

Untangling between fake-news and truth in social media to understand the Covid-19 Coronavirus

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Abstract—“Covid-19 is a virus developed to rule the world” is just one of the many fake-news published on the Web. In this pandemic period, the Web is flooded with real news, allegedly true or blatantly false. To understand how fake news is affecting the Covid-19 perception, we selected 40 news (either true or fake) related to the origin, diffusion, treatment and effects of Covid-19 and we asked 293 volunteers to express their opinion on the truthfulness of the news. Then, we propose an Awareness index to compute knowledge degree of the volunteers. The results highlight a large ignorance on medical news, ignorance that goes beyond educational background. The study highlights the need for Health Institution to enter social media platforms in order to clearly explain what is true and what is false on Covid-19.

Index Terms—Covid-19, Coronavirus, psychometric analysis, Awareness Index, Real-world study.

I. INTRODUCTION

“The coronavirus was made in military labs”, “Do not go to Chinese stores or Chinese restaurants because many products come from the Wuhan area and therefore may contain the virus and you might get infected”, “Hospitals are full of infected people, but health officers don’t say it openly to avoid panic”, “Coronavirus is a big pharma commercial operation designed to sell the related vaccine”. These are just few examples of fake news that have been circulating on social media since the health emergency was launched at the beginning of January 2020.

Fake news has always existed and will always exist because people love such stories. Umberto Eco, the famous Italian semiotician who wrote “*The name of the rose*”, once said that traditionally the creators of fake news never hurt anyone because they were listened to by just few friends, but he blamed social media to amplify their voice by giving them the opportunity to make proselytes on a global scale. That’s why we have many people who believe in a flat earth and in airplanes that release chemicals to infect people, in theories that state that big pharmas create diseases in labs to sell vaccines, in aliens ruling the world, and so on.

From a cultural phenomenon, fake news have become a dangerous threat to our society when the focus moved to public and personal health issues [1]–[3]. Healthcare institutions have been trying to warn the public for years that social media can give rise to misinformation, that on social media there are people without any competence who disclose and create false information [4]–[6]. However, if you look for disease information on any social media platform, you will find both interesting discussions and exchanges of views [7], [8] and a different parallel world, having less and less trust in institutions and relying in improvised gurus who use social media to amplify their thoughts (and their business) [9]–[11]. You will likely find conversations about useless treatments, non-existent diseases, denial of official medicine, apotheosis of alternative medicines, cancers that can be treated with a good mood, diabetes that heals by drinking a glass of hot water at wake-up time [12]. Some of such remedies might rise smiles, but the issue is serious because personal health choices might affect in a negative way the welfare of the whole society [13], with the Covid-19 pandemic being just the latest example. Indeed, the World Wide Web provides an abundant source of medical information and this information has the potential to increase the anxieties of people who have little or no medical training [14]. For example, the increasing number of social media posts that talk about measles vaccinations is decreasing the measles vaccination coverage [15] and vaccine-skeptical websites create communities of people that disseminate misinformation [16]. In various fields, social media are exploited to improve the real-world scenario. Indeed, business intelligence analyses try to identify influencers [17], people’s sentiment [18], users’ behavior [19], [20], to promote TV programs [21], [22] and even mathematical models to predict the future [23]. In the health sector, although social media are changing the way individuals transmit and receive health related information [24], the voice of the health authorities seems to be dominated by the conversations produced by ordinary citizens.

In this context, motivated by the high number of news circulating on the Web and in social applications about the Covid-19 pandemic, we have tried to understand how fake news affects the knowledge that people have about this virus.

The research question we asked ourselves is “**How much do fake news affect Covid-19 perception?**” To address it, we focused on news related to the origin, spread, treatment and effects of the Covid-19 coronavirus. We selected 40 different news, true, allegedly true or blatantly false taken from both authoritative health sources (e.g., World Health Organization Website, Health Government FAQ) and unknown sources (i.e., news circulating on social networks and/or social applications).

To understand how people perceive every single piece of news, we designed a 7-point psychometric Likert scale and we asked 293 volunteers of different ages and with different educational backgrounds to express their opinion among: *Strongly Agree, Agree, Somewhat Agree, Neither Agree nor Disagree, Somewhat Disagree, Disagree, Strongly Disagree*.

