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<div align="center">The Interplay Between Social Media and Eating Disorders</div>

INTRODUCTION

In this digital age, people's perception of how they should behave are greatly affected by social media. There is an abundance of health/fitness influencers and content that contributes to people's relationship with food and their body image. The reason behind the development of an eating disorder (ED) is complex, but in my paper I will focus specifically on the prevalence of tweets with *#thinspo*, short for thinspiration, which is pictures/affirmations/etc. used to "inspire" people to engage in disordered eating habits to lose weight. There exists pro-ana (anorexia) and pro-mia (bulimia) websites; tweets with *#thinspo* is a small fraction of the pro-ED community.

Social media is a vehicle for the spread of Western culture and its beauty standards. In fact, there were no reports of EDs on the island of Fuji until after Western TV was introduced. Western media led to the development of the idolization of thin white bodies among the Fuji people (Ireland 2009). Ironically, skinny, affluent white girls are still the "cover girls" of EDs, and as a consequence, other groups of ED victims go largely untreated (Thomas-Michigan 2018).

PRIMARY MODEL

The primary model is a contagion model, which models the spread of information, behaviors, diseases, etc., through a population. I model the spread of EDs with the number of tweets with the keyword *'thinspo'* over time. An assumption I'm making is that an ED can be spread since it's a mental illness, not a fad diet.

A contagion model is helpful for this problem because an ED is a mental illness, so it is a "disease" in a way; an ED is characterized by certain behaviors (and people can develop disordered eating behaviors before/without developing a full-blown ED); and pro-ED "tips" and motivation is the information that is being spread. A contagion model provides insight into the primary ways in which EDs are spread (through a single source or "word of mouth").

I specifically employ a diffusion model, which displays the spread of products, ideas, etc., by "word of mouth," as opposed to a broadcast model, which displays the spread through a single source. There are multiple people tweeting pro-ED content, and this content/idea is spread through replying to, retweeting, and quoting tweets. P_spread (probability of spread) is the probability that the infected person has of passing on the "disease" (ED or disordered eating behavior) to those whom they come into contact with. In the context of Twitter (and other social media platforms), "coming into contact" can be interpreted as seeing a pro-ED tweet. Since an ED is a mental illness, for the purpose of analyzing the diffusion model, an ED can be thought of as a "disease." Thus, choice does not play a role in determining the probability that a person

"catches" an ED. For instance, someone with pre-existing mental health issues is more likely to develop an ED when exposed to pro-ED content since EDs often stem from needing a coping mechanism for other mental illnesses. P_spread is also dependent on genetics, gender identity, age, household income, etc. P_contact (probability of contact) also differs among individuals: people who have a disordered eating history or tendencies are more likely to see pro-ED content. People who are into fitness and dieting and therefore following accounts that tweet about these topics are also more likely to come into contact with pro-ED content, because there is sometimes a thin line between health/fitness and disordered eating/exercise (especially on social media). Maybe less obvious, but people who are into K-pop are also more likely to come into contact with pro-ED content. In fact, a good portion of pro-ED content talks about "K-pop diets" and uses K-pop stars as (thin)spiration for losing weight.

Tweets with 'thinspo'

