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Dancing to the #challenge: The Effect of TikTok on Closing the Artist Gender Gap

Completed Research Paper

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Abstract

This study examines how an interesting technological phenomenon called the “Hashtag Dance Challenge” (HDC), made popular on the short video platform TikTok, may drive artists’ popularity on the digital music streaming platform, and, importantly, help women, artists, to achieve traction that is needed to succeed commercially. Using data from TikTok, Spotify, and music analytics companies, we analyze the impact of HDCs on artists’ popularity growth rate on Spotify. We find that artists with an HDC-related song achieve a significant daily increase in followership on Spotify, representing traction and appeal within the music industry, relative to similar artists who do not have an HDC. Importantly, the daily growth of Spotify followers increases by approximately 3% more for female artists than male artists, given an HDC-associated song. Our findings shed new light on the role of social media with respect to artist self-promotion, especially in making the music more inclusive and attractive to female music artists.

Keywords: social media, viral product design, short-form video; women, discrimination, music industry

Introduction

It is well-established that the entertainment industry, particularly the music and film industries, lack equal representation across multiple demographics. In particular, these industries suffer from a significant under-representation of women. In the music context specifically, a recent Billboard report concludes that women represent less than one-third of all performers and 12.5 percent of songwriters across the 800 most popular songs from 2012 to 2019. Women account for only 11.7% of the Grammy award nominees from 2013-2020, which translates to a gender ratio of 7.5 males to every 1 female nominee, mirroring disparities in other creative fields and beyond.

Many reasons have been postulated for why these gender disparities exist in the music industry. These include systematic discrimination, discounting of the abilities of women artists, unwanted stereotyping or

sexualization, uncomfortable studio cultures, and lack of female role models (S.L. Smith et al. 2020). However, one specific factor that may explain this underrepresentation remains understudied in the literature – the inability to self-promote or the penalty associated with the self-promotion by women within the industry. It has been observed across multiple contexts that women shy away from promoting their work or showcasing their abilities, when compared to equally capable or talented men (Moss-Racusin et al. 2010, Exley and Kessler 2019). Furthermore, women tend to under-state their preferences, requirements and wage expectations (Gneezy et al. 2003, Chan and Wang 2018), which enhances the odds of their being left out of the competitive arena. When women do speak up and engage in self-promotion, they are often faced with disproportional levels of discounting, criticism, or negativity, since self-promotion is often viewed as being a “masculine” stereotypical trait (Foschi 1996, Brescoll 2016, Haines et al. 2016). Thus, from a gender concordance perspective, the inability to self-promote one’s artistic abilities or output can contribute to the gender skew observed in the arts. These obstacles make it difficult for female artists to access the variety of resources and opportunities needed to facilitate a successful career, including a supportive musician network and opportunities to promote musical works, resulting in limited changes of being included in lineups compared to male artists. The literature suggests that these costs associated with self-promotion for women exist even on social network sites (SNS). For example, user-generated content posted by women on older forms of SNS such as YouTube and Facebook receive greater levels of negative commentary and criticism relative to men (Wotanis and McMillan 2014). However, newer forms of social media platforms, such as those involving the sharing of short-form videos, may provide a feasible solution to address these dynamics, especially for women in the music industry.

We seek to examine an interesting technological phenomenon called the *hashtag dance challenge*, rooted in the world’s largest short-form video platform, TikTok, launched in 2017. Hashtag dance challenges (HDCs) are short video clips wherein an original piece of music by an artist is re-created in combination with a series of dance steps and posted on the platform for others to enjoy or emulate. Users who are interested in participating in the challenge can then film themselves performing the same dance steps, and post these as well on the platform adding the hashtag of the dance challenge.

Both artists and users can create an HDC. The common theme across these videos that use the same music and dance steps is the hashtag that is used to link them together, and to the original video that was posted. HDCs have become popular and have led to significant traffic on the platform, since they represent a combination of original content (in terms of the chosen music) and user-generated content (the user adapts the original music to a specific set of dance moves). Moreover, they tend to possess all the features typically associated with viral content – they are creative, are easily viewed and broadcasted, evoke emotional reactions in the audience, and invite imitation and sharing. Thus, it is not surprising that HDCs are largely well-received, remain popular, and are widely shared on TikTok by a variety of users who apply their own creative styles to the original music.

How do HDCs help music artists more directly? We suggest that artists benefit from the wave of amateur content creators responding to HDCs for two reasons. First, HDCs represent, at their core, virtual advertisements for the underlying music that is used. By virtue of their popularity and their viral nature, they can increase the likelihood that users will share with their peers, thereby increasing the salience of the original music content and drawing attention to the music as well as the original artist. Second, since the music is almost always credited to the original artist, there is a direct link to enhancing the brand appeal and popularity of the original artist. Third, and importantly, given the potentially viral nature of HDCs, there is likely a significant spurt of attention provided to the artist, which could result in actual action. That is, the average user is likely to sign on as a follower of the artist’s music on musical platforms like Spotify rather than display a passive interest in the artist. It is this demonstrated increase in popularity that we aim to capture in our analysis. Thus, our first research question is: to what extent does the introduction of an HDC enhance the artist’s popularity, in terms of followers on streaming music platforms?

Beyond the main effect of the HDC, and more to the point of our work here, we argue that *female artists* are more likely to benefit from the presence of HDC on TikTok for multiple reasons. First, HDCs are primarily initiated by users, and are a pathway to advertise music that does not require self-promotion by the artist. Therefore, an HDC initiated by a user is by definition devoid of any self-promotion bias that tends to punish female artists. Female artists are unlikely to experience the self-promotion penalty from HDCs featuring their work, since these activities are initiated by third-party users. Thus, female artists should enjoy the positive aspects of user-generated viral content featuring their music on the platform, while being

released from the downsides of self-promotion discounting. Second, extant literature on dance and role incongruity argues that as an art form, dance is more deeply associated with women artists, especially in contemporary dance and choreography (i.e., Jeschke 1991). From a gender role congruity perspective, there is a greater association of women with artistic excellence in dance, rather than men. In such contexts, it is arguable that female artists are more likely to see an increase in popularity when their music is associated with HDC. This brings up our second research question: *to what extent is the effect of a HDC on an artist's popularity moderated by the gender of the original artist?*

We examine these proposed research questions using a set of HDCs initiated on TikTok between the 1st January 2020 and the 30th May 2020. We obtain song level and artist level data from Chartmetric – a music analytics company that collects data from Spotify, the world's largest music streaming service, and the artist's social media activity. We collaborate with a TikTok API authorized analytics company to gather data on individual HDCs that were posted on TikTok. Our dependent variable captures the changes in the artists' popularity, measured by the daily percentage change of followers for the artist on Spotify. While there are other ways to follow an artist's musical work, following the artist on Spotify represents an easy and feasible way to measure how popular an artist is, and correspondingly their commercial appeal in the marketplace.

