



# Psychological and experiential drivers of vaccine confidence after compliance

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## ABSTRACT

**Background:** Determinants of COVID-19 vaccine confidence have been widely studied among unvaccinated individuals, but less is known about factors shaping confidence among those already vaccinated.

**Methods:** We conducted an online survey (December 2021) among 3171 fully vaccinated French-speaking adults in Belgium. Vaccine confidence (1–9 scale) was analyzed using stepwise regression including health variables, fear of COVID-19, and personality traits.

**Results:** Higher confidence was associated with comorbidities, fear of COVID-19, conventionalism, and authoritarian submission. Lower confidence was associated with self-reported adverse events and conspiracy beliefs. Psychological and experiential factors showed stronger associations than health characteristics alone.

**Conclusions:** Vaccine confidence remains heterogeneous among vaccinated individuals and is shaped by both psychological traits and post-vaccination experiences. These findings suggest that vaccine confidence is not a static attitude but a dynamic construct that remains associated with individual beliefs, emotional responses, and post-vaccination experiences. Addressing safety concerns and fostering trust may be essential to sustain engagement in ongoing vaccination programs.

## 1. Introduction

Since January 2020, humanity has faced the global challenge of a novel coronavirus, leading to the COVID-19 pandemic [1]. By early 2021, several COVID-19 vaccines became available and were adopted as the primary global strategy to control the pandemic [2], with some authors [3] even describing vaccination as “the only acceptable path to herd immunity”, while others welcomed it as the “Holy Grail” of the pandemic’s ending [4]. However, the success of vaccination campaigns has depended not only on vaccine availability but also on public acceptance. Yet, the World Health Organization (WHO) had already listed vaccine hesitancy among the top threats to global health in 2019 [5], highlighting that reluctance toward vaccines predates the COVID-19 pandemic. Following the launch of the global mass vaccination campaign, much attention was given to understanding why people were refusing or delaying vaccination [6], with low confidence emerging as a key factor [6,7]. This issue became particularly salient during the

COVID-19 pandemic, as rapid vaccine development and widespread dissemination were accompanied by a large dose of uncertainty. Physicians reported emotional reversals, as patients shifted from fear of infection to rejecting vaccines in months, which some termed “emotional epidemiology” [8]. This dynamic illustrates how rapidly perceptions and attitudes toward health risks can evolve. Beyond fear, a European survey of over 10,000 unvaccinated individuals highlighted the influence of trust in policymakers: conspiracy beliefs increased hesitancy, while trust in government reduced it [9]. These findings underline the central role of trust and belief systems in shaping vaccination attitudes. Recent frameworks such as the WHO’s ‘Behavioural and Social Drivers’ model suggest that vaccination-related attitudes and behaviors emerge from the interaction of cognitive, emotional, social, and experiential factors. The variables examined in this study, including fear of COVID-19, adverse vaccine experiences, conspiracy beliefs, conventionalism, and authoritarian submission, can be understood within this broader framework [10]. Importantly, most previous

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research considered vaccine hesitancy as a mental state of indecision that precedes a possible decision to take a vaccine (or not). Therefore, vaccine hesitancy is considered as an attitude, a feeling, whereas vaccination is a behavior (or not), whose rates can be objectively calculated [5]. This distinction suggests that the factors leading someone to hesitate before vaccination may differ from those influencing confidence among individuals who have already been vaccinated. Notably, factors determining vaccine confidence were mostly assessed in unvaccinated people (i.e., vaccine hesitant attitude) while, to our knowledge, few studies examined the factors explaining vaccination confidence among people who had finally decided to act. Understanding what took place within this group is particularly important, as confidence among vaccinated individuals may influence booster uptake, recommendations to others, long-term trust and medical adherence in vaccination programs. In this paper, we examined various factors relating to health, feelings and personality that could influence confidence in COVID-19 vaccines in a large sample of people who had received the full course of vaccinations.