Data source: Tweet API
P_contact: 0.31, P_spread: 0.2
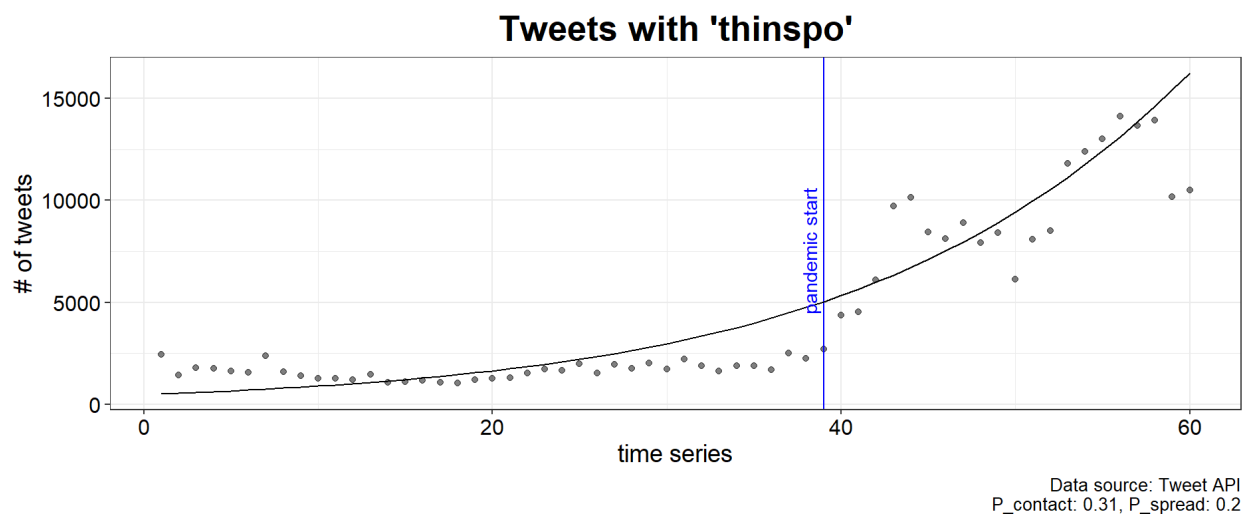
P_contact (0.31) is higher than P_spread (0.2): people can (relatively) easily come into contact with pro-ED content, but they're less likely to develop an ED or become involved in pro-ED communities as a result of that contact. However, P_contact is still only 0.11 higher than P_spread, so coming into contact with pro-ED content still provides relatively high risk for developing disordered eating behaviors.

The start of the pandemic is highlighted on the diffusion model with a blue vertical line. COVID-19 and quarantine was/is particularly triggering for those with disordered eating tendencies. It's clear that there was a significant increase in the number of tweets with "thinspo" once the pandemic began (on 3/11/2020). Discussion on ED subreddits showed changes in ED symptoms and exercise routines. People who started treatment before the pandemic hit could no longer access treatment, or their treatment was altered in a way that was no longer or not as effective. Some people were trapped inside with people they had triggering relationships with (Parker). Quarantine's worsening impact on individuals' non-ED mental health issues triggered disordered eating behaviors and/or made them worse. There was stress from living alone; plus, EDs thrive in social isolation because EDs are usually kept private due to shame. The pandemic

also brought on a sense of lack of control, and EDs are often about control. Relapsing into an ED or intensifying ED behaviors is used as an attempt to give people a false sense of control. The pandemic also increased anxiety surrounding food. Food scarcity can create anxiety in anyone, but the consequences are worse for those who already have anxiety around food on a regular basis (Konstantinovsky 2020). Interestingly, there were people with EDs who reported having higher motivation to recover during the pandemic (Termorshuizen et al. 2020). The more positive reports could be from people who quarantined with people who were supportive, and/or from people who, as a result of quarantine, realized that giving in to their EDs made them lose out parts of their lives that they may not have another opportunity to relive.

The number of tweets peak near the end of 2021, but there seems to be a "dip" starting in November. This could indicate that there was a significant decrease in pro-ED activity (and intensity of EDs) once quarantine restrictions began to be lifted, but there needs to be significant data after December 2021 to make conclusions. If the number of tweets continues to dip after the last time point, then it can be concluded that coming out of quarantine led to less pro-ED tweets, which displays a decrease in the spread of EDs. The severity of the pandemic lessening towards the end of 2021 could also have decreased the anxiety and out-of-control feelings that people had that triggered their EDs.

Tweets with "thinspo" appear to represent the spread and prevalence of EDs, but is that true of other social media platforms? Most websites/servers and social media platforms try to ban/block pro-ED content and forums, but that often isn't enough to stop people from spreading pro-ED content online. There are many other terms that pro-ED posters use for their content, but "thinspo" is a if not the primary term. It is surprising that Twitter does not block "thinspo" at all, not even with a content advisory message. So, is it the lack of content censoring that makes Twitter the ideal home for pro-ED content? *Is* Twitter the ideal home? I explore these questions with my secondary model, a spatial model.

SECONDARY MODEL

A spatial plots preferences in a space relative to some chosen dimension(s). A spatial attribute has no best value; each "individual" has a "preferred" amount of the attribute. This model is useful because of its emphasis on what's "closer" to ideal points rather than "more" or "less." A spatial model is helpful in this case because while it may be logical to think that a higher level of policing leads to less pro-ED content, that is not always true. Separating the social media platforms into groups of different combinations of level of policing and level of interactions provides extra insight into the analysis. An assumption I make for this model is that social media platforms with different methods of content regulation can be "ranked" by their level of policing.