To identify the effect of the HDC, we compare songs that have an HDC initiated on TikTok during our observation window to similar songs that do not have a HDC on TikTok, using propensity score matching in conjunction with a differences-in-differences econometric specification (e.g, Jeffrey Smith and Todd 2005, Liu and Lynch 2011). We further consider the role of gender by conducting interaction and subsample analyses, examining the different impact of HDCs across female and male artists. For the time being, we focus only on two primary genders – male and female, given the limitations in establishing non-binary genders in secondary data.

Our results suggest that, on average, an HDC boosts an artist's daily Spotify followers by approximately 1% across the period of our analysis. While we differentiate between HDCs initiated by the artists themselves and those initiated by users, we see no difference in terms of their effectiveness on artist popularity. Furthermore, we find that female artists benefit significantly more than male artists – female artists' Spotify followers grow by roughly 3% greater in the presence of an HDC, while we do not observe a significant effect of HDCs for male artists. These results show that TikTok represents a new and impactful way to promote music, by virtue of HDCs and their appealing nature. More interestingly, female artists associated with a user-generated HDC show a significant 3.9% increase compared to male artists with an user-generated HDC, indicating that HDCs appear to help female artist to overcome the penalty associated with self-promotion through user-generated mechanism, as well as highlighting a combination of dance and music that is uniquely positively associated with female artists. While prior research on gender role incongruity has largely focused on how women are not treated on par with men in many fields (Mo 2015, Jakubowska and Byczkowska-Owczarek 2018), we find that in the specific case of HDCs, female artists are better positioned to benefit in terms of their popularity, relative to men.

Our work contributes to the IS literature in three distinct ways. First, our work addresses the immediate question of how social media platforms may be used by music artists to gain visibility and traction. We show that HDCs, rooted in the context of short-form video platform, are particularly useful in generating attention. Prior research has established how viral content is capable of facilitating social influence, in turn affecting user behavior (Phelps et al. 2004, Aral and Walker 2011), as well as the broadcasting nature of viral content can increase user production adoption (Y. Chen et al. 2011, Z. Chen and Berger 2016), user engagement (Huang et al. 2020), and media attention (Berger and Milkman 2010). We show that HDCs – in the form of short form video – tend to possess all of the features typically associated with viral content and are particularly useful in generating attention and salience of an artist, regardless of whether the content was generated by the artist or a fan. These results speak to both the appeal of the short-form video context and the relative democratization of social media, where users can help artists gain popularity.

Second, our paper addresses an important issue female artists face in promoting their music work, since self-promotion is penalized in multiple ways. Intriguingly, we find that HDCs are more useful for female artists in terms of achieving traction, since they help remove the stigma of self-promotion while building on the stereotypical congruity between dance and women artists. Our results suggest that at least in the short term, HDCs may be a viable way for female artists to promote their music without experiencing any backlash. Whether these remain in place in the future remains an open question.

Finally, at a macro level, our work addresses questions pertaining to gender parity, especially within the digital music industry (e.g., Born and Devine 2015, Wang et al. 2021) and in creative labor more broadly (e.g., Bielby and Bielby 1992, Lutter 2015). Many studies show discrimination and bias towards women in the digital music context (e.g., Wolfe 2019, Ferraro et al. 2021, Lesota et al. 2021), research on mitigating these frictions and biases is relatively scarce. The advent of social media and user-generated content (UGC) can potentially correct some of these imbalances by providing women with a safer and collaborative platform for self-promotion. Although platforms like YouTube were expected to serve as these equitable forums, research shows that this is not the case (Wotanis and McMillan 2014). Our study highlights the combination of user-generated dance and music that characterize HDCs may serve as these forums instead, facilitating all artists, especially female artists, having a fair shot at increasing the visibility of their work.

Background Theory and Hypothesis

The Role of Hashtag Dance Challenge (HDC) on Artist Promotion

Hashtag dance challenges, which started as a phenomenon on TikTok, are affect-rich and broadcast, typically associated with viral content. Evidence that affect-rich content is more likely to go viral has been well established. For example, Berger and Milkman (2010) examined New York Times articles over three months and find a strong relationship between emotion and virality: affect-laden content is more likely to make the most emailed list, whether positive or negative. Consistently, Palka et al. (2009) suggested that surprising and interesting content may be viral due to its high entertainment value. Sharing surprising information may reflect positively on the sender, suggesting that he or she knows interesting and unusual things. Heath et al. (2001) explore the role of emotion in selecting which information—urban legends, in particular—get passed along and find that people report a greater willingness to share more surprising urban legends. In a similar vein, Peters et al. (2009) study social anecdotes in everyday conversation, finding that people are more willing to share affect-rich episodes that arouse interest, surprise, and happiness. As per this research, the affect-rich characteristics present in HDCs are instrumental in evoking strong feelings within viewers of the videos, thereby creating salience and grabbing attention. In addition, since the HDC video content is easily viewed and broadcast across the platform, it could potentially attract more users to adopt the content of the challenges (Chen et al. 2009, Aral and Walker 2011) and generate more user engagement (Shi et al. 2014), resulting in broad user adoption of the music clip associated with the challenge content. Thus, it is evident that HDCs are designed to be viral in nature and assimilate quickly through the TikTok network, whereby the growth in their viewership is exponential.