We defined the **Awareness Index** to weight every single opinion and provides a degree of the knowledge that participants have on each individual news. Results show that fake-news do affect the knowledge related to Covid-19. For instance, people believe that the virus is due to the Chinese culinary tradition. The study also highlighted a communication problem of health institutions: news related to medical aspects do not reach people, a clear evidence of the wrong or incomplete communication of health authorities.

The remainder of this paper is organized as follows. Section II describes the research question and the proposed Awareness Index; Section III shows and analyzes the obtained results. Main findings and conclusions are drawn in Section IV.

II. THE INVESTIGATION

The main Research Question that we address in this study is “**How much do fake news affect Covid-19 perception?**”.

We considered news related to four topics concerning coronavirus:

- **Origin:** the origin of the coronavirus;
- **Propagation:** the diffusion of the coronavirus;
- **Treatments:** the treatments against the coronavirus;
- **Effects:** the effects of the coronavirus on the human body.

We browsed the Web and collected 10 different news related to each topic: some news were taken from Healthcare authorities (i.e., Government, Health Department, Italian Health Organization, World Health Organization) and some others were taken from social networks and/or social applications. The selection was made in order to have some true statements and some false statements. As for the latter, we established they were false by searching among authoritative sources: either the news was explicitly denied (sometimes softly denied, because no scientific evidence of its truth was found up to that time), or was given no mention at all. It is interesting to note that sometimes news concerning on going studies or theories yet not proven by the scientific community have been

TABLE I
VALUES RETURNED BY THE LIKERT() FUNCTION: THE HIGHER THE VALUES THE LOWER THE KNOWLEDGE.

News type	Value
False	Strongly Disagree \mapsto 0
	Disagree \mapsto 1
	Somewhat Disagree \mapsto 2
	Neither Agree nor Disagree \mapsto 3
	Somewhat Agree \mapsto 4
	Agree \mapsto 5
True	Strongly Agree \mapsto 6
	Strongly Disagree \mapsto 6
	Disagree \mapsto 5
	Somewhat Disagree \mapsto 4
	Neither Agree nor Disagree \mapsto 3
	Somewhat Agree \mapsto 2
Agree \mapsto 1	
	Strongly Agree \mapsto 0

divulged even by newspapers as if true (e.g., the fact that Vitamin D assumption/production decreases the probabilities of being infected). We collected the 40 news that are listed in Table II.

We investigate users’ perception using a 7-point Likert scale. For each statement, the user is asked if she *Strongly Agree, Agree, Somewhat Agree, Neither Agree nor Disagree, Somewhat Disagree, Disagree, Strongly Disagree*. We consider the 7-point scale because it is considered the most accurate of the Likert psychometric scales and it gives a better reflection of the respondent’s true evaluation [25].

To understand the degree of knowledge of the participants on each individual statement, we introduce the following **Awareness Index**:

$$AIndex(news) = \sum_{i=1}^N Likert(User_i)/N \quad (1)$$

where *news* is the considered news, *N* is the number of participants, *User_i* is the *i* – th participants, *Likert()* returns a value ranging from zero to six. A zero score means the participants has a completely right perception of the news, i.e., if the news is false, the strongly disagree option returns zero, and if the news is true, the strongly agree option returns zero. Conversely, a six score means the participant has a completely wrong perception of the topic reported in the news.

Table I shows the values returned by the Likert() function.

Therefore, the more the value of the Awareness Index is closer to zero, the higher is the participants right overall perception towards the considered news.

III. PERCEPTION ANALYSIS

The invitation to fill the questionnaire has been posted to our Universities forums and to many different Whatsapp Groups. It has been posted on April 11 2020 and it stayed on-line up to April 26 (15 days). We had 293 people who answered the questionnaire: 57% female and 43% male. The age group of the participants is the following: 16..20 (17%), 21..30 (47%), 31..40 (12%), 41..50 (12%), 51..60 (12%).

