

Occupational Visibility on YouTube: Gender and Skill-Level Biases in Video Recommendations

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Abstract

This study investigates the representation of gender and skill biases in YouTube's video recommendation system for occupations in Germany. Using a dataset of 526,535 synonyms and variants of male, female, and neutral job titles, we analyse recommendations across a broad set of occupational domains, including computer science, preschool teaching, food manufacturing, mechatronics, police service, interior architecture, hairdressing, domestic services, and sales. This selection covers a wide spectrum of professions with different gender distributions and skill levels, ranging from helper roles to highly complex specialist tasks. The analysis reveals nuanced patterns in how video recommendations respond to gendered occupational terms. In female-dominated professions such as child care, hairdressing, and domestic services, recommendations retrieved via male- and female-coded search terms show considerable overlap. In contrast, male-dominated fields such as mechatronics and police service display less consistent intersections, and in some cases, videos retrieved using neutral occupational terms exhibit a disproportionately higher share of negative sentiment. A detailed analysis of metadata and word frequency patterns highlights the influence of linguistic framing, educational focus, and cultural associations in shaping algorithmic recommendations. However, these factors alone do not fully account for the sentiment distributions or intersection structures observed. The findings underline the importance of multi-method research approaches to uncover algorithmic bias, and they point toward practical implications for platform developers, regulatory bodies, and media literacy initiatives. This work contributes to the broader discourse on fairness and inclusion in algorithmically mediated digital environments.

Keywords

Social Media Research, Gender Bias, Skill bias, Video data

1. Introduction

The increasing integration of artificial intelligence into everyday digital experiences has brought both opportunities and challenges, particularly concerning algorithmic bias in content delivery. YouTube, as one of the largest platforms for information dissemination, wields significant influence over societal perceptions of various topics, including professions across different sectors and skill levels. Its video recommendation system, driven by advanced algorithms, shapes how users encounter and understand different occupations, thereby giving rise to critical questions about the representation of gender and skill biases in algorithmically suggested content.

This study aims to investigate the potential for bias in YouTube's recommendation algorithm regarding the portrayal of occupations in Germany, and, if such biases exist, to understand their specific manifestations. In this context, bias is understood as a systematic distortion in the representation of occupations on YouTube, where deviations from real-world gender distributions or skill profiles are not solely attributable to linguistic norms, but may instead reflect the amplification of societal stereotypes through the recommendation system. The central research questions guiding this study are as follows: Is it possible to identify algorithmic bias in YouTube's recommended content related to professional roles? If biases are present, what are their patterns, and how do they affect the representation of gender

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and skill levels in video recommendations? To address these inquiries, an exhaustive dataset comprising 526,535 synonyms and variants of male, female, and neutral forms of job titles was meticulously analyzed. This extensive lexicon was then utilized to generate the top 30 video recommendations for a broad range of occupational fields, culminating in the compilation of a comprehensive dataset containing 71,992 video metadata entries. These entries encompass a diverse set of occupational domains, covering technical, social, service-oriented, and creative professions. The selection reflects a deliberate inclusion of roles with varying degrees of gender representation and skill complexity. Examples include computer science, childcare, food manufacturing, mechatronics, police service, interior architecture, hairdressing, domestic services, and sales. To ensure neutrality in the recommendation process, all YouTube searches were conducted in incognito mode using a clean browser with no user account, cookies, or prior search history. This setup minimized the risk of personalization influencing the results.

The objective of this study is to elucidate the patterns of potential bias in YouTube's recommendation system, with particular attention to how gendered occupational terms and varying skill levels are represented across a broad array of professions. By identifying these biases, it is anticipated that a more profound comprehension of the manner in which algorithmic systems influence public perceptions of occupations will be attained. This research underscores the necessity for fair and balanced recommendation systems and offers actionable insights for the promotion of inclusivity and equity in digital spaces.