Exponential growth in viewership of an HDC is likely to enhance the availability of the music. A rich stream of literature in availability heuristics has provided evidence that the more available information on a certain product is, the more likely it will be consumed compared to products that are less available, i.e., individuals are susceptible to the availability heuristic in making their consumption decisions. For example, Chernev (2003) noted that generally the more available products tend to be the more preferable products. Wiles (2007) found that making information about brand's achievement and testimonials available enhance customer trust. Since making information available tends to lead to positive affect, and since music with HDC are more available to people compared to music without HDC, there is a much greater probability that the focal viewer remains positively influenced by the HDC on the margin. Thus, when a HDC is generated about a specific song, it is more likely that the focal user will track down the original song (which is typically credited) and will also follow the original artist. The virality of the HDC as well as the significantly enhanced salience from the exposure to the HDC in its multiple forms on the platform will induce purposive action on the part of the user.

We expect that the presence of an HDC will lead to an organic increase in the number of followers of the original musical artist. As a leading platform for music consumption, we expect these effects to manifest on Spotify as a proxy for overall artist appeal. Thus, we formally hypothesize:

H1. The presence of a HDC will result in an increase in followers for artists on Spotify.

Differential Effects of HDC on Women Artists

In digital music and on social media, why are women less represented and why do they tend to achieve less traction compared to equally talented and capable men? Research over the past decade has documented

one key factor here - a significant and persistent gender gap in self-promotion. Women are more likely to downplay their accomplishments instead of promoting them for a variety of underlying reasons. Not only have women presented as communally orientated (Diekmann et al. 2015), likely to underrate their abilities relative to men (Singh et al. 2002, Heilman and Caleo 2018), but also are less willing to take credit for their successes (Barber and Odean 2001, Exley and Kessler 2019). The research also shows that when faced with opportunities that match their talent or capabilities, women tend to forbear from participation and choose to not push their candidacy when compared to men (Jessi Smith and Huntoon 2014).

Consistent with the broader literature, recent work shows that even on social media, women are less likely to promote their own work, although they are willing to promote other people's work and achievement (Jessi Smith and Huntoon 2014). These trends are particularly striking when marketing and promoting creative endeavors are considered key aspects of the democratization of public discourse. Even when women do self-promote, the feedback is often negative since self-promotion is viewed as a stereotypically male trait (Manian and Sheth 2021). Role incongruity theory argues that when people display behavior that is inconsistent with either their expected roles or those determined by stereotypes, the response tends to be more negative (Eagly and Karau 2002) Specifically, stereotypically female behavior in a perceived male role magnifies negative reactions, and similarly for stereotypically male behavior in a perceived female role.

Along the same lines, stereotypical behavioral gender traits that are deemed incongruent with observed gender are disproportionately evaluated negatively (Heilman 2001, 2012). For example, women who self-promote are not as well-received as those who do not (Rudman 1998, Bosak et al. 2018), and women are consistently disadvantaged in leadership roles as these are stereotypically associated with men (Yang and Aldrich 2014, Mo 2015). Furthermore, behavior, and the tonality of that behavior, associated with each gender is punished when deemed incongruent (Moss-Racusin and Rudman 2010, Brescoll 2016). Thus, when women engage in self-promotion, they are perceived as highly competent but risk incurring backlash for their assertive behavior. Women are aware of the penalties for counter-stereotypical behavior and, as a result, may behave defensively to avoid the risks of attracting penalties (Rudman and Fairchild 2004). Thus, self-promotion by women on social media tends to elicit negative responses, given the association of self-promotion with male behavior. Role incongruity theory would suggest that even when women do choose to promote their own work or creative endeavors online, they do not receive the same level of traction that men may receive. It is in this context that we argue that the HDC helps change the narrative.

How do HDCs change this narrative? We argue that HDCs can potentially benefit female artists by offering them two benefits: First, HDCs are primarily initiated and broadcast by users rather than artists themselves, and therefore any penalty associated with self-promotion for women should be minimized. Second, dance, especially modern and contemporary dance, is stereotypically more associated with women, as an art form (Jeschke 1991). Recall that from role congruity theory, we understand that men may also be penalized for performing non-masculine activities (Rochlen et al. 2009, Moss-Racusin et al. 2010) and achieving success in feminine domains (Cherry and Deaux 1978, Rudman and Fairchild 2004). Thus, when a feminine characteristic like dance is combined with music produced by a female artist, there is more role and task congruity compared to when dance is combined with music produced by male artists, on the margin. The effects of role congruity are likely to accrue positively to women artists associated with a HDC, relative to male artists. Therefore, we propose:

H2. The positive impact of HDCs on Spotify followers will be higher for female artists compared to male artists.

Furthermore, note that although HDCs are primarily initiated by users, they can be also offered by the artists. As argued, user generated HDCs should have no self-promotion penalty, but we should expect to see some residual self-promotion penalty show up if HDCs are offered by a female artist herself. In other words, it is likely that TikTok users choose to promote a HDC that incorporates music from a female artist that is unrelated to the user, the positive spillover on the artist's popularity is likely more enhanced than if the artist herself were to present an HDC using her own music. Based on this logic, we propose:

H3. The positive impact of HDCs on Spotify followers will be higher for user generated HDCs for female artists as compared to male artists.

Data and Empirical Methodology

We examine the above research questions using HDCs created on the TikTok platform. To create and share a HDC, the user first chooses an existing song clip on TikTok or uploads a song clip. Once the song clip is selected, the user can record a 15-60 second dance move and post the video with a formatted hashtag (#songnamechallenge). These dance challenges are the foundation we use to conduct our analysis. We compile our data by triangulating across song-level, artist-level, and TikTok platform level, specified below.

The first component of the dataset compiles song-level information. We first obtained 2,949 newly released songs on Spotify between January 1st, 2020, and April 30th, 2020, in North America, specifically Canada and the United States. For each song, we obtained song-related information, including release date, artist name, and music genre. We also leverage underlying musical attributes for each song, including measures of beats per minute, danceability, causticness, energy, liveness, valence, speech-ness, and duration from Spotify. To ensure clean identification, we only consider singles – songs released separately from an album and songs by individual artists rather than bands. This step results in 1,873 unique songs.