## 2. Material and methods

A voluntary online survey was conducted between December 4 and 18, 2021, among 3171 French-speaking adults in Belgium who had completed a full COVID-19 vaccination schedule. Participants were recruited through an online panel, and data were collected using a structured online questionnaire via LimeSurvey.

Respondents provided information on their socio-demographic and health characteristics, including age, comorbidities, and self-reported adverse events following COVID-19 vaccination. Vaccine confidence was assessed using the item: “How much confidence do you have in COVID-19 vaccines?”, rated on a Likert scale ranging from 1 (“not at all”) to 9 (“complete confidence”).

Psychological and attitudinal variables included fear of COVID-19 and personality-related constructs. Fear was assessed through perceived risk of infection using the item: “How afraid are you of contracting COVID-19?”, rated on a Likert scale ranging from 1 (“not afraid at all”) to 9 (“extremely afraid”). Personality traits included: conspiracy beliefs, “I think that the official version of the events given by the authorities very often hides the truth”; conventionalism (e.g., “The rules in society should always be respected”); and submission to authority (e.g., “We must trust our leaders even if we don't fully understand their decisions”), using a Likert scale ranging from 1 (Strongly disagree) to 9 (Strongly agree) (see Supporting Information).

Stepwise regression models were used to identify predictors of vaccine confidence. Health-related variables (including adverse events) were entered in a first block, followed by fear-related variables, and finally personality traits. This sequential approach allowed assessing the incremental contribution of each group of variables. Analyses were conducted using SPSS version 30, and statistical significance was set at  $p < .05$ . Likert scales were analyzed as continuous variables in the regression analyses, consistent with recommendations supporting the use of parametric methods for Likert-type scales with multiple response categories and large sample sizes [11,12].

The study adhered to all ethical standards. Approval was obtained from the local ethics committee (IACCHOS) on November 19, 2021, prior to data collection. Participants were informed about the study objectives and their rights through the online questionnaire and provided informed consent before participation. No identifying information was collected, ensuring anonymity.

## 3. Results

Table 1 presents descriptive statistics for all study variables, including means, standard deviations, and observed ranges. These results provide an overview of the characteristics of the study sample. Correlations between all the factors used in our sample of 3171

**Table 1**

Descriptive data for all the variables used in this study.

| Variables (Min-Max)           | Mean (SD)      |
|-------------------------------|----------------|
| Vaccine Confidence (1–9)      | 5.36 (2.67)    |
| Sexe (Ratio F/M)              | 58.5% (Female) |
| Age (16–89 Years Old)         | 46.29 (13.51)  |
| Nb of Comorbidities (0–4)     | 0.45 (0.74)    |
| Nb of Adverse Events (0–10)   | 0.63 (1.26)    |
| Fear of Covid (1–9)           | 2.93 (2.18)    |
| Conventionalism (1–9)         | 5.01 (2.33)    |
| Submission to authority (1–9) | 3.05 (1.72)    |
| Conspiracy level (1–9)        | 4.81 (2.58)    |

vaccinated people are shown in Table 2. After Bonferroni adjustments, with  $p$ -level of significance set at 0.001, confidence in COVID-19 vaccines was significantly correlated with many predictors. Mostly, positive significant correlations were observed with the number of comorbidities ( $r = 0.09$ ,  $p < .001$ ), conventionalism ( $r = 0.595$ ,  $p < .001$ ), fear of COVID-19 ( $r = 0.355$ ,  $p < .001$ ) and submission to authority ( $r = 0.580$ ,  $p < .001$ ). Confidence in COVID-19 vaccines was also negatively correlated with the number of adverse events reported ( $r = -0.283$ ,  $p < .001$ ) as well as with respondents' general conspiracy level ( $r = -0.619$ ,  $p < .001$ ).

