Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Anxiety and covid-19 compliance behaviors in the UK: The moderating role of conspiratorial thinking

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ABSTRACT

The Covid-19 pandemic raised many societal problems, one of them being convincing people to comply with government measures to control its spread. In the UK, many unprecedented measures were taken to that end. Public health bodies often use fear appeals to encourage people to obey the rules. What happens though when individuals hold beliefs contrary to government narrative? In this study, the relationship between coronavirus induced anxiety and compliance behavior over the first UK lockdown is examined in relation to general conspiratorial beliefs and specific Covid-19 conspiracy myths. Results suggest a small interaction between specific Covid-19 conspiracy beliefs and anxiety, and that while for most, increased anxiety enforces compliance, for those with conspiratorial beliefs regarding Covid-19 (but not general conspiratorial beliefs), this may not be true. Fear appeals may be successful for the majority, but a small minority may continue to ignore advice. Implications for public health are discussed.

1. Introduction

In March 2020, the UK, went into full lockdown, preventing individuals from leaving homes, visiting loved ones and attending work, amongst many other activities. Such interruptions to life are not easily coped with and many individuals either partially comply or outright refuse. Governments are challenged to ensure public health campaigns successfully promote compliance to keep contact, and thus infection, to a minimum. One tactic is to use fear appeals (Demirtas-Madran, 2021).

Fear appeals emphasize negative consequences of ignoring instructions to elevate fear and anxiety to encourage compliance. Fear and anxiety are powerful behavioral motivators and are adaptations preventing engagement in risky behaviors (through hypervigilance) and to encourage escape from immediate threats (Gray & McNaughton, 2000). Fear and anxiety provoking campaigns can be put to effective positive uses in some circumstances. Cypryanska and Nezlek (2020) and Harper et al. (2020) show that dysfunctional anxiety and fear were positive predictors of preventative behaviors during the early stages of the Covid-19 pandemic. Koniak and Cwalina (2020) also showed that fear correlates with less negative views on the introduction of social restrictions.

This relationship is not always straightforward (Blonde & Girandola, 2019; Demirtas-Madran, 2021). Too much fear can promote defensive reactions, while too little can make the appeal ineffectual (Morris & Swann, 1996). The relationship can also be moderated by factors such as optimism ("*x is unlikely to happen to me*"; Blonde & Girandola, 2019). This can be detrimental to public health aims. A recent international study suggested that optimism bias is a problem, with many individuals interpreting risk in such a way as to believe they were unlikely to become infected with Covid-19 (Kuper-Smith et al., 2020). Policy makers must therefore be careful about how public health messages are promulgated to maximize effectiveness.

While fear appeals are effective, they can also promote misinformation and disinformation (inaccurate or deliberately misleading information). Analyses of anti-vaccination messages in Twitter posts for instance showed similar strategies used to discourage Covid-19 vaccine uptake (Scannell et al., 2021). Misinformation, disinformation and conspiratorial thinking have been a problem throughout (and of course, not limited to) the coronavirus pandemic, to the point of being declared an "infodemic" by the WHO in February 2020.

Irrational beliefs are barriers to vaccine uptake and preventative health measures and can erode trust in public health. Jolley and Douglas (2014) showed a negative relationship between vaccine conspiracy beliefs surrounding vaccinations and intentions to vaccinate a fictional child. Those exposed to anti-vaccination literature (compared to positive information and control) were also less likely to vaccinate a fictional child. These effects were mediated by several factors, including perceived dangers around vaccination. Such beliefs have already been

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contributing to declines in routine vaccinations in the UK (Jolley & Douglas, 2014). Conspiracy theories thus have damaging, real world effects.

Conspiracy theories are not limited to vaccinations and endorsement of some form of conspiratorial thinking is widespread. For example, approximately 70% of Americans endorse conspiracies surrounding the death of President Kennedy in 1963 (Swami, 2012). This may suggest that holding conspiracy beliefs are harmless. As discussed above though, some theories, and in some contexts, have consequences. Many theories suggest that secret cabals of capitalists, politicians etc., engineer events for social, political, or economic gain. From a health perspective, theories focus on pharmaceutical greed, faked results, and the ongoing cover-up harmful side effects (Kata, 2012). Research also shows that those who endorse one theory are likely to endorse multiple, often unrelated or contradictory theories (Freeman et al., 2020; Wood et al., 2012). The endorsement of health unrelated conspiracies also increases negativity towards vaccination (Lewandowsky et al., 2013).