For the 1,873 single songs we identify, we use a database of 19,305 North American artists from Chartmetric to identify corresponding artists' information. We only consider solo artists because band membership production is considerably different. Chief among the artist-level data is artist gender. We coded artist gender as a binary variable and cross-checked the accuracy following studies that infer gender assignment through names (Bertrand and Mullainathan 2004) or profile pictures (Kelan 2008). Because the artist can adopt a stage name, we cross-checked gender coding based on the artist profile on Chartmetric. We were able to identify the gender of all 1,873 artists following this strategy. To obtain additional artist-level data, we extract time-invariant information such as artists' main genres and time-varying information such as daily digital music platform engagement (i.e., Spotify followers) between Dec 1st, 2019, and May 31st, 2020.

Among 1,873 songs we identified, 570 are available on TikTok in some format, i.e. as a short clip, part of a video, or as part of a dance challenge. We note that not every song is associated with a TikTok dance challenge. We worked with a TikTok analytics company to identify if a HDC was associated with a specific song, if any, that occurred between January 1st, 2020, and April 30th, 2020. Note that our empirical strategy relies on comparing songs on TikTok that are associated with a HDC to songs on TikTok that are not associated with a HDC. Our treatment of interest is whether the song had a dance challenge on TikTok between January 1st, 2020, and April 30th, 2020. Thus, songs that appear on TikTok but that do not have a HDC serve as our control group. Following this strategy, we identified 62 TikTok dance challenges for newly released songs in the period of interest. Furthermore, we identified whether the challenge was initiated by a user or an artist and include this as dummy variable in our dataset.

Variable Description

Table 1 provides a detailed description of the variables used in our analysis.

Dependent Variable: Our primary dependent variable of interest is the daily percentage change of Spotify followers on the artist level. This dependent variable is chosen because of two reasons. First, since we are interested in whether users are likely to proactively sign on as a follower of the artists. Therefore, the change in the rate of artists' followers demonstrates an effective measure of the shift of users expressing interest in the corresponding artists' music work. Second, due to the nature of viral content, the shift in artist follower can be salient overnight, thus we measure this trend as a daily percentage change. We log-transformed the daily Spotify followers to adjust for the right skewness of the variable. Then we take the first differences to obtain the daily Spotify follower change in the log form.

Independent Variables: Our key independent variable is the hashtag dance challenge status of a song on TikTok (denote HDC). It takes the value of 1 if there is a dance challenge associated with the song. Post HDC is defined as the time before (Post HDC = 0) and after (Post HDC = 1) a dance challenge.

Control Variables: We control for both time-variant and time-invariant variables on song and artists levels. Song-level control variables include time-invariant music attributes (i.e., danceability, speechiness, acousticness, instrumentalness, liveness, valence, tempo, loudness, and main genre, see Table 1 for variable descriptions) and time-variant variables including number of days since the song has been released on

Spotify, as well as the song's tenure on TikTok. We also include artist gender dummies (female) coded 1 for female and 0 otherwise.

Variable	Description	Unit of Range
$\Delta \log(\text{spotifyfollower}_{it})$	Daily percentage change of spotify follower of an artist	continuous
Post HDC	Time period after hashtag dance challenge occurs	0/1
HDC	Song associated with a hashtag dance challenge	0/1
Female artist	Artist gender is female	0/1
Song attributes		
Danceability	How suitable a track is for dancing	Continuous
Speechiness	Detects the presence of spoken words in the track	continuous
Acousticness	Measures the likelihood a track is acoustic	continuous
Instrumentalness	Predicts the likelihood that a track has no vocals	continuous
Liveness	Accounts for the presence of an audience in the recording	continuous
Valence	The musical positiveness conveyed by the track.	continuous
Tempo	Estimated tempo of a track in beats per minute	continuous
Loudness	The loudness of a track measured on a negative decibel (dB) scale averaged across the entire track.	continuous
sinceRelease	Days between song release date and date in the panel	continuous
TikTokTenure	A song's tenure on TikTok. 1 = song has not been added to TikTok in the panel 2 = song added to TikTok within 6 days in the panel 3 = song added to TikTok between 7 and 11 days in the panel 4 = song added to TikTok greater than 11 days in the panel	Categorical
Song genre	main genre of a song. 1 = pop ; 2 = hip pop ; 3 = EDM 4 = rap ; 5 = country ; 6 = CCM 7 = rock; 8 = indie ; 9 = R&B 10 = folk; 11 = other	Categorical