Stepwise regression analyses (Table 3) were then performed by first entering health-related factors such as age, number of reported comorbidities and number of adverse events reported; followed, in a second step, by fear of COVID-19; in the third step, by the personality factors measuring conventionalism and submission to authority; and finally, in the fourth step, by the respondents' general conspiracy level. Confirming the correlations, the results of these regressions highlight that, apart from age, which was excluded during stepwise analyses, the other six predictors explained a total of 56% of the variance of the level of confidence in COVID-19 vaccines. The level of conventionalism and fear of COVID-19 alone positively predicted respectively 21.3% and 10.4% of the variance (R-squared change). On the other hand, the adverse events of the vaccine and the level of general conspiracy negatively predicted 8% and 9% of the variance.

To facilitate interpretation of the regression findings, a complementary analysis was conducted by categorizing participants according to their level of vaccine confidence. Three groups were created: low confidence (scores 1–3;  $n = 918$ ), moderate confidence (scores 4–6;  $n = 894$ ), and high confidence (scores 7–9;  $n = 1359$ ). A multivariate analysis of variance (MANOVA) was then performed to compare these groups across the variables identified in the regression analyses. The MANOVA revealed significant differences between vaccine confidence groups for all predictors. As shown in Table 4, participants with low, moderate, and high confidence displayed a largely linear pattern across the significant predictors identified in the regression models.

## 4. Discussion

The results of our study emphasize that, in vaccinated individuals, confidence in vaccines against COVID-19 is dependent on many factors related to respondents' health status, emotional reactivity and personality. These findings are broadly consistent with the WHO's ‘Behavioural and Social Drivers’ framework, which proposes that vaccination-related attitudes emerge from the interplay between emotional responses to disease, social influences, and previous vaccination experiences. In our study, fear of COVID-19 and adverse events primarily reflect the “thinking and feeling” domain, whereas conventionalism and authoritarian submission may be interpreted as components of the “social processes” domain [10]. Importantly, these findings suggest that vaccine confidence remains dynamic even after the decision to vaccinate has been made. Factors that are associated with high vaccine confidence are mainly the number of reported comorbidities, fear of COVID-19, level of conventionalism (conformism) and authoritarian submission. On the

**Table 2**

Correlations between all the factors used in the present study of 3171 vaccinated people.

|                            | 1       | 2       | 3       | 4       | 5      | 6       | 7       | 8 |
|----------------------------|---------|---------|---------|---------|--------|---------|---------|---|
| 1. Vaccine Confidence      | 1       |         |         |         |        |         |         |   |
| 2. Fear of Covid-19        | 0.355*  | 1       |         |         |        |         |         |   |
| 3. Age                     | 0.061*  | 0.111*  | 1       |         |        |         |         |   |
| 4. Adverse Events          | −0.283* | −0.049* | −0.060* | 1       |        |         |         |   |
| 5. Comorbidities           | 0.091*  | 0.220*  | 0.277*  | 0.007   | 1      |         |         |   |
| 6. Conventionalism         | 0.595*  | 0.413*  | 0.047   | −0.139* | 0.094* | 1       |         |   |
| 7. Submission to Authority | 0.580*  | 0.327   | 0.074*  | −0.176* | 0.065* | 0.575*  | 1       |   |
| 8. Conspiracy              | −0.619* | −0.244* | 0.010   | 0.199*  | 0.003  | −0.430* | −0.544* | 1 |

Note. \*  $p < .001$ .**Table 3**

Stepwise regressions of the predictors of vaccine confidence in a sample of 3171 vaccinated participants.