Douglas et al. (2017, 2019) suggest that conspiratorial thinking is not monological despite correlations between different beliefs. Instead, they argue that conspiratorial thinking satisfies psychological needs to understand and control situations, while maintaining positive representations of the self or groups (*epistemic*, *existential*, and *social* motivations). Each of these motivations likely plays a role in creating and proliferating Covid-19 conspiracy theories.

Epistemic motivations focus on explanation in the face of uncertainty. Douglas et al., review evidence that suggests individuals seek meaningful patterns in randomness and coincidence when impactful events lack official explanations. Those less critical and analytical are susceptible to conjunction fallacies and confirmation bias while often misattributing agency and intentionality, leading to acceptance of conspiratorial beliefs. *Existential* motivations emerge under conditions of threat and anxiety, and a desire to alleviate these feelings. Under conditions of alienation, anomie, existential anxiety, powerlessness etc., irrational beliefs may form as a coping mechanism to allow individuals to manage perceived threats within their environment. *Social* motivations can use conspiracist ideas as a way of maintaining or boosting the image of the self or a group. This may be particularly important for individuals in disadvantaged or minority groups attempting to explain situational threats, their subordinate status or threats or discrimination against them (and based on historical precedents, is not always truly irrational). They may also be mechanisms by which to increase self-esteem or worth if they feel they possess important knowledge of truths. In an expansion of this framework van Prooijen (2020) suggests that these three motivations are not independent and proposes that existential threat is the beginning of a causal process that leads to the creation and the cyclical generation of conspiracy theories.

According to Douglas et al. (2017, 2019), uncritical individuals seeking to satisfy these motives can come to irrational conclusions and accept unwarranted beliefs (even if these beliefs do not necessarily satisfy the motivation). In a fast-moving pandemic where etiology remains unknown (epistemic gaps), infection and death rates are high (existential threat) and often reported as disproportionate in some minority groups (social threats), emergent conspiratorial beliefs around the pandemic are ways to make sense of the information, alleviate existential anxiety and potentially defend their social position.

To that end, it is unsurprising that Covid-19 conspiracy theories are abundant regarding etiology, spread and treatment (see Appendix 1 for examples of such). Freeman et al. (2020) showed that approximately 25% of UK participants endorsed some form of pandemic related false belief. Covid-19 conspiracy myths were also related to general conspiracist ideation and reduced lockdown compliance. They concluded it was "*likely that conspiracy beliefs drive behaviour or at the very least remove barriers to carrying out unhelpful behaviours*" (p13) rather than conspiracy theories being post-hoc rationalizations for compliance failures and suggest that conspiratorial beliefs have real-world impacts. However, this study does not directly assess causality. Furthermore, recent criticism (Garry et al., 2020; Sutton & Douglas, 2020) on measurement grounds suggest prevalence of conspiratorial endorsement and the strength of the relationship with compliance is weaker than Freeman et al., suggest.

This raises questions of how holding conspiratorial beliefs interact with other beliefs or emotional states in relation to public health measures. Levinsson et al. (2021) found a relationship between conspiratorial thinking and sympathy for violent radicalization, but that this relationship was moderated by psychological distress (a measure closely aligned with anxiety). The more distressed participants were, the stronger the relationship became. Constantinou et al. (2021) showed that psychological distress also moderated the relationship between conspiratorial beliefs and psychological flexibility, which in turn led to reduced compliance with government guidelines. These studies therefore suggest that relationships between conspiratorial and various outcomes is not necessarily straightforward. Imhoff and Lamberty (2020) also showed that different forms of conspiratorial thinking can have different impacts. Conspiracies focusing on the pandemic being a hoax decreased compliance behaviors, while those centered on the virus being man-made increased behaviors such as stockpiling. General conspiratorial mindsets did not seem to be correlated with compliance behaviors but were so with prepping behaviors.