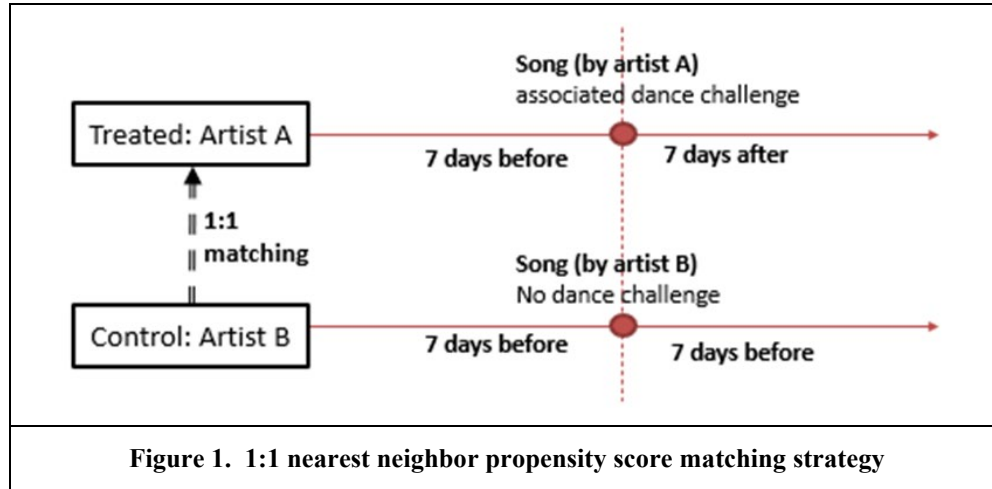
Table 1. Variable Description

Empirical Specification

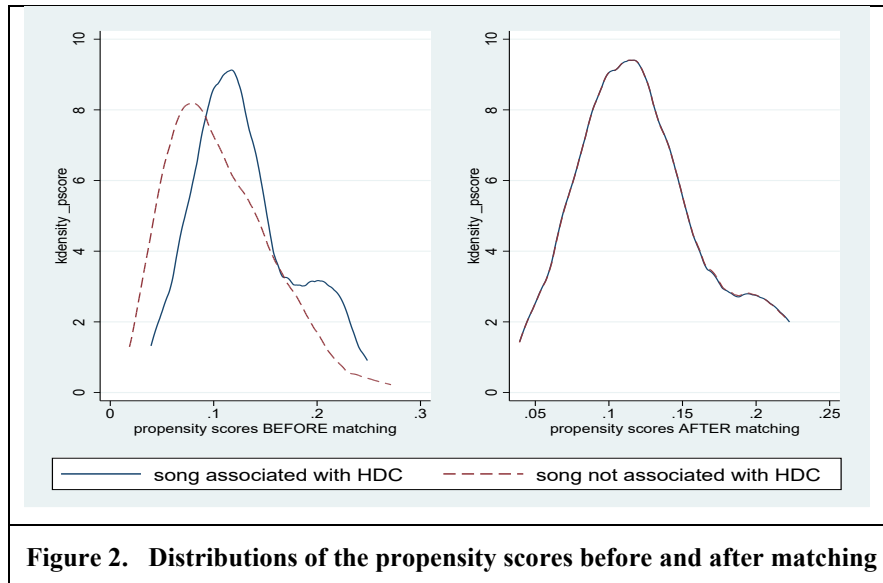
To examine the causal effect of the TikTok challenge on an artist's daily Spotify follower growth, we adopt a difference in difference (DID) model (Meyer 1995). In our case, the treatment is defined as the HDC, and the treated are the songs associated with a HDC, while the control group consists of songs on TikTok without a HDC. Given that the HDC in our context is staggered and occurs at different times, we follow prior research (Gao and Zhang 2017) and normalize the time dimension to simulate an "event study" approach to identification (Callaway and Sant'Anna 2021, Goodman-Bacon 2021). We identify an observation window of 15 days to access the short period 'viral' dance challenge effect. We set the day a song starts a HDC to day 8, with days 1-7 as pre-treatment and 8-15 as post-treatment periods.

One challenge we face in our DID estimation approach is the endogeneity issues arise when we cannot be sure the songs that received the treatment are randomly selected, so we need to address the selection bias in the songs that receive the treatment. Approaches to addressing this issue include matching a control group with the treated group (Abadie 2005). We use propensity score matching, which has been employed in various non-experimental setting when the assignment of treatment is not controlled by the researcher (Dehejia and Wahba 2002). Propensity score matching (PSM) has been frequently used in combination with DID analysis for causal inference of the effect of a non-exogenous intervention (e.g., Mayzlin et al. 2014, Kumar et al. 2018, Tan and Netessine 2020). We first predict the propensity score of the song receiving the treatment (HDC) using a logistic regression on musical attributes for each song. To minimize the bias in the estimated treatment effect, for every treated song, we apply one-to-one nearest neighbor matching without replacement on the propensity score to identify a matched control song that is used as a match only once (Austin 2010). Given each song is associated with one unique artist, the PSM process

results in 62 artists who have songs with an HDC, and a matched sample of artists with songs not associated with an HDC. We demonstrate this matching strategy in Figure 1.



Next, we check if the distribution of song-level and artist-level attributes remain consistent after the propensity score matching. We present Figure 2 to show the distributions of propensity scores for the subsamples before and after matching, again confirming that the control and treatment samples are similar after PSM. We further compare the daily percentage change across treated and control before the treatment taken place and ensure no significant difference in terms of the percentage change of the spotify follower between groups prior to the treatment (t-stat = 1.97, $p > 0.1$).



This process results in a sample of 62 treated songs and 62 matched songs in the control group that is used for the baseline DID model as shown below.

$$\Delta \log(\text{Spotify follower}_{it}) = \alpha_0 + \alpha_1 * \text{post HDC}_t + \alpha_2 * \text{HDC}_i + \alpha_3 * \text{HDC}_i * \text{post HDC}_t + \alpha_4 * \text{female artist}_i + \alpha_5 * \text{DayRelease}_i + \alpha_6 * \text{TikTok tenure}_i + \alpha_7 * \text{song controls}_i + \alpha_8 * \text{month dummy}_t + \varepsilon_{it}$$

In model (i), $\Delta \log(\text{Spotify follower}_{it})$ represents percentage change in Spotify follower from day $t-1$ to t i.e., $\log(\text{Spotify follower}_{it}) - \log(\text{Spotify follower}_{it-1})$. HDC_i is a dummy variable indicating if song i is in the treated group ($\text{HDC}_i = 1$) or in the control group ($\text{HDC}_i = 0$). The dummy variable post HDC_t denotes

post-HDC period vs pre-HDC period. Specifically, $post\ HDC_t = 1$ if $8 \leq day \leq 15$ and 0 if $1 \leq day \leq 7$ for every treated song and its matched control song.

We control for several variables that might also affect an artist's Spotify follower growth, such as 1) *DayRelease* is the number of days since the release of the song; 2) *TikTok tenure* is a categorical variable measuring the duration since the track was added to TikTok, as described in Table 1; and 3) *song attributes* (i.e., danceability, acousticness). In addition to controlling for these variables, we control for seasonality by including month fixed effects in the model. To investigate whether the impact of a TikTok dance challenge varies based on the gender of the artist, we added the three-way interaction $HDC_i * post\ HDC_t * female\ artist_i$ to the DID model. The baseline comparison groups are the male artist in terms of artist gender.