Platform Policing vs. # of Interactions
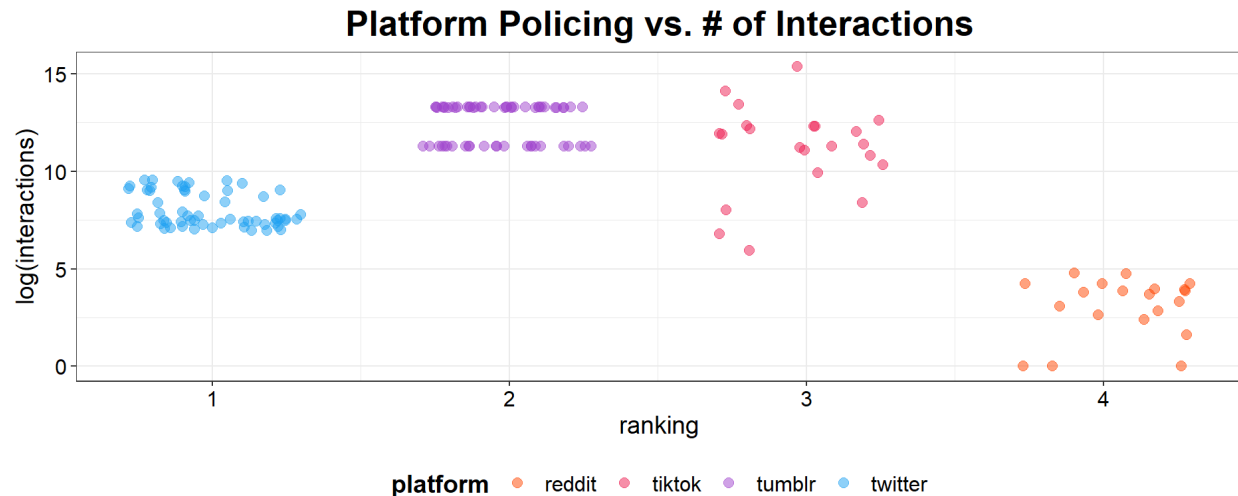
Reddit is ranked as the most policed despite not blocking any of these keywords or mentioning eating disorders in their community guidelines. There were posts with pro-ED keywords, but not attached to pro-ED content—they were from subreddits that existed as support groups for those with EDs. Reddit bans subreddits that are pro-ED. Also, what is unique to Reddit that none of the other platforms have is human moderators. Human, unpaid moderators. The moderators are all volunteers, so they actually care and are therefore good at monitoring content and behavior on their respective subreddits.

Tik Tok and Tumblr as a group have a medium level of policing, but have the highest level of interactions. Despite having the most minimal level of policing, Twitter only has a medium level of interactions. If the graph is split vertically in half between low level of policing and high level of policing, then Tik Tok has a high level of policing but still has one of the highest if not the highest amount of pro-ED content. Reddit, on the other hand, fits the idea that higher levels of policing lead to lower levels of interactions.

There is more range in the level of interactions in the higher-policing group than the lower-policing group. This suggests that increasing regulation of content can only do so much. Tik Tok and Reddit are also very different kinds of social media platforms. On Reddit, you can "cherry-pick" the content that you see in the sense that you're only shown content from subreddits that you're a part of (or content you specifically search for). On Tik Tok, the "For You" page shows videos from all over the platform. In addition, Tik Tok is much more visual than Reddit, so the content is easier to consume and therefore easier to be triggered by.

The range of levels of interactions is much smaller in low policing groups, which encompasses Twitter and Tumblr. The only policing that Tumblr does that Twitter does not is give a content advisory; however, there is an option to view the posts anyways, so the content advisory is mostly irrelevant. Tumblr does also specify prohibiting content that promotes EDs, but clearly does not enforce this policy, so that is also mostly irrelevant. Tumblr's lack of real action against the pro-ED content on their platform explains the small difference between the level of interactions. Twitter and Tumblr are also more similar to each other than Reddit and Tik

Tok are to each other, both being text-based. Tweets have a 140 character limit, but you can write an entire short story in a Tumblr post. However, from viewing a couple of popular pro-ED tweets, many of these Twitter users are using threads to expand on their tweets, so they end up writing a lot of text for "one" tweet. The pro-ED community attempting to use Twitter like Tumblr can also explain why Tumblr has more content—Tumblr already has the tools for the type of content that pro-ED communities want to post.

