of occupations may be influenced by factors not included in the main analysis, such as changes in skill requirements or educational composition. To address this concern, I expand the list of covariates beyond text-based controls to include labor market variables that may shape

perceptions of an occupation's gender association and symbolic value. I cumulatively add controls to the TWFE model, beginning with *basic labor market* characteristics—mean hourly wage (CPI-adjusted), mean years of education, returns to education, and changes in occupational employment share. Next, I include *basic skill* measures, such as required levels of routine cognitive and numerical skills (Autor et al. 2003), followed by a *full controls* model that incorporates measures such as verbal and clerical perception skills. As shown in Figure 8, the negative effect of female typing on perceived potency and general prestige remains robust, except for the Ngram model with basic labor market and skill controls, which becomes marginally significant ($p = 0.056$). This change is driven more by increased standard errors than by a reduction in effect size. For instance, the Ngram estimate declines from –0.091 (with only text-based controls) to –0.075 (with labor market and skill controls), a 28.6 percent decrease, whereas the standard error rises

from 0.025 to 0.039, a 56.0 percent increase. This increase in uncertainty is largely due to the reduced number of time points for estimation (from 11 decades in 1900–2009 to four decades in 1960–1999). Overall, the results suggest a persistent cultural devaluation process, net of human capital and broader structural labor market changes.

Part E.6 of the online supplement presents two additional robustness checks. First, I relax the parallel trends assumption in the TWFE estimates by allowing prestige trajectories (slopes) to vary across occupational groups (E.6.3). Second, I examine whether the devaluation effects apply to both male and female incumbents of an occupation (E.6.4). In both cases, the results remain robust: the penalties in general prestige and potency associated with cultural feminization persist even when occupational trajectories differ, and these effects hold for both male and female workers in culturally feminized occupations.

DISCUSSION

Summary of the Results and Implications

In this article, I introduce word embedding models that are frequently used in the sociology of culture (Jones et al. 2020; Kozlowski et al. 2019) to the study of labor markets, where gender inequality is often presumed to be based on a cultural process of the devaluation of work that is (more) associated with women. By mapping occupation titles to a high-dimensional vector space with varied linguistic distance to gender- and prestige-signaling phrases in historical and contemporary publications and products of popular culture, I construct a set of new *longitudinal* measures of how much occupations are stereotyped as female, and how multiple dimensions of symbolic value are associated with occupations over the past 120 years. In each decade, these measures generally align with the actual gender composition of the occupation in the labor market and survey-based

measures of occupational prestige. By tracing the dynamics of occupations being stereotyped as more or less female, and how much occupations are associated with terms symbolizing value and prestige, with a new fixed-effects estimator over time, I find that an occupation's shift toward being stereotyped as female is generally coupled with a decline in its symbolic associations with potency and general prestige, but not strongly with moral standings or liveliness.

These embedding-based results support the devaluation hypothesis, which has often been challenged by conflicting findings regarding the link between changes in occupational gender composition and wages, or evaluations of occupations with varying female shares—typically without clear theoretical or empirical reconciliation. I highlight two substantively important findings that are obscured in prior noncultural studies. First, the assumption that a rising share of female workers is accompanied by an increasing stereotypical association with women—the cultural basis necessary for devaluation to occur—does not consistently hold. Instead, cultural feminization has largely occurred in lower- and middle-income occupations; high-income professional and managerial occupations, despite feminizing rapidly in recent years, have largely resisted corresponding cultural shifts. These occupations continue to be stereotyped as male, likely because they remain overwhelmingly dominated by men, particularly in the upper echelons that are most culturally visible. In this sense, previous studies reporting a wage "premium" for occupations with rising female shares—often driven by changes in high-paying professions (Busch 2018)—may be misleading, as the cultural association with women and symbolic valuation in these occupations have remained largely unchanged.