A key assumption of the DID estimation is the control and treated groups have a parallel time trend in the absence of the treatment. We have tested parallel trend assumption following Angrist and Pischke (2008), a commonly used method in the economics literature. Specifically, we estimate the interaction of treatment and the pretreatment period on the daily percentage change of Spotify followers. We report the estimation result in Table 2. None of the estimated coefficients for the pretreatment dummies are positive and statistically significant, suggesting that in the PSM sample, there did not exist significant difference in the outcome variables between the treated and control group, prior to the treatment.

Variable	Estimates	
	(I) Coefficients	(II) Std. Err.
Pre-Treatment Trends		
Day 1-Pre (7)	0.00175	0.00284
Day 2-Pre (6)	0.00027	0.00255
Day 3-Pre (5)	-0.00069	0.00203
Day 4-Pre (4)	-0.00414	0.00434
Day 5-Pre (3)	-0.00265	0.0057
Day 6-Pre (2)	0.00167	0.00172
Day7-Pre(1) - reference	-	-
Note: The table assesses the parallel trend assumption in the DID model for the PSM sample of the 124 artists, which 62 artists have a song associated with the HDC during the observation period. The coefficients are estimated in Col (I). Standard errors in parentheses = "+ p<0.1 * p<.05 ** p<.01 *** p<0.001"		
Table 2. Pre-Treatment Trends in The PSM sample		

Results and Discussion

Table 3 shows the summary statistics of our sample. Across 124 artists, Female artists constitute 33.3% of the sample, which is close to the average of gender distribution in the digital music industry. Among all 62 HDCs, 63% are initiated by users, 37% are initiated by artist.

Variable	Mean	Std. Dev.
$\Delta \log(\text{spotifyfollower}_{it})$	0.006	0.033
Post HDC	0.533	0.5
HDC	0.5	0.5
Female artist	0.339	0.478
Song attributes		
Danceability	0.721	0.118
Speechiness	0.121	0.100
Acousticness	0.190	0.237
Instrumentalness	0.003	0.010
Liveness	0.152	0.118
Valence	0.549	0.229

Tempo	121.07	29.006
Loudness	-6.234	2.094
sinceRelease	14.959	35.901
TikTok tenure	2.274	1.241
If HDC = 1		
User generated	0.629	0.483
Artist generated	0.371	0.483
Note: Summary statistics of variables of interest. The sample is selected using propensity score matching within the sample of songs on TikTok, We provide a detailed discussion in the Empirical Specification.		
Table 3. Summary Statistics		

Next, we calculate and plot the average daily Spotify follower change rate across gender in different dance challenge stages, as shown in Figure 3. On average, we observe that female artists have a lower Spotify daily follower growth rate compared to their male counterparts, regardless of whether they have a song associated with a dance challenge or not. However, when their songs are associated with dance challenges, female artists have a noticeable increase in their Spotify follower growth ($\text{Mean}_{F, \text{Post HDC}=1} = 0.0339$) compared to their male counterparts ($\text{Mean}_{M, \text{HDC}=1} = 0.0077$).

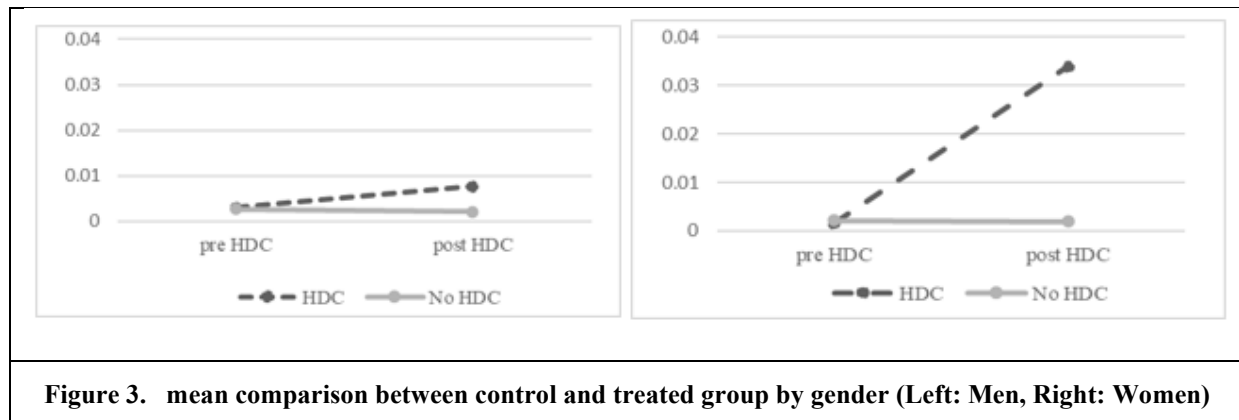


Figure 3. mean comparison between control and treated group by gender (Left: Men, Right: Women)

The Effect of TikTok Dance Challenge

The results of the DID estimation are presented in Table 4. We observe the main treatment effect, i.e., the presence of HDC significantly increases the number of the focal artist's daily Spotify followers, indicated by the positive coefficient of the interaction term ($\beta=0.00934, p<0.05$, Column I). This shows that, on average, the ratio of followers at time t to followers at time $t-1$ is 1.01 times greater for the treatment group as compared to the control group.