In successful fear appeals, increases in measures of fear or anxiety should translate into compliance. However, increasing fear likely increases existential anxiety, particularly if the context and origin of the threat is not well understood. This may increase epistemic, existential, and social motivations, which, in an 'infodemic', likely leads to the proliferation of conspiratorial thinking. However, the consequences of conspiratorial thinking in response to these motives are not well understood (Douglas et al., 2017, 2019; van Prooijen, 2020) and requires exploration. One possibility is that increased endorsement of conspiratorial beliefs changes the nature of the relationship between anxiety and compliance. Those who are anxious and low in conspiratorial belief may be expected to comply. Those who are anxious but high in conspiratorial belief though, based on the above studies of psychological distress, would be expected to be more non-compliant. This would make public health appeals based on increasing anxiety problematic for a segment of the population. This non-experimental study thus has the following hypotheses:

H1. There will be a positive relationship between Covid-19 related anxiety and lockdown compliance.

H2. The relationship between Covid-19 anxiety and lockdown compliance will be moderated by conspiratorial thinking.

2. Method

2.1. Participants

187 participants (mean age 29.26, 19.3% male) were recruited opportunistically online (via Twitter, Call for Participants, Reddit forums and a university recruitment portal) between January 4th and May 31st, 2021. In January 2021, England reported 1,079,236 cases and 33,315 deaths due to COVID-19. By May 2021, this had declined to 61,641 cases and 462 deaths (ONS, 2022). Participants were aged 18 and above and resident in the UK since March 23rd, 2020. There were no additional exclusion criteria. No incentives were offered.

2.2. Measures

2.2.1. Coronavirus Anxiety Scale (CAS)

The CAS (Lee, 2020) was designed to measure pandemic induced dysfunctional anxiety. It consists of five items (e.g. '*I felt nauseous or had stomach problems when I thought about or was exposed to information about the coronavirus*') measured on a five-point scale ranging from *not at all* to *nearly every day for the past two weeks*. Higher scores equate to higher

anxiety.

Compliance Scale (CS): This 15-item scale was developed for this study and examined compliance with rules enforced during the UK lockdown between March 23rd and June 25th, 2020. Items included everyday behaviors such as '*Exercised outdoors for more than 1 hour per day*' and '*Allowed non-resident household members into your home*'. These were measured on a five-point likert scale from *Always* to *Never*. Higher scores indicate greater compliance.

2.2.2. Coronavirus Conspiracy Scale (CCB)

This scale was developed to measure endorsements of various Covid-19 conspiracy myths. The scale included ten myths that appeared on social media (see Appendix 1 for full list) measured on a six-point likert scale from *Definitively Not True* to *Definitely True*. Higher scores were indicative of greater endorsement of Covid-19 conspiracy beliefs.

Generic Conspiracy Beliefs Questionnaire (GCB): This 15-item scale measures general beliefs in conspiracy theories (Brotherton et al., 2013) and includes items such as '*A small, secret group of people is responsible for making all major world decisions, such as going to war*'. These were measured on a five-point likert scale from *Definitively Not True* to *Definitely True*. Higher scores were indicative of greater endorsement of general conspiracy beliefs.

2.3. Procedure

Ethical approval was granted by Teesside University's School of Social Science Humanities and Law ethics subcommittee. Participants responded to the invitation via an online survey link where they were given information prior to consent. Participants then completed all measures before reaffirming age and consent. A debrief sheet was then presented. Analysis was conducted using SPSS (V26) via the PROCESS macro (V3.5.2, Hayes, 2018). Measurement models were tested using the *R* package lavaan.

3. Results

Analysis first focuses on establishing the properties of measures using factor analysis. Descriptive statistics of the final measures are then presented before proceeding with correlation and moderation analysis. Five participants had missing values in the GCB. These were estimated via multiple imputation.