It's interesting that both Tumblr and Tik Tok are in the high level of interaction group because Tumblr *can* be very text-heavy, while Tik Tok is not at all. Tumblr features many post options, so there is more flexibility in the content that people want to post on Tumblr. Many of the pro-ED posts on Tumblr *are* visual, but they can easily be text-heavy if needed.

The primary age range of users on each social media platform is also likely to contribute to the level of pro-ED content. Tik Tok's primary age group is those between the ages 16-24, the most vulnerable for EDs. The main age group for both Twitter and Tumblr is 18-29, which makes sense because the difference in interactions between the two platforms is relatively small. Reddit has mostly users between the ages 20-29, the oldest age group of all these platforms, with ages 30-39 coming in pretty close (Statista).

Perhaps Reddit proves that blocking pro-ED keywords and showing content advisory messages is useless against pro-ED content on the internet, and what social media really needs is human moderation—humans who actually care, not social media corporations adding a few lines to their community guidelines and listing mental health resources ("the 2020 equivalent of handing a teen a tri-fold brochure," according to psychiatrists Neha Chaudhary and Nina Vasan) to appease the once-in-a-blue-moon angry article about pro-ED content on these platforms

The author of "Tik Tok Has a Pro-Anorexia Problem" is scared that social media platforms will remove all ED content (Gerrad 2020), but Reddit is able to have subreddits that are support groups for people with EDs while having minimal pro-ED content. In addition, the difference between non-pro-ED ED content on Reddit versus that on platforms like Instagram and Tik Tok is that the former is mostly features support groups for those with EDs, while the latter two features many "pro-recovery" accounts that often seem more in pseudo-recovery than real recovery. My personal opinion is that Reddit has more real content, while the latter has more "fake" content; EDs are competitive by nature, so recovery "influencers" try to prove they're recovered as a different kind of competition.

LIMITATIONS AND CONCLUSION

Finding pro-ED content is straightforward on Twitter because the platform doesn't block that content. On the other social media platforms, I had to search for other, usually misspelled or otherwise tweaked versions of the traditional keywords (listed in appendix). This means that the amount of pro-ED content is dependent on my personal ability to find the content, which is affected by my familiarity with the platform, the time I spent looking for content, etc. As for Reddit, I could only find one pro-ED subreddit that was created in 2022. This is obviously limiting the accuracy of the data because I can't find all the content nor can I get data for the

same percentage of content on each platform. However, ease of finding content could also translate to ease of users coming into contact with such content.

Using pro-ED keywords in general is also limiting, because pro-ED posts can not have any of the keywords. In the future, I could train a machine learning algorithm to detect ED content on social media platforms. This could actually address both problems because the machine learning algorithm would be able to find all or at least a similar percentage of pro ED content across platforms.

There is still the question of defining pro-ED content—is it only explicitly pro-ED content? "Subtle" pro-ED content possibly be more triggering than explicitly pro-ED content because the author of the former is unaware of being sick or pretends not to be. As a consequence, people who view this content develop or worsen these disordered eating behaviors without realizing that the behaviors are dangerous and not normal. For instance, there's no way to be sure that recovery "influencers'" What I Eat in a Day's are real, leading to those truly attempting to recover feel guilt/shame when they also eat a lot and don't stay thin.

The praise and large following that these accounts get while people who are overweight and in recovery continue to be fat-shamed displays the (1) very-much-still-present stigma surrounding EDs, and (2) the consequences of the thin white woman still being the (only) image that immediately comes to mind when "eating disorder" is invoked. Recovery "influencers" being almost all thin white women does not help the second issue—and they can never address the struggles/consequences of EDs that are unique to, for example, people of color.