2. Data and Methods

In Germany, a number of occupations are predominantly populated by male or female workers. This phenomenon has been extensively studied, with discussions often focusing on issues such as gender pay gaps, occupational segregation, and related aspects, see [1, 2, 3, 4, 5, 6, 7, 8]. Research has also explored the representation of occupational gender biases on social media, investigating how such biases relate to critical media literacy, see [9, 10, 11, 12, 13]. However, research specific to German-speaking countries remains limited. A notable exception is the Austrian labor agency's chatbot, which attracted significant media attention for perpetuating stereotypes about the labor market [14]. In this study, we investigate how occupational recommendations on social media platforms, specifically YouTube, reflect gender biases.

From a sociological perspective this is important since the algorithm's recommendations can be understood as a result of existing disparities based on gender stereotypes. The idea would be that these stereotypes are reflected in the data YouTube can gather (including comments and transcripts to videos). But at the same time, for individuals seeking information on occupations, these stereotypical recommendations also shape the ideas and concepts in which the individual thinks about these occupations. So while recommendations are a result of a representation of reality, at the same time they help construct a reality. To our knowledge this interplay has not been analysed for the specific situation of YouTube and its recommendations, but for other social fields [15, 16, 17, cf.].

Our analysis is based on a dataset comprising 526,535 synonyms and variants of male, female, and neutral job titles, provided by the German Federal Employment Agency (BA)¹. The analysis focuses on three occupational domains with distinct gender profiles: Computer Science, Preschool Teaching, and Food Manufacturing. The selection of these domains is predicated on the presence of varying degrees of gender representation (on the influence of such representations see [18]; for the definition of female- or maledominated occupation we use common thresholds of at least 70 % of an occupation's incumbents being either female or male), as detailed in Table 1. Furthermore, the dataset enables differentiation between skill levels, such as untrained, vocational training, and university-educated roles. The analysis focuses on a set of occupational domains selected for their varying gender distributions and skill levels. Initially, the study includes three core domains—Computer Science, Preschool Teaching, and Food Manufacturing—chosen based on distinct gender representation profiles. According to data from the German ETB occupational database [19], approximately 11 % of workers in Computer

¹Available at <https://www.arbeitsagentur.de/institutionen/dkz-downloadportal>.

Table 1

Occupations considered within this paper, both VET and university training

VET		University Training	
Computer Science			
43102	Occupations in computer science (without specialisation) – skilled tasks	43104	Occupations in computer science (without specialisation) – highly complex tasks
43412	Occupations in software development – skilled tasks		
Preschool Teaching			
83113	Occupations in child care and child-rearing – complex tasks	91334	Occupations in pedagogy – highly complex tasks
Food Manufacturing			
29301	Cooks (without specialisation) – unskilled/semiskilled tasks	29202	Occupations in the production of food-stuffs (without specialisation) – skilled tasks
29302	Cooks (without specialisation) – skilled tasks	29204	Occupations in the production of food-stuffs (without specialisation) – highly complex tasks
29382	Cooks (with specialisation, not elsewhere classified) – skilled tasks	82284	Nutritional counselling / health and wellness occupations (not elsewhere classified) – highly complex tasks
Mechatronics			
26112	Mechatronics technician – skilled tasks	26113	Mechatronics technician – complex specialist tasks
Domestic Services / Housekeeping			
83212	Domestic services (housekeeping) – skilled tasks		
Police Service			
53212	Police service – skilled tasks	53214	Police service – highly complex tasks
Interior Architecture			
93212	Interior architecture – skilled tasks	93213	Interior architecture – complex specialist tasks
Hairdressing			
82311	Hairdressing – helper tasks	82312	Hairdressing – skilled tasks
Marketing and Sales			
92112	Marketing and advertising – skilled tasks	92123	Dialogue marketing – complex specialist tasks
Banking			
72112	Bank clerk – skilled tasks	72113	Bank clerk – complex specialist tasks

Science are female, making it a male-dominated profession; in contrast, Preschool Teaching is female-dominated with 85 % female workers, while Food Manufacturing is relatively gender-balanced with 43 % women. These contrasting distributions provide a robust foundation for investigating the influence of occupational gender profiles on YouTube's recommendation patterns. To deepen the analysis and test the generalisability of initial findings, the study includes five additional occupational domains: Mechatronics, Police Service, Interior Architecture, Hairdressing, and Domestic Services. These occupations were

selected to reflect a broader range of gender representation, including male-dominated technical fields (e.g., Mechatronics, Police), female-dominated care and service roles (e.g., Hairdressing, Domestic Services), and more balanced creative professions (e.g., Interior Architecture). Furthermore, the dataset allows for differentiation by skill level—from helper and vocational training positions to highly complex specialist and academic roles—enabling the study to examine not only gender bias but also potential skill-based bias in algorithmic recommendation systems. All selected occupations are sufficiently represented on YouTube to support reliable empirical analysis, as shown in Table 1.