3.1. Measurement models

The four scales were each first tested for their underlying structure (especially important given that two were designed specifically for this study). Confirmatory Factor Analysis (CFA) was used to assess underlying unidimensionality of each. No alternative multidimensional models were tested as the sample was not large enough to combine exploratory and further confirmatory analysis. The following fit statistics were examined to determine how well the models fit the data: Chi Square, comparative fit indices (CFI), Tucker-Lewis Indices (TLI), Root mean square error approximation (RMSEA) and the Standardized Root Mean Square Residual (SRMR). Ideally, Chi Square should be non-significant, CFI and TLI in excess of .95, RMSEA less than .08 and SRMR lower than .08 (Hu & Bentler, 1999). Estimation was conducted using diagonally weighted least squares due to the ordinal nature of the items. Internal consistency was examined using McDonald's Omega, which unlike the more commonly used Cronbach's Alpha, does not assume tau equivalence between items and their associated latents. Table 1 illustrates the results of these analyses.

All measures appear to fit the data well (the LCS being possibly the weakest, but only marginally) and suggests these can be treated unidimensionally. No modifications to the models were made. For the purposes of further analysis, factor scores were saved to represent these latent constructs and used in moderation analysis. Table 2 presents descriptives and reliabilities for all constructs in this study. To assist with understanding, raw score totals and standardized scores are presented (although raw scores are not used in the analysis).

Table 1
Model fit statistics.

Model	X^2	DF	p	CFI	TLI	RMSEA	SRMR
CAS	0.32	54	.997	.99	.98	.00	.03
LCS	70.86	65	.289	.99	.99	.02	1.00
CCS	12.04	35	1.000	1.00	1.00	.00	.06
GCB	64.26	90	.982	1.00	1.00	.00	.06

CAS = Coronavirus Anxiety Scale; LCS = Lockdown Compliance Scale; CCS = Coronavirus Conspiracies Scale; GCB = General Conspiracist Beliefs.

Table 2
Descriptive statistics.

Measure	Omega	Unstandardized mean (SD)	Standardized mean (SD)
CAS	.898	1.770 (3.178)	−0.001 (0.961)
LCS	.809	7.059 (6.250)	0.000 (0.917)
CCS	.879	6.722 (6.485)	0.004 (0.962)
GCB	.931	16.193 (12.380)	0.000 (0.969)

3.2. Correlations

Correlations for all measures are presented in Table 3. Correlations are Spearman's rho due to non-normality. Anxiety (CAS) seems related to compliance (CS) as hypothesized but not related to measures of conspiratorial thinking. Compliance is related to all other measures in expected directions. The measures of general conspiratorial belief (GCB) and the Covid-19 conspiracies (CCS) are strongly correlated.

3.3. Moderation

Two moderation analyses were conducted to examine if specific (Model 1) or general (Model 2) conspiratorial beliefs altered the relationship between anxiety and lockdown compliance. Table 4 presents the results of each.

Model 1 was significant overall, $F(3, 183) = 9.949$, $p \leq .001$ and explained 14.02% of the available variance. Model 2 was also significant, $F(3, 183) = 3.259$, $p = .023$ and explained 5.10% of the variance. Conspiratorial beliefs significantly predict compliance behaviors in both models and are also the strongest indicators of compliance relative to anxiety and the interactions. Only in model 1 is moderation significant. The effect of specific Covid-19 conspiracy beliefs also appears stronger than general conspiracy beliefs in predicting lockdown compliance. Table 5 presents the relationships from model 1 at the level of the mean and one standard deviation above and below the mean.

It appears that while overall, compliance increases as anxiety increases, this only happens at low levels of conspiratorial belief. At high levels of conspiratorial belief (one standard deviation above the mean), this relationship reverses (albeit non-significantly) and those who are more anxious become less compliant.

Table 3
Correlation matrix.

	CAS	LCS	CCS
LCS	.160*	–	–
CCS	.086	.294**	–
GCB	-.038	.161*	.741**

** $p < .01$.
* $p < .05$.

Table 4
Moderation analysis.

	B [95%CI]	SE	p	r_{sp}	Structure coefficients
Model 1					
Constant	0.000 [−0.123, 0.124]	0.063	.982		
CAS	0.055 [−0.076, 0.185]	0.066	.251	.057	.219
CCS	−0.335 [−0.464, −0.205]	0.066	<.001	-.349	−.901
CAS * CCS	−0.154 [−0.300, −0.008]	0.074	.039	−.142	−.380
Model 2					
Constant	−0.006 [−0.130, 0.124]	0.066	.927		
CAS	0.040 [−0.101, 0.182]	0.072	.577	.041	.036
GCB	−0.184 [−0.319, −0.049]	0.069	.008	−.193	−.853
CAS * GCB	−0.096 [−0.240, 0.048]	0.073	.192	−.096	−.444

Table 5
Model 1 moderation coefficients.