	DV = $\Delta \log(\text{spotifyfollower}_{it})$			
	I		II	
Post_HDC	0.0053***	(0.0015)	0.0052***	(0.0014)
HDC	0.0002	(0.0015)	-0.0009	(0.0015)
DID (Post_HDC*HDC)	0.0094*	(0.0038)	0.0017	(0.0031)
Female artist	0.0034	(0.0022)	-0.0042**	(0.0016)
Female artist*DID			0.0305***	(0.0085)
sinceRelease	0.21×10^{-4}	(0.3×10^{-4})	0.27×10^{-4}	(0.3×10^{-4})
TikTokTenure = 2	-0.0007	(0.0031)	-0.0005	(0.0030)
TikTokTenure = 3	-0.0076+	(0.0039)	-0.0081*	(0.0039)

TikTokTenure = 4	-0.0056	(0.0047)	-0.0054	(0.0046)
_cons	0.0011	(0.0084)	0.0094	(0.0088)
N	1860		1860	
R-sq	0.036		0.061	
Song attribute control	YES		YES	
TSong genre control	YES		YES	
Seasonality control	YES		YES	
Standard errors in parentheses = "+ p<0.1 * p<.05 ** p<.01 *** p<0.001"				
Note: the observation window is 7 days before and after treatment (dance challenge), in total of 15 days for 124 songs. The level of analysis is song-day level.				
Table 4. The effect of Hashtag Dance Challenge (HDC)				

The main results examining the moderating role of artist gender is reported in Table 4 column II. Here, we focus on the three-way interaction term involving artist gender, where the baseline comparison group is male artists. The coefficient of the three-way interaction term for female artists is positive and significant ($\beta = 0.0305$, $p < 0.001$, Column II). This shows that, on average, the daily growth of Spotify followers increases by approximately 1.03 times more for female artists as compared to male artists, when she has a song associated with a HDC.

To better understand how the effect of the HDC differs within genders, we conduct additional subsample analysis by artist gender and compare across models in Table 5. We find a significant effect of dance challenge within the female artist group, which suggest that female artists whose song associated with an HDC received an approximate 1.04 times increase of daily spotify followers relative to female artist without a song associated with HDC ($\beta = 0.0367$, $p < 0.001$, Column I). However, this is not the case within the male artist group ($\beta = -0.0032$, not significant). We then follow Clogg et al. (1995) and conduct statistical test for comparing two models and confirm that the effect of dance challenge on Spotify follower growth is significantly different across female and male subsamples ($\chi^2(1) = 14.99$, $p < 0.001$).

	DV = $\Delta \log(\text{spotifyfollower}_{it})$			
	Female Artist (I)		Male Artist (II)	
Post_HDC	0.0009	(0.0010)	0.0090***	(0.0024)
HDC	-0.0053	(0.0034)	-0.0004	(0.0016)
DID(Post_HDC* HDC)	0.0367***	(0.0100)	-0.0032	(0.0037)
sinceRelease	0.0001+	(0.0001)	-0.0000	(0.0000)
TikTokTenure = 2	0.0027	(0.0058)	-0.0007	(0.0017)
TikTokTenure = 3	-0.0081	(0.0072)	-0.0042	(0.0027)
TikTokTenure = 4	-0.0120*	(0.0055)	0.0001	(0.0040)
_cons	0.0076	(0.0178)	0.0261*	(0.0110)
N	630		1230	
R-sq	0.127		0.035	
Song attribute control	YES		YES	
Song genre control	YES		YES	
Seasonality control	YES		YES	
Standard errors in parentheses = "+ p<0.1 * p<.05 ** p<.01 *** p<0.001"				
Note: the observation window is 7 days before and after treatment (dance challenge), in total of 15 days for 124 songs. The level of analysis is song-day level.				
Table 5. The effect of Hashtag Dance Challenge (HDC), by gender group				

Comparison between user vs. artist generated challenge

Next, we test whether there is a significant difference between user- and artist-generated challenges and examine potential heterogeneity across gender. First, to investigate whether the impact of HDC depend on users, we add the three-way interaction term $post_HDC_t * HDC_i * user_gen_i$. The baseline comparison groups are the HDCs that are generated by the artists. We report main results in Column 1, Table 6. While we obtain consistent results on the main effect of HDC, the coefficient of the three-way interaction term for

user generated HDCs is insignificant. This result show that, although HDCs have an impact on the number of artists' daily Spotify followers, we see no difference in terms of their effectiveness on artist popularity based on whether they were generated by the user or the artist. We also conduct additional sub-sample analyses and report results in Table 6, Column II and III. While we obtain consistent results on the main effects of HDC on Female artist subsample, we find no differences between user-and artist-generated HDCs.

Robustness Check

One might suspect that since a dance challenge only occurs after a song clip is added to TikTok, the change of Spotify followers could be due to the song making an appearance on the app, regardless of the dance challenge. Considering this possibility, we isolate the songs on TikTok without a dance challenge and match with the songs, not on TikTok. Following the same propensity score matching approach, we matched based on song-level attributes, song genre, and pre-song released artists' Spotify popularity. This step results in a total of 214 songs – 107 on TikTok despite having a challenge and 107 matched songs that are not on TikTok. To ensure the consistency of the analysis, we continue using a 15-day observation window. The results are presented in Table 7. As shown in Column I, we find that uploading a song clip on TikTok does not significantly boost the growth of an artist's Spotify followers ($\beta = -0.005$, not significant). In addition, we find no significant evidence that female artists benefited by simply uploading song clips to TikTok, despite the coefficient being positive, as shown in column II ($\beta = 0.004$, not significant). We also conduct additional split-sample analyses by artist gender group and found that the effect of song clips on TikTok does not significantly differ across genders in terms of the daily follower growth. This set of results shows that songs that simply appear on TikTok will not significantly impact artists' Spotify follower growth.

	DV = $\Delta \log(\text{spotifyfollower}_{it})$					
	Full sample (I)		Female subsample (II)		Male subsample (III)	
Post_HDC	0.0053***	(0.0015)	0.0006	(0.0012)	0.0090***	(0.0024)
HDC	0.0002	(0.0014)	-0.0009	(0.0025)	-0.0004	(0.0016)
DID (Post_HDC*HDC)	0.0089+	(0.0047)	0.0307**	(0.0105)	-0.0008	(0.0054)
Female	0.0035	(0.0023)				
Post_HDC*HDC*user_gen	0.0008	(0.0054)	0.0147	(0.0154)	-0.0036	(0.0045)
sinceRelease	0.16x10 ⁻⁴	(0.00003)	0.72x10 ⁻⁴	(0.0001)	0.72x10 ⁻⁶	(0.00003)
TikTokTenure = 2	0.0007	(0.0029)	0.0047	(0.0063)	-0.0002	(0.0018)
TikTokTenure = 3	-0.0069**	(0.0026)	-0.0118+	(0.0068)	-0.0038	(0.0025)
TikTokTenure = 4	-0.0049	(0.0033)	-0.0151*	(0.0068)	-0.0001	(0.0040)
_cons	0.0001	(0.0084)	-0.0111	(0.0178)	0.0252*	(0.0108)
N	1860		630		1230	
R-sq	0.036		0.128		0.035	
Standard errors in parentheses	Standard errors in parentheses = "+ p<0.1 * p<.05 ** p<.01 *** p<0.001"					
Note: the observation window is 7 days before and after treatment (dance challenge), in total of 15 days for 124 songs. The level of analysis is song-day level.						
Table 6. Comparing between User and Artist generated challenge						