In order to analyse the data, the initial step is to examine the overlap in suggested videos generated by different search terms. This allows for the identification of numerical algorithmic biases in YouTube’s recommendation system. Additionally, sentiment analysis is applied to assess whether the sentiment of suggested videos varies across gendered and neutral job title variants. For this purpose, we employ the german-sentiment-bert model [20], a transformer-based classifier fine-tuned for German. The model categorizes text into positive, neutral, or negative sentiment using contextual embeddings. It is acknowledged that differences in video suggestions may stem from the specificity of search terms; therefore, the sensitivity of the recommendations to gendered language is also evaluated. For instance, the search term “Köchin” (female cook) might yield results predominantly featuring women, reflecting a linguistic and cultural bias.

To further explore these differences, natural language processing (NLP) techniques are employed on the metadata of the suggested videos, including titles and descriptions. This analysis helps to identify the most frequently occurring terms and uncovers patterns that characterise videos associated with the selected occupational categories. By combining these methods, we aim to uncover both numerical and linguistic biases in YouTube’s recommendation system and examine how gendered language influences content delivery.

3. Selected results in brief

Table 2

Overlap of recommended videos by search term type across occupations

ID	Occupation	Only f	Only m	Only n	f & m	f & n	m & n	f & m & n
Female-dominated								
82311	Hairdressing (assistant level)	103	84	42	29	1	6	15
83113	Childcare	416	429	461	461	26	28	151
83212	Domestic Services	326	365	389	294	23	22	114
Male-dominated								
26113	Mechatronics (specialist level)	123	141	1143	116	16	26	112
53212	Police (skilled tasks)	172	173	433	121	12	20	101
43104	Computer Science	344	369	2910	299	34	90	111
Mixed								
72113	Bank Clerk (complex specialist)	462	503	846	206	51	53	104
29202	Interior Architecture	256	434	726	251	12	13	101
82284	Cooking	127	92	1330	72	10	9	42

The analysis of recommended video overlaps across different search term types (see Table 2) reveals differentiated patterns that challenge the assumption of consistent gender-based behavior in algorithmic recommendations. In several female-dominated occupations, such as Domestic Services (83212) and Child Care (83113), the number of shared videos between male- and female-coded search queries is notably high, suggesting a strong convergence of content. However, this is not a universal trend: for example, in Hairdressing (82311) — despite being female-dominated — the overlap between male and female search results is comparatively low, indicating more distinct and potentially gendered content streams.

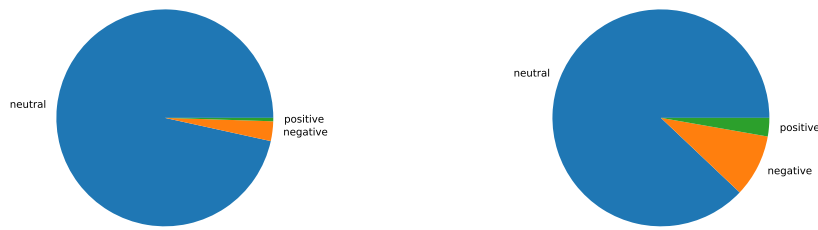


Figure 1: Sentiment for video descriptions found with male and neutral occupational names (26113) (Mechatronics – complex specialist tasks)