CCS	B	SE	p	95%CI
−0.763	0.172	0.080	.033	[0.014, 0.330]
0.004	0.054	0.066	.415	[−0.077, 0.185]
0.966	−0.094	0.105	.371	[−0.300, 0.113]

4. Discussion

The results show significant correlations between anxiety and compliance as well as between conspiratorial thinking and compliance, supporting previous results (Constantinou et al., 2021; Freeman et al., 2020; Garry et al., 2020) and hypotheses one. The moderation results partially support the hypothesis that conspiratorial thinking changes the nature of the relationship between anxiety and compliance. While general beliefs don't seem to have a significant impact, specific beliefs regarding Covid-19 do (albeit a small effect). Generally, as pandemic related anxiety levels increase, so does compliance. For those with virus related conspiracy beliefs, this is not true, and although not statistically significant, they become increasingly non-compliant as their anxiety increases. This interaction is small but statistically significant (explaining 2% of variance). On a positive note, from a public health perspective, messages instilling anxiety regarding the crisis may be working for those not endorsing conspiracy theories.

For some, this could be problematic from the perspective of infection control. Policies relying on heightened anxiety, while effective for most, may not have the desired effect in those who hold epistemically questionable beliefs. This may help explain why some flaunt rules designed to protect the public and, occasionally, go further by actively creating and spreading misinformation regarding issues such as vaccination. The more anxious they become about infection, the more they blame the system and react against it, paradoxically increasing their infection likelihood. This could be evidence that conspiratorial beliefs are used by some as defense mechanisms to justify continued non-compliance.

The results could also support the works of Douglas et al. (2017, 2019) and van Prooijen (2020). These theorists suggest that conspiratorial thinking emerges in response to existential threat (something ever present in a public health campaign) and serves both sense making and social motivations (even if they don't achieve these aims). While most become compliant, increasingly conspiratorial individuals either don't modulate behavior or worse, do the opposite. Their irrational beliefs may thus be countermanding the protective effects of pandemic anxiety. Further work examining the relationship between anxiety and compliance in the face of irrational beliefs should thus be a priority to determine the extent of its effects and to potentially develop public health strategies to ameliorate it.

Quantifying the extent to which individuals endorse irrational beliefs is problematic (see Garry et al., 2020). As such, some context is provided around endorsement in this study for clarity. Individuals represented by the conspiratorial group are a relatively small proportion of the sample (16.58%) and not as high as in other UK based studies (i.e., Freeman et al., 2020). It is thus encouraging that for most people anxious about infection, they generally follow advice and guidance, and suggests that appeals via a sense of threat may keep people acting safely.

This study used a balanced scale measure of Covid-19 myths (equal weight given to disagree and agree statements). Generally, endorsement of Covid-19 conspiracies was low (10.1% believed all were *definitely not true*) and 72.73% had scores less than 20 (out of a maximum of 60, suggesting average endorsements of *very unlikely to be true*). Only 4.28% had scores over 30, which means average responses on items represent *possibly untrue*. The conspiracies endorsed the most appeared to be "*COVID-19 was released from a laboratory in China*" (Mean 2.67, SD 1.25) and "*minority groups are not being treated for COVID-19*" (Mean 2.22, SD 1.16) although, average scores suggest most believed these to be on the untrue side of the scale, even if they were less confident in saying it was *definitely not true*. It is perhaps less surprising that there is uncertainty on these items, given that mainstream media kept these two issues in the public domain throughout the pandemic. Frequencies of endorsements are provided in Appendix 1.

However, while the endorsement of conspiracies is low, if that 4.28% translated into continued non-compliance and/or anti-vaccination attitudes then, scaled up to a national level, represents a non-trivial population segment at continued risk of undermining national measures to control infection. Recent analysis from the UK Office for National Statistics (ONS, 2021) suggests that while only 9% of the UK population were hesitant to receive a vaccination, this rate was 17% in 16–29-year-olds. Given the age of this sample, this is a similar figure to those endorsing conspiracy myths and while conspiratorial thinking was not measured by the ONS study, adherence to irrational belief may explain some of that hesitancy.