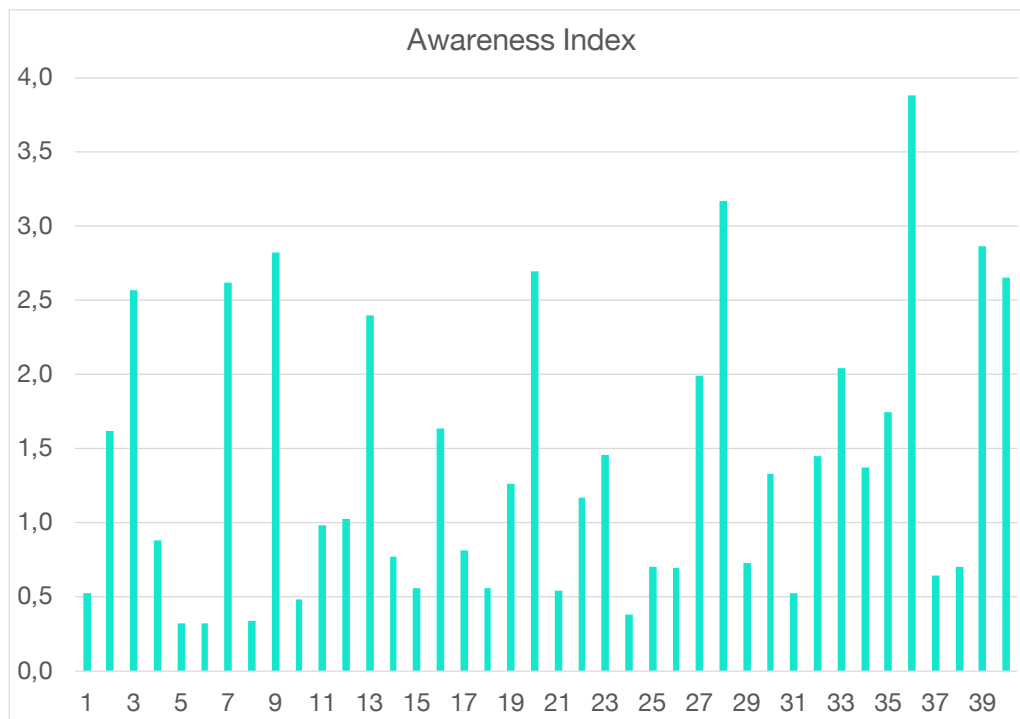


Fig. 1. Awareness Index measured for each of the 40 news.

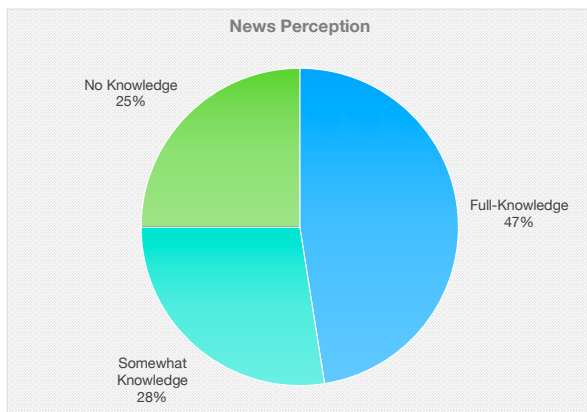


Fig. 2. News Perception according to the Awareness Index.

Figure 1 shows the Awareness index for each individual news. To deepen the analysis, we consider the following categorization:

- **Full-knowledge.** News with A-Index smaller than 1;
- **Somewhat knowledge.** News with A-index between 1 and 2;
- **No-Knowledge.** News with A-index larger than 2.

We divided the 40 news according to such categories:

- **Full-knowledge news:** the category contains 19 news: #1, #4, #5, #6, #8, #10 (related to the topic "Origin", resulting the topic better known by the participants, with

6 questions in this category); #11, #14, #15, #17, #18 (belonging to the topic "Propagation"); #21, #24, #25, #26, #29 (related to the topic "Treatments"); #31, #37, #38 (belonging to the topic "Effects").

- **Somewhat knowledge news:** the category contains 11 news: #2 (related to the topic "Origin"); #12, #16, #19 (related to the topic "Propagation"); #22, #23, #27, #30 (related to the topic "Treatments"); #32, #34, #35 (related to the topic "Effects").
- **No-knowledge news:** the category contains 9 news: #3, #7, #9 (related to the topic "Origin"); #13, #20 (related to the topic "Propagation"); #28 (related with the topic "Treatments"); #33, #36, #39, #40 (related to the topic "Effects", resulting the topic with the worst understanding from the participants, with 4 questions in this category).