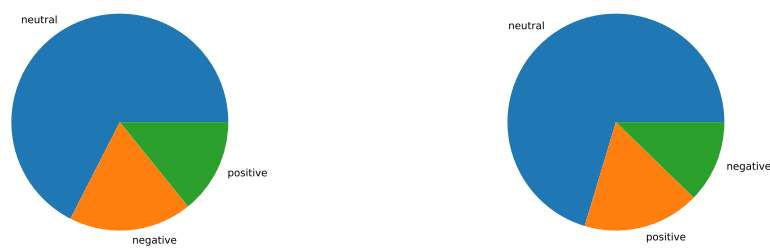


Figure 2: Sentiment for video descriptions found with female and neutral occupational names (82312) (Occupations in the hairdressing trade – vocational-level tasks)

In contrast, certain male-dominated fields such as Mechatronics (26113) or Police Service (53212) display surprisingly high intersections across gendered queries. This suggests that in these professions, algorithmic recommendations may be more standardized, possibly due to a more homogeneous or instructional content base that transcends gender-coded search terms.

The findings also show that neutral search terms often yield large numbers of unique recommendations (e.g., in Interior Architecture or Cooking), but their overlap with gendered terms varies significantly depending on the domain. These inconsistencies highlight that gender dominance alone does not account for intersection patterns. Instead, other factors — such as the degree of content professionalization, platform conventions, or the semantic specificity of occupational titles — likely contribute to how algorithms organize and present content across gender-coded inputs.

In the context of sentiment analysis, the Videos retrieved using male- and female-coded occupational names exhibit largely analogous sentiment patterns. However, a notable pattern emerges when analyzing neutral occupational terms. For male-dominated professions such as Computer Science, Mechatronics (26113), and Police Service (53212/53214), searches using neutral terms yield a higher proportion of negative sentiment compared to gender-specific queries. This suggests that neutral job titles are more likely to surface content addressing broader societal discussions, critical reflections on the profession, or reports of workplace-related challenges, rather than instructional or promotional content. In contrast, gender-specific search terms predominantly return task-oriented or educational materials. Interestingly, this pattern is not mirrored in female-dominated professions such as Hairdressing (82312) or Domestic Service (83212). For these occupations, neutral search terms do not lead to a substantial increase in negative sentiment, indicating a different framing of professional content in algorithmic recommendations (see Figure 2.)

A thorough examination of the metadata through detailed word analysis reveals subtle yet significant differences in framing across search groups and occupational domains. Neutral occupational names frequently yield content with an educational or academic focus, particularly in technical professions

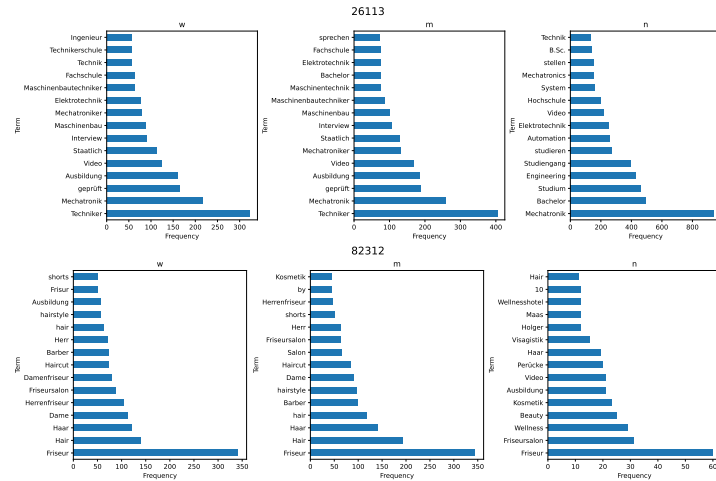


Figure 3: Top words for occupations 26113 (Mechatronics – complex specialist tasks) , and 82312 Hairdressing occupations – skilled vocational task)

such as computer science (43104) and mechatronics (26113), as shown in Figure 3. For instance, terms like *Studium*, *Bachelor*, *Engineering*, and *Data Science* dominate the neutral search group in these fields, indicating a strong academic framing.

In contrast, gendered search terms in the same technical domains often highlight vocational aspects, using words such as *Ausbildung*, *Lehre*, or job-specific titles like *Mechatronikerin*. This distinction suggests that gendered language steers recommendation algorithms toward more practice-oriented or apprenticeship-related content, while neutral language triggers more formal or university-level material.