Thus, in agreement with Garry et al. (2020) and Sutton and Douglas (2020), this study suggests that the role of conspiratorial thinking, while being small (in terms of endorsement and correlation strength), in this domain is likely non-trivial, with potential real-world impacts. Future research is needed to examine the direct effect of conspiratorial thinking on vaccine uptake rather than simply measures of vaccine hesitancy or intention.

While general conspiracy beliefs do not interact with anxiety, these beliefs remain correlated with endorsement of Covid-19 conspiracy myths and support the notion that those with a general mindset to believing epistemically suspect beliefs are more likely to endorse other such beliefs (including multiple specific ones; Freeman et al., 2020; Wood et al., 2012). This suggests that strategies designed to reduce the effects of conspiracy theories likely need focus on more than specific theories to be effective.

4.1. Limitations

There are limitations to be acknowledged. Firstly, sensitivity analysis suggests that the minimum detectable effect of the moderator is $r^2 = 0.040$ in a sample this size. Effect sizes presented for moderators here were 0.020 ($\beta = 0.50$) for Covid Conspiracies and 0.009 ($\beta = 0.25$) for general conspiracies. Low power is therefore an issue and a larger replication is required for more precise estimates. Secondly, the sampling method was one of convenience and involved a university recruitment portal. While student status was not recorded, it is likely (given the mean sample age) that many of these participants represent that population. Generalizability is therefore a problem. Thirdly, two

measures employed were bespoke to this study (CCS and LCS) and require further testing in terms of their validity (although correlations with existing measures and basic structural tests suggest they have performed well). This is unavoidable however given that such measures did not exist in a validated form at the time of this study. Time may also be an important factor. A recent Norwegian study (Bierwiaczonek et al., 2020) suggests that while conspiratorial beliefs decrease over time, social distancing compliance increased. However, the social distance increase was lowest in those who held stronger conspiratorial beliefs. Finally, the study timing meant that it did rely on retrospective self-report, which while common to this kind of study, raises known issues of potential bias.

5. Conclusion

While increased anxiety in individuals who are less conspiratorial seems to be good for compliance behavior, there are some where the opposite of the desired response may occur. This study highlights potentially damaging impacts that endorsement of conspiracy narratives may have on public health behaviors and suggests that strategies reducing these impacts need consideration in public health policy. If this is not achievable, then finding alternative strategies that enforce compliance on those who hold conspiratorial views will be necessary instead.

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Dr. Lee Copping was the sole author of this paper and did not receive assistance at any point from any other researcher.

Declaration of competing interest

None.

Appendix 1. Endorsement of conspiracy items

	Definitely not true	Very unlikely to be true	Possibly untrue	Possibly true	Very likely to be true	Definitely true
COVID-19 is evidence of a disease that has come from space	88.80%	9.60%	0.50%	0.50%	0.50%	0%
COVID-19 was released from a laboratory in China	19.80%	31.60%	18.20%	24.10%	5.30%	1.10%
5G towers are at least partially responsible for the spread of COVID-19	86.10%	9.10%	3.20%	1.60%	0%	0%
The spread of COVID-19 is all part of a wider capitalist conspiracy	62.60%	14.40%	10.20%	11.80%	0.50%	0.50%
Evidence suggests that minority groups are not being treated for COVID-19	34.20%	29.40%	19.80%	12.80%	3.70%	0%
The financial sector is responsible for the COVID-19 outbreak	64.70%	19.30%	12.30%	2.10%	1.60%	0%
There is no COVID-19. The epidemic is an international experiment in social control	82.40%	10.20%	4.30%	3.20%	0%	0%
Pharmaceutical companies already had a working COVID-19 vaccine and withheld it	59.90%	14.40%	12.80%	10.70%	2.10%	0%
The outbreak of COVID-19 is part of a financial scheme to inflate the value of digital currency	67.90%	19.80%	5.30%	5.90%	1.10%	0%
COVID-19 is a virus engineered to target minority groups	66.80%	18.20%	8.60%	5.90%	0.50%	0%

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