Second, a decline in occupational prestige contingent on its cultural feminization does not occur across all dimensions of symbolic evaluation. By unpacking the normative component of prestige into four dimensions, I find that increased cultural association with women

is linked to declines in perceived potency and general prestige, but not to changes in moral evaluation or liveliness. These null results contrast with a significant curvilinear relationship between gender typing and moral evaluation observed in cross-sectional analyses in some decades: occupations strongly associated with either women or men tend to be rated higher in moral worth than those seen as gender-neutral (for detailed results and discussion, see Part E.3 of the online supplement). While the main analyses focus on devaluation as a longitudinal process, these cross-sectional findings may help explain the curvilinear relationship between occupational gender composition and survey-based prestige identified in prior studies (Krueger et al. 2022; Valentino 2020). However, it is important to note that such curvilinear patterns do not emerge in longitudinal analysis (see Part E.4 of the online supplement), nor in other prestige dimensions in cross section, suggesting that prior studies relying on unidimensional prestige measures may have produced mixed findings due to overlooking prestige's multidimensional structure.

Overall, I highlight cultural devaluation as an important mechanism linking occupational gender typing to actual hourly wages. By tracing how occupation symbolic value associated with gender typing relates to actual hourly wages in the current or following decades, I find that cultural devaluation accounts for roughly a quarter of the total association between gender typing and pay. These findings align with core claims in economic and cultural sociology that emphasize how the economic system, instead of being solely reduced to the market forces of supply and demand that are socially neutral, may be embedded in and partly shaped by cultural norms and framings (Zelizer 2000)—including gender roles and associated stereotypes.

Indeed, although this article does not directly examine organization-level status- and wage-setting dynamics, the workplace—where inequality materializes through the unequal distribution of resources and asymmetric power relations, and where wages are practically determined—may represent an important site where the gender disparities documented in this study are reproduced. Cultural beliefs that associate female labor with lower potency, as well as gendered perceptions of occupational status, may shape how employees assert claims to respect, authority, and resources within organizations (Sauer et al. 2021), and how employers evaluate, reward, and assign individuals to specific roles and positions in the workplace (Avent-Holt and Tomaskovic-Devey 2014). Such symbolic associations become especially salient in contexts of organizational ambiguity and information asymmetry (Goldin 2015), where decision-makers rely on cultural cues and status beliefs to assess individuals in hiring (Pedulla 2014), on-the-job training (Tomaskovic-Devey and Skaggs 2002), and promotion (Ridgeway 2001). Workplace-level devaluation processes may not only mirror, but also reinforce and amplify, the symbolic penalties observed at the occupational level. A fuller account of economic inequality would benefit from research that traces how these cultural processes unfold relationally within organizations—from occupational classification to workplace practice (Avent-Holt and Tomaskovic-Devey 2014).

In the emerging field that uses text to trace the evolution of implicit gender stereotypes in shared culture, this article's findings align with prior studies documenting persistent cultural biases against female-associated characteristics. For example, Charlesworth and colleagues (2022) show that portrayals of women as less competent than men have remained surprisingly stable in public discourse, with gender-based distinctions proving more resilient over time than racial, ethnic, or national divides—likely because gender serves as a universal organizing principle across societies (Ridgeway and Correll 2004). Similarly, analyzing U.S. print media from 1930 to 2009, Boutyline, Arseniev-Koehler, and Cornell (2023) found that portrayals of women as communal and men as agentic remained consistent over eight decades. Finally, using 2018 Twitter data, Friedman

and colleagues (2019) demonstrate that gender gaps in real-world political representation and economic participation are reflected in the gender images in online discourse (e.g., female words are farther from government-associated words, such as senate and parliament)—with the most pronounced gender biases found in regions with the greatest gender inequality.

Limitations and Recommendations

Word embedding models and extensive textual corpora offer a unique opportunity to uncover latent cultural dynamics central to theories of social inequality, but they are not without limitations. In particular, the relational nature of embedding models—capturing word meanings through higher-order co-occurrence patterns—implicitly links cultural dimensions such as occupational symbolic value and gender association *by construction*. Although this property may be desirable in studying multidimensional and interwoven cultural structures (Kozlowski et al. 2019), the absence of explicit exogenous variation and counterfactual scenarios in this case may obstruct a clear causal interpretation of results in the labor market. To enhance causal inference in the TWFE framework, I draw on recent methodological advances that decompose estimates into multiple first-difference comparisons, allowing the parallel trends assumption to be more plausibly satisfied in the short run. Still, the time horizons over which this assumption holds are not explicitly grounded in the text data. Future research might incorporate exogenous shocks—either from the labor market or linguistic shifts—to better isolate causal effects in text-based analyses.