This dual framing does not appear uniformly across all professions. In female-dominated fields such as child care (83113) or hairdressing (82312), the vocabulary remains consistently practical across all search groups (see Figure 3). Terms such as *Kindergarten*, *Erzieherin*, *Jugendhilfe* or *Friseur*, *Haar*, and *Salon* dominate regardless of gender coding, indicating less differentiation in educational framing.

These findings imply that the algorithmic construction of occupational content is not solely guided by the nature of the profession but is also shaped by linguistic and cultural perceptions tied to gender and education. While metadata analysis helps identify these tendencies, it does not fully explain the sentiment disparities or intersection patterns observed in earlier analyses. Thus, the results further reinforce the need for a multi-method approach to effectively capture the complex dynamics of algorithmic bias in occupational representations.

4. Discussion and Outlook

The findings of this study highlight the complexity of algorithmic biases embedded in video recommendation systems. The overlap between male- and female-coded search terms, especially in female-dominated professions such as child care or domestic services, suggests a tendency toward content convergence. However, this is not a universal pattern. For instance, in hairdressing—a similarly female-dominated field—recommendations vary considerably across gendered queries, indicating that gender dominance alone does not fully explain recommendation behavior. Conversely, male-dominated fields such as mechatronics or police service exhibit substantial overlap between male and female search terms (see Table 2), a result that might be attributed to more standardized and homogeneous video content in technical or institutionalized professions.

Sentiment analysis provides additional nuance. In male-dominated professions like computer science, mechatronics, and police work, neutral search terms often yield a higher proportion of negative sentiment (see Figure 1). This may reflect broader societal discourse, including critical reporting, depersonalized descriptions of the role, or discussions about occupational challenges. In contrast,

female-dominated occupations like hairdressing (82312) and domestic services (83212) do not exhibit a comparable increase in negative sentiment for neutral queries (Figure 2), pointing to differing cultural framings in algorithmically suggested content.

Metadata analysis reinforces these observations. In technical fields like mechatronics (26113), neutral search terms are more likely to surface academically framed videos, emphasizing concepts such as "Studium", "Automation", and "Technik", while gendered terms tend to be associated with vocational aspects like "Ausbildung" or "Lehrstelle" (see Figure 3). In contrast, in service-oriented professions such as hairdressing (82312), all search variants—regardless of gender—tend to produce videos with practical, lifestyle-oriented vocabulary ("Salon", "Haare", "Frisur"), reflecting a consistent framing across gender codes (Figure 3).

These patterns suggest that algorithmic systems do not merely reflect real-world occupational structures or labor market distributions, but actively shape how professions are framed and represented in digital environments. Gender-coded queries interact with occupational context and cultural narratives in complex ways, giving rise to differentiated exposure, sentiment, and framing depending on the query used.

By expanding the analysis to include a broader set of professions with varying gender profiles and qualification levels, this study provides deeper insight into how algorithmic biases manifest not only in academic or technical fields but across diverse sectors such as law enforcement, personal services, and household labor. The consistent application of Venn diagrams, sentiment scores, and word frequency analyses across these new cases helps to validate the generalizability of earlier findings while revealing new divergences in specific domains.

These findings can inform the development of fairer and more inclusive recommendation systems by demonstrating how algorithmic outputs are shaped by occupational, linguistic, and gendered dimensions. For researchers and developers, this highlights the importance of transparency, dataset auditing, and awareness of cultural framing within algorithmic media.

Future research should adopt a multi-method approach that includes qualitative analyses of video content, recommendation mechanics, and user interaction patterns. Additionally, cross-platform studies could uncover whether similar biases emerge across different recommendation infrastructures, such as TikTok, Instagram, or search engines. Longitudinal studies might also assess whether such biases persist over time or evolve in response to shifting content trends or regulatory interventions.

Declaration on Generative AI

During the preparation of this work, the authors used DeepL in order to: Grammar and spelling check. After using these tool(s)/service(s), the authors reviewed and edited the content as needed and take(s) full responsibility for the publication's content.

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A. Online Resources

The sources for the *ceur-art* style are available via

- GitHub,
- Overleaf template.