Figure 2 shows the cardinalities (in percentage) of the three categories. It is to note that, in general, participants showed no really good perception, as only half of the news were correctly perceived: a random choice is expected to give the same result. However, only one fourth was really badly perceived, and there are only two news scored more than three, meaning that no news misled the large majority of participants.

In the following, we analyse the news in each category, with a deeper interest in the most critical no-knowledge one. Indeed, understanding why participants ended up with a wrong perception about certain news, might help delivering a better communication to people in the future.

Full-Knowledge news: the news with lowest AIndex (below

TABLE II
THE 40 NEWS COLLECTED FROM HEALTH-AUTHORITATIVE SOURCES AND FROM SOCIAL APPLICATIONS.

Type	N.	News
Origin	1	There is a correlation between Covid-19 and 5G
	2	Covid-19 originated from animals
	3	Covid-19 is a mutated influenza virus strain
	4	Covid-19 is a Chinese bacteriological weapon
	5	Covid-19 originated in Wuhan, China
	6	Covid-19 is a disease created by the new world order organization
	7	The first Covid-19 coronavirus infection occurred in an unknown way
	8	The coronavirus Covid-19 is a Russian bacteriological weapon
	9	Covid-19 is due to the Chinese culinary tradition
	10	Covid-19 is a disease created by vaccine manufacturers
Propagation	11	Domestic pets can transmit the Covid-19 coronavirus
	12	Covid-19 can be transmitted through mosquito bites
	13	When returning home, it is always necessary to wash cloths, footwear and even hair
	14	Children are unlikely to be Covid-19 infected
	15	People from Africa cannot be Covid-19 infected
	16	Scientific studies proved that Covid-19 coronavirus survives on surfaces
	17	5G weakens the immune defenses and thus it facilitates the Covid-19 infection
	18	Covid-19 infected people might be asymptomatic
	19	Immunosuppressed people are more at risk of contracting Covid-19
	20	Tobacco smokers are a Covid-19 risk category
Treatments	21	Washing your hands reduces the likelihood of being infected by Covid-19
	22	Eating garlic, protein, lemons and oranges prevents Covid-19 infection
	23	Hot water above 26-27 Celsius degrees kills Covid-19
	24	Gargle with bleach, steroids, essential oils and salt water protect from Covid-19
	25	Paracetamol-based treatments cures Covid-19 patients
	26	Drinking lots of water pushes Covid-19 into the stomach where it is destroyed by acids
	27	Antibiotics have no effect on the Covid-19 coronavirus
	28	Street disinfections is required to stop Covid-19
	29	Seasonal flu vaccine protects against Covid-19
	30	Vitamin D reduces the chance of Covid-19 infection
Effects	31	Covid-19 coronavirus makes men sterile
	32	Covid-19 coronavirus resists at 37 Celsius degrees
	33	Most people who contracted Covid-19 did not need hospitalization
	34	Once healed, you can no longer contract Covid-19
	35	Lost of taste and smell are typical Covid-19 symptoms
	36	Liver damages are a consequence of Covid-19
	37	You always know whether you are Covid-19 infected
	38	Covid-19 creates serious problems to older people, but everybody can be infected
	39	Covid-19 can be transmitted by pregnant mothers to unborn children
	40	Covid-19 lung injuries are not permanent and healing is complete

0.5) in this category are few (5 out of 19 in the category, plus two very close to 0.5) and mainly the most extravagant fake-news related to the origin of the virus. Luckily people are aware they are not true, e.g., people do not believe News #8 (*Covid-19 is a Russian bacteriological weapon*) or News #24 (*Gargle with bleach protects from Covid-19*). Following, mainly related to virus propagation and treatments, we have news with higher AIndex (but still below 1). Such news are either extravagant enough (e.g., for News #17, *5G facilitates Covid-19 infection as it weakens immune defences*, there is no scientific evidence) or have been often repeated and widely discussed on traditional media (e.g., News #14, *Children are unlikely to be infected*, is supported by numbers and correctly believed to be true) and have become common knowledge.