Social media is representative of the spread of EDs because secrecy is one of the hallmarks of EDs—people can only be openly disordered behind their screens. Maybe nothing social media platforms can do to regulate content will significantly decrease pro-ED content on the internet. Even if all pro-ED content is removed, there is still "subtly" pro-ED content. Even looking at photos of people—posts that have nothing to do with eating, exercise, etc.—can be triggering for some. Maybe what we really need is real, uncensored, inclusive discussion and education about EDs so that we can finally remove the stigma surrounding EDs. Then, we can reduce/remove the shame that ED victims face that leads them to search for self-expression on the Internet—which can often do more harm than benefit.

APPENDIX

Twitter contagion model

It is true that the number of tweets (and social media use) increased in general as a result of the pandemic, so naturally, the number of tweets with "thinspo" would also increase. However, this can also mean that the rise in the use of social media led to more pro-ED content being posted online, which resulted in increased prevalence of EDs and worsening of ED behaviors *because* the competitive nature of EDs make them thrive in environments with widespread pro-ED content.

The following graph shows both the # of tweets (with "thinspo") and the mDAU (monetized daily active users on Twitter) over time.

Tweets w/ 'thinspo' & Twitter mDAU Worldwide
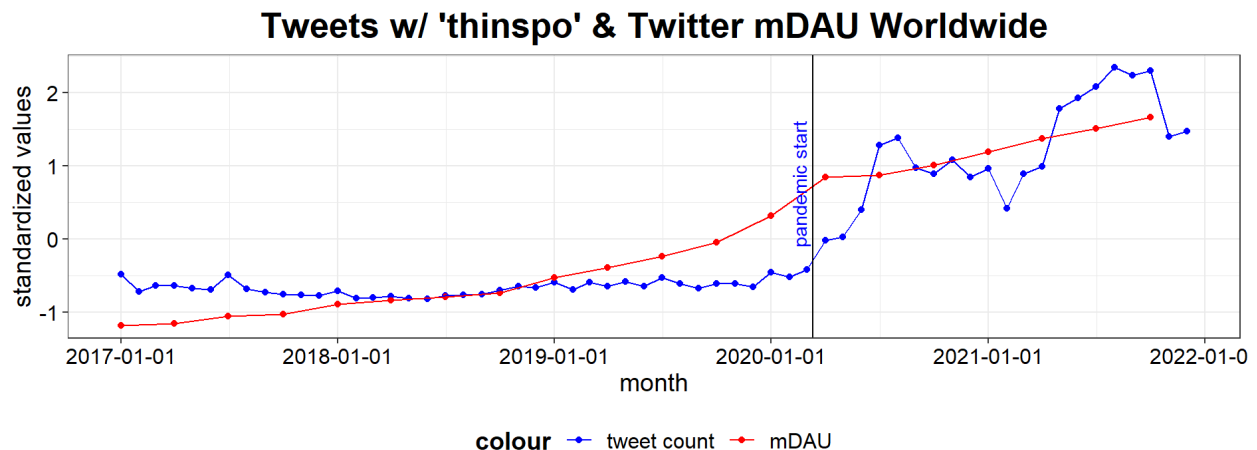
Data source: Statista, Twitter API
Author: Rachel Lin

Spatial model

The x-axis is the "ranking" of policing on the social media platform, from least policed to most policed (1 is least policed, 4 is most policed). The y-axis is the number of interactions: for all the platforms excluding Tik Tok, this means the number of posts (each data point represents the number of interactions per month). For Tik Tok, I instead used the total number of video views per month. Tik Tok is different from the other platforms where the primary post media is video rather than text. The number of videos for Tik Tok is much lower than the number of views, however: (1) Tik Tok is well-known for being rampant with pro-ED content, and (2) it's generally easier to make a text post than to create a video, and videos with little-to-no text is

easier for users to consume than a text post is (and therefore is easier to be triggered by), so the view count matters more. Actually, the y-axis is the log of the number of interactions because the range of the number of interactions was too large, and it is relative differences that are key, not absolute differences.