	DV = $\Delta \log(\text{spotifyfollower}_{it})$			
	I		II	
Post song on TikTok	0.0030	(0.0028)	0.0030	(0.0028)
Song On TikTok	0.0024	(0.0080)	0.0025	(0.0081)
DID (Post song on TikTok * Song on TikTok)	-0.0055	(0.0073)	-0.0066	(0.0084)
Female artist	0.0030	(0.0033)	0.0019	(0.0044)
Female artist*DID			0.0037	(0.0056)
sinceRelease	0.23x10 ⁻⁴	(0.0001)	0.18x10 ⁻⁴	(0.0001)
_cons	0.0247	(0.0266)	0.0251	(0.0270)

N	3210		3210	
R-sq	0.004		0.004	
Song attribute control	YES		YES	
Song genre control	YES		YES	
Seasonality control	YES		YES	
Standard errors in parentheses = "+ p<0.1 * p<.05 ** p<.01 *** p<0.001"				
Note: the observation window is 7 days before and after a song added to TikTok, in a total of 15 days for 214 identified songs. The level of analysis is song-day level.				
Table 7. Effect of Song Being on TikTok				

Conclusion

The music industry has undergone a significant transformation with the growth of digital technologies and has transformed how music is produced and consumed today (Mortimer et al. 2012). Thanks in part to these radical changes, many artists' promotional practices in the music industry that were useful in the past are no longer practical given the growth of social media and music streaming services. In fact, online users increasingly discover and consume music through social media apps (Crupnick 2018) and music streaming platforms (Datta et al. 2018), leading to a wider variety of music consumption and a subsequent increase in the variety of music available (Aguilar and Waldfogel 2018).

Given the large user base, social media has naturally become a powerful marketing strategy for artists to promote musical work, enhance fan engagement and attract more followers (Bennett 2012, Perkins 2012), resulting in significant impacts on music sales across artists (Dewan and Ramaprasad 2014). However, with respect to new artists trying to promote their own creative work through social media platforms, they face two significant obstacles: recommender systems and paid ads. Recommendation systems tend to favor influential artists within social network systems, leading to significant popularity biases (i.e., Voorveld et al. 2018, Abdollahpouri 2019, Mena-Maldonado et al. 2021). These dynamics make it harder for an up-and-coming music artist with a smaller following count to get discovered. Although music streaming platforms like Spotify also use human editors as gatekeepers (Ross 2020), the popularity bias persists as the editors prioritize musical works from already popular artists in the curated playlist, in effect making the 'rich richer'. Even though such platforms introduce curated playlists that feature up-and-coming artists, the staying power of established songs and artists continues, requiring significant effort to break in for the new artist or song (Datta et al. 2018).

Paid ads, as an alternative, offer a way to gain online traction as they are highly data-driven and targeted, but are expensive and requires artists to approach content production with a social media ad plan and clear perspectives on their target audiences. These requirements present difficulties for up-and-coming artists with limited budgets and bandwidth. While constructing well-tailored social media posts can surely help the budding musician gain attention, these are difficult to achieve for musicians with only a few releases under the belt. To sum, in a highly saturated market, in which so many thousands of music artists compete over each other to get noticed, only a lucky few will see results using the 'traditional' social media promotion approaches. Even artists who pay for influencer campaigns can fail in their efforts, as plenty find themselves unable to sell tickets or merchandise despite their efforts.

As a result, in spite of the arguments about the democratization of discourse on social media, there exists significant evidence of under-representation and bias on these platforms. Gender biases, where women are less effective in social media platforms in being able to garner positive attention (Wotanis and McMillan 2014), are particularly evident. Even on platforms like Instagram, users appear to more interested in the appearance and personal lives of female users than in their professional or creative work (Baker and Walsh 2018, Butkowski et al. 2020). Given these obstacles, up-and-coming artists, especially female artists, may need a different strategy to gain traction in the marketplace for digital music.

This paper examines the effect of an interesting technology-driven phenomenon, the hashtag dance challenge, on the number of Spotify followers for up-and-coming artists. More importantly, we isolate the potential mechanisms for why and how female artists benefit more from this phenomenon. The introduction of a HDC significantly increases the artist's day-wise Spotify followers: 1.01 times greater than artists without an HDC-related song. More importantly, women artists experience an increase in followership of approximately 3% (1.03), relative to the equivalent male artist. The combination of dance,

music, and the stereotypical feminine characteristics that these creative forms evoke appears instrumental in explaining the disproportionately positive effect women artists gain from HDCs.

Given our preliminary findings, an exciting question naturally follows is how this democratizing music discovery approach ultimately affects digital music streaming. Although we can provide some initial evidence through the number of followers on Spotify, we cannot provide a definitive analysis of this important question because we do not have data on the specific demand for each artist. Despite this limitation, we hope that our findings are critical for an academic audience to uncover and understand how a technology-driven phenomenon may encourage and empower women in digital music production industry. Furthermore, from a policy perspective, our findings have implications for management at short-form video platforms such as TikTok, as they look to increase platform diversity and inclusion.

We believe our work is one of the first studies to examine the motivation and identify the role of technology-driven platforms that empower women in music production to succeed in their careers. Future steps include finding mechanisms to motivate these platforms to be more inclusive and attractive to women in digital music production. Overall, our study shows that in settings where low female representation persists because of systemic industry biases, a technology-driven, democratized music promotion process such as hashtag dance challenge may engender positive and meaningful change.

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