Somewhat Knowledge news: this category contains some of the most controversial news, in particular those that seem to be supported by scientific evidence. The real issue is that scientific knowledge about the virus is continuously evolving, many studies are set up to test different hypothesis on virus origin, propagation and treatments, and very often news report ongoing researches as if they already were confirmed results. Once such studies are concluded, even if they prove their initial thesis to be wrong, people already got a distorted perception. For example, News #30 (*Vitamin D reduces the chance of Covid-19 infection*), appeared on Italian newspapers since the end of April 2020 citing a scientific study conducted at the University of Torino [26]. However, a deeper investigation, conducted at the time we prepared the questionnaire, revealed that the document was a preliminary study that did not undergo any review process yet. At the time we are writing this paper (beginning of May 2020), the peer-review version of that article has been published [27], however the evidence that the news is true is still hypothetical. Indeed, the abstract of the paper states that “*higher vitamin D₃ doses might be useful. Randomized controlled trials and large population studies should be conducted to evaluate these recommendations*”.

Another example concerns News #16 stating that *scientific studies proved that Covid-19 survives on surfaces*. At the time we posted the questionnaire it was only known that the SARS virus did survive on surfaces. However, given that the Covid-19 virus belongs to the same virus family of the SARS virus, hypothesis were that also Covid-19 survives on surfaces. At the time we are writing this paper, scientific results did show that Covid-19 might survive on surfaces (up to 72 hours on plastic and stainless steel, less than 4 hours on copper and less than 24 hours on cardboard [28]), but participants were convinced the news was true even before any scientific solid result was delivered.

No-Knowledge news: the news in this category mainly fall into those concerning the origin of the virus and effects of the virus.

Participants do not have a clear idea about the origin of the virus: News #3 (*mutation from the Influenza virus*), News #7 (*first Covid-19 infection*, and News #9 (*Covid-19 is due to the Chinese culinary tradition*). Likely, the perception has been

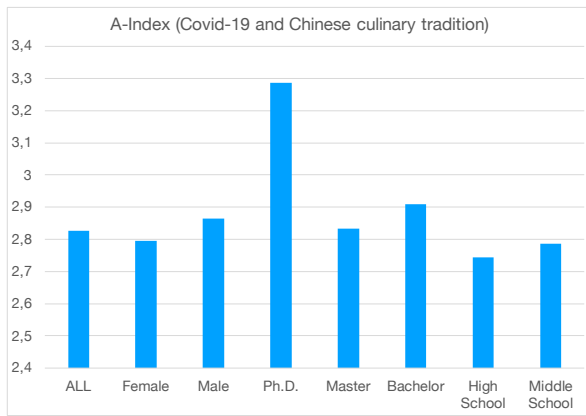


Fig. 3. News #9 Perception grouped by all, gender, and schools.

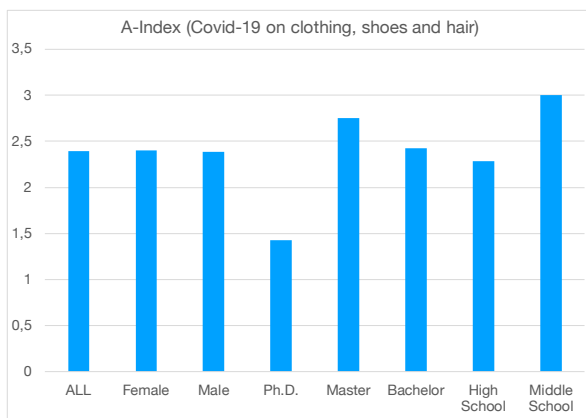


Fig. 4. News #13 Perception grouped by all, gender, and schools.

influenced by an Italian politician who blamed the Chinese culinary tradition of eating alive mice to be the origin of the coronavirus Covid-19 spread [29], [30]. This news likely affected the knowledge related to the first Covid-19 infection. Although science has no explanation, so far, of how the first Covid-19 case happened, participants believe the opposite.

Figure 3 shows details of News #9. There is no substantial difference between men and women, whereas there is a difference with the educational background. Surprisingly, participants with a Ph.D. believe in a correlation between the origin of the virus and the Chinese culinary tradition. Participants do not know how the transmission of the virus works: News #13 (*necessity to wash everything when returning home*). So far, as we already mentioned, there are scientific evidences that Covid-19 might survive on surfaces, but no studies refers to clothing, shoes or hair. Likely, the underlying idea is that studies talk about surfaces in general and therefore, participants are confused and derive a wrong knowledge on the topic.