Social media policing ranking method

       I ranked the social media platforms' policing by considering their response to explicit searches for pro-ED content and their community guidelines. A social media platform was moved higher on the ranking system if their community guidelines included *specific* reference to eating disorders. Tumblr and Tik Tok were the only ones who explicitly stated that content promoting disordered eating was prohibited. I searched for a range of pro-ED keywords, starting with the more obvious ones like "thinspo," "proana," "thinspiration," to see if the platform blocked content with these terms. The platform was moved up on the ranking system if there is some kind of content advisory message when these obvious keywords are searched. However, some platforms had an option to view the posts anyways (which, really, defeats the purpose, because people with an ED will almost always choose to view the triggering content they were looking for), so the platforms *without* that option were moved higher up. The content advisory message always includes links to resources, but Instagram links general mental health resources rather than specific ED resources like the NEDA helpline. Platforms with links to ED-specific resources were ranked higher. Tik Tok even has buttons to call and message NEDA instead of just a link to their website, making for easier access.

       However, despite some of these social media platforms' attempts to block content with pro-ED keywords, users find loopholes by purposely misspelling these words. Tik Tok surprisingly blocks a number of these misspelled pro-ED keywords, including "thinspao," "th1nsp0," and "skinnycheck," (Paul 2021) which led to Tik Tok being ranked higher.

Spatial model: Tumblr

       Tumblr values aren't very spread out along the y-axis because I used the same number for each month per year. Tumblr's strict API limit + the large number of pro-ED posts restricted my data scraping abilities. It was not feasible to scrape all the posts, so I scraped the posts for a month or a portion of the month (and estimated for the whole month), then used that number for every month for that year.

Spatial model with Instagram

Instagram had to be removed because I couldn't scrape all the data so I estimated based on the number that was listed under the hashtag name on the Instagram app. Therefore, Instagram could not be sorted by month, or even year.

As you can see, Instagram has a medium level of policing but relatively low interactions. This differs a lot from its neighbors, Tumblr and Tik Tok, which have much higher interactions levels. I think this is largely attributed to Instagram's pro-ED content being subtle, as discussed in the paper.

Platform Policing vs. # of Interactions
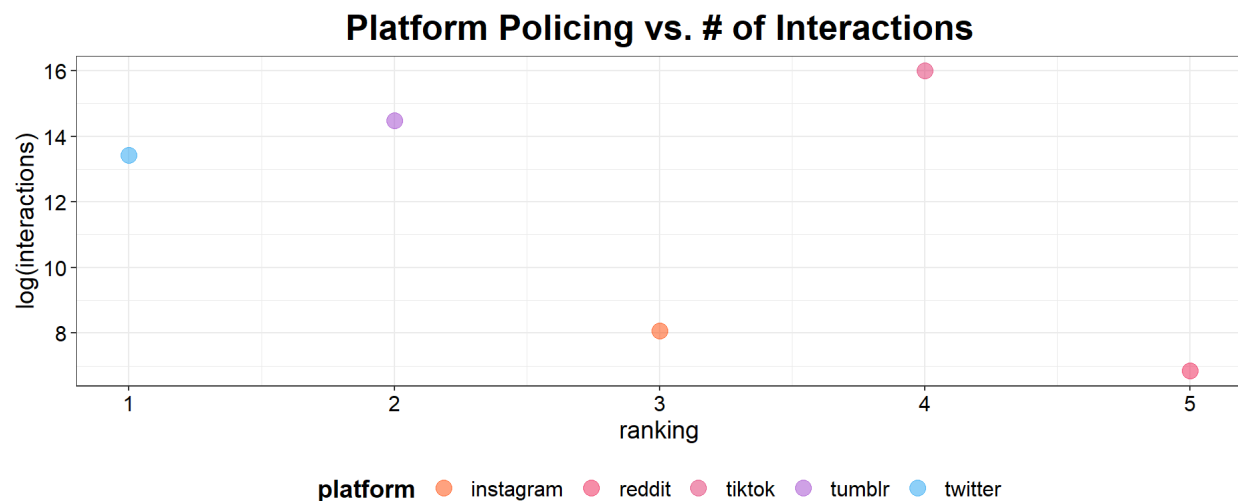
Hashtags used for pro-ED content

Tik Tok	Instagram
thinrspo thrnspo iwillbeskinny ednotsheran* thinpo caltok ëdtøk skinnyisbetter kittysspo edtt ugw somidiet iudiet	thursdaythinspiration thinspam th1nspiration skinnycore skinnygirlsstarve edtumblr an0rexia

*I also saw a pro-ED video with the hashtag #edsheeran, no tweaks.

As you can see, people on Tik Tok get really creative. There is likely more; I had limited time to dig for these tags.

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