Second, textual materials such as Google Ngram that are disproportionately produced by social and cultural elites may not represent general cultural norms without potential biases (Kozlowski et al. 2019). These biases, however, may create both limitations and opportunities for future research. On the one hand, they may affect the measurement of

constructs such as occupational prestige (see discussion in the Data section); on the other hand, scholars may leverage such biases to evaluate the potential heterogeneity of the studied cultural process (e.g., devaluation) across social segments. Compared with other social groups, the better-educated and socially-advantaged authors overrepresented in Ngram are more likely to culturally value occupations requiring substantial human capital and training (Lynn and Ellerbach 2017; Valentino 2021). As women now surpass men in overall educational attainment, these culturally valued occupations increasingly overlap with feminized professions (Harris 2022), which elites may be more reluctant to devalue. This may help explain why the magnitude of the negative association between female typing and prestige or potency is consistently smaller in Ngram than in COCHA (see Figure 6), suggesting a potentially weaker devaluation effect in elite discourse. For future research on other cultural processes that may diffuse unevenly across U.S. society, it may be similarly important to cross-validate the Ngram-based results with other textual sources, including the genre-balanced COCHA as used in this study.

Last, and more important from a theoretical standpoint, this study is confined to *occupation*-level cultural typing and wage dynamics, drawing on the standardized occupational classifications and wage data provided by the Census. However, prior research demonstrates that both wage dispersion (Avent-Holt et al. 2020) and gender segregation (Martin-Caughey 2021) are often more pronounced *within* occupations—at the finer-grained job level—than *between* them, a level of analysis beyond the scope of this study. However, if, as Huffman and Velasco (1997) contend, the economic penalty associated with female representation is more accurately conceptualized and observed at the job level than the occupation level, then the prestige devaluation documented here may plausibly extend to detailed jobs as well. Indeed, the text-based approach used in this study is well suited for such extensions, as it

can be adapted to examine categorical distinctions at the job (and workplace) levels—where inequality is more closely enacted and experienced. Recent developments in the collection of write-in textual data on job titles and descriptions (Martin-Caughey 2021), job-level reviews of work experiences (Wilmers, Tong, and Zhang 2025), and narratives about job tasks and workplace environments (Corritore, Goldberg, and Srivastava 2020) offer promising avenues for investigating the micro-organization of inequality. These data have illuminated emerging forms of gender segregation (Martin-Caughey 2021), cultural constructions of productivity (Corritore et al. 2020), and the reproduction of wage inequality across detailed firms and jobs (Wilmers et al. 2025). Future research may build on these innovations to more fully integrate text-based measures with job-level data, advancing a more granular and relational account of how categorical distinctions, such as gender, structure workplace- and job-level stratification.

Acknowledgments

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Data Note

Access to the data used in this study, as well as the code to replicate the results, can be found at https://github.com/wenhaojiangsoc/devaluation.

Notes

1. Throughout, I use the terms "sex" ("male" and "female") and "gender" ("men" and "women") interchangeably, following prior research that often treats these constructs as binary and overlapping, despite my recognition of the important distinction between biological sex and socially constructed gender.
2. I exclude the literature that includes between-occupation variations in estimation using cross-sectional data, where unobserved heterogeneity is not accounted for. I also exclude studies that focus on the same person's wage change associated with moving into occupations with different levels of female proportion, without exploring occupation-level dynamics. Results that suggest devaluation were typically reported in such studies.
3. For example, Busch (2018) speculates that devaluation is embedded in time- and space-specific contexts.
4. Grönlund and Magnusson (2013:1015), for example, call for a "refinement of the theoretical discussion" and to pay more attention to "the search for mechanisms." Busch (2018:1352) similarly notes that devaluation studies have a "persistent insecurity about its underlying causal mechanisms."
5. The given gender descriptions and anticipated changes of the occupation may not align with the actual composition and changes; these descriptions are used as a treatment that alters the subjective sex typing of the occupation.
6. The evaluation dimension in Affective Control Theory (ACT) encompasses a broader range of traits, including warmth and caring, but I emphasize its link to moral standing for interpretive clarity.
7. Smith and Son (2014) updated the measure in the 2012 interviews of the 2008 GSS sample based on the 2010 Standard Occupation Code (SOC), but I did not include it for comparison as the drastic difference between 2010 SOC and 1950 COC may incur nontrivial measurement errors.
8. The important rule of my harmonization is that all occupations are summarized in a gender-neutral approach. For example, waiter and waitress are transformed into server.

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