Figure 4 shows details of News #13. There is no substantial difference between men and women, whereas the educational background produces different perceptions. Participants with

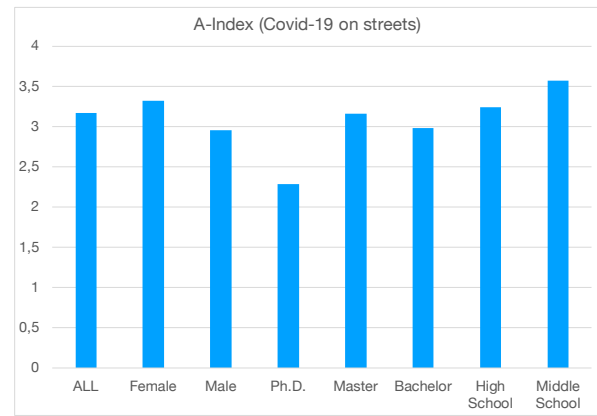


Fig. 5. News #28 Perception grouped by all, gender, and schools.

a Ph.D. have a correct knowledge. In general, participants know how to deal with the virus, with the exception of News #28 (*streets disinfection are required to stop the virus*). So far, science stated that “*there is no evidence that walking surfaces are involved in transmission of the virus. Moreover, spraying hypochlorite could increase the amount of harmful substances in the environment. Street cleaning with conventional soaps/detergents is still advised.*” [31]. Likely, people confuse a simple suggestion with a necessity.

Figure 5 shows details of News #28. There is little difference between men and women, and there are large differences among people with different educational background. Although participants with a Ph.D. have a higher knowledge than people with other educational background, the AIndex is remarkable even for people with a Ph.D. Participants have little knowledge about Covid-19 effects: News #33 (*most people who got infected did not need hospitalization*), News #36 (*Liver damages associated to Covid-19*), News #39 (*Transmission between pregnant mother and unborn child*), and News #40 (*permanent or not lung injuries*). The poor knowledge towards Covid-19 effects concerns very detailed medical aspects. This shows a weakness in health communication. Indeed, very detailed medical aspects hardly find space in the big newspaper headlines or in the main TV news reports. Therefore, people without medical background are often unaware of the consequences of the virus. What really surprises is News #33. Indeed, during the lockdown, almost daily Italian media have repeated over and over again that the majority of patients that contracted Covid-19 did not need hospital treatment, and that a period of isolation at home was sufficient. The lack of knowledge about this news could be due to a lack of trust in the institutions and their communication.

Figure 6 shows details of News #33. There is little difference between men and women (men are less informed), and there are no substantial difference among people with different educational background. Also in this case, surprisingly people with a Ph.D. do not believe that most of the people do not need to be treated in hospitals.

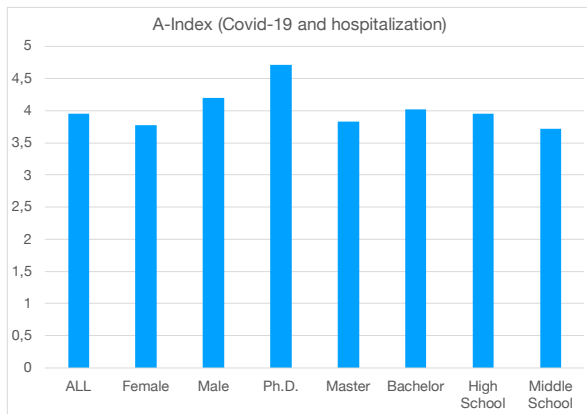


Fig. 6. News #33 Perception grouped by all, gender, and schools.

IV. MAIN FINDINGS AND CONCLUSIONS

Confusion and ignorance are surely normal, but fake news contributed to confuse peoples' perception on what is true and what is not with respect to Covid-19. In this regard, the study highlighted that men and women behave similarly, whereas it surprised that people with the highest educational qualifications have less knowledge in many of the considered news. The study also highlighted a communication problem of our institutions: news related to medical aspects do not reach people, a clear evidence of the wrong/incomplete communication of either health authorities or politicians.

In conclusion, the obtained results showed that, in half of the cases, people have not been influenced. However, some news has managed to breach the general confusion surrounding the virus. A possible approach to fight this misinformation is to increase the presence of health authorities in social channels.

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