| STEPS             | Vaccine confidence         |                      |         |         |
|-------------------|----------------------------|----------------------|---------|---------|
|                   | R <sup>2</sup> CHANGE/STEP | Standardized $\beta$ | t       | p value |
| 1. Adverse Events | .080                       | −.283                | −16.586 | <.001   |
| 2. Adverse Events |                            | −.284                | −16.703 | <.001   |
| Comorbidities     | .090                       | .093                 | 5.457   | <.001   |
| 3. Adverse Events |                            | −.266                | −16.694 | <.001   |
| Comorbidities     |                            | .018                 | 1.105   | .269    |
| Fear of Covid     | .109                       | .338                 | 20.693  | <.001   |
| 4. Adverse Events |                            | −.206                | −14.931 | <.001   |
| Comorbidities     |                            | .016                 | 1.115   | .265    |
| Fear of Covid     |                            | .131                 | 8.537   | <.001   |
| Conventionalism   | .213                       | .511                 | 33.793  | <.001   |
| 5. Adverse Events |                            | −.175                | −13.318 | <.001   |
| Comorbidities     |                            | .018                 | 1.341   | .180    |
| Fear of Covid     |                            | .095                 | 6.548   | <.001   |
| Conventionalism   |                            | .348                 | 21.116  | <.001   |
| Submission        | .064                       | .315                 | 19.690  | <.001   |
| 6. Adverse Events |                            | −.139                | −11.532 | <.001   |
| Comorbidities     |                            | .037                 | 3.099   | .002    |
| Fear of Covid     |                            | .078                 | 5.916   | <.001   |
| Conventionalism   |                            | .292                 | 19.116  | <.001   |
| Submission        |                            | .164                 | 10.305  | <.001   |
| Conspiracy        | .086                       | −.358                | −24.813 | <.001   |

other hand, factors related to reduced confidence in vaccines are mainly (self-reported) vaccine-induced adverse events and a higher level of conspiracy belief. This highlights the coexistence of reinforcing and undermining mechanisms of confidence within the vaccinated population.

Our observations are entirely consistent with findings among the non-vaccinated showing that conspiracy promotes reluctance to get vaccinated, while trust in government reduces it [9]. Our results extend these findings by showing that such psychological drivers continue to operate even after vaccination uptake. On the other hand, the positive role of authoritarian submission and conventionalism might be related to data highlighting that people became more authoritarian and conservative as COVID-19 cases increased, and that COVID-19 threat was

positively correlated with the level of authoritarianism and conservatism in the US [13]. These traits may facilitate adherence to public health recommendations beyond the initial vaccination decision. Our findings also show that fear of COVID-19 positively predicted vaccine confidence, which supports the literature showing that personality traits related to fear and stress sensitivity (i.e., neuroticism) predicted mean levels of attention to COVID-19-related information and worry (crisis preoccupation) [14]. This suggests that perceived threat continues to play a motivational role even after vaccination. In the same vein, higher neuroticism (i.e., threat sensitivity) levels were found to be associated with lower levels of COVID-19 vaccination hesitancy in the UK [15]. This is consistent with a study showing that national averages of neuroticism accounted for an additional 6 to 9% of COVID-19 vaccine coverage across 56 countries [16]. It is particularly useful to remember that our sample is composed of people who ultimately chose to be vaccinated. This distinguishes this study from most of the previous research that has either surveyed the population before the vaccines were available, or surveyed individuals who had not decided (yet) to take the vaccine. By focusing on vaccinated individuals, our study provides insight into the determinants of sustained confidence rather than initial acceptance. These findings have important implications for public health communication and vaccine policy, particularly in the maintenance of vaccine confidence.

First, our results reinforce the growing consensus that vaccine messages and policies are not universally received in the same way. Prior work has shown that opposition to vaccines (i.e., vaccine hesitancy) is often rooted not only in informational content, but also in deeper psychological constructs such as fears, ideologies, worldviews, and identity needs, collectively referred to as “attitude roots” [17]. Our findings extend this perspective by showing that, even among those who chose to be vaccinated, confidence levels varied significantly based on individual differences, especially in personality traits like conventionalism, authoritarian submission, and conspiracy, which appear to shape how people interpret public health information and make decisions about their health. This variability may help explain why some vaccinated individuals disengage from subsequent vaccination efforts such as booster campaigns, and may also signal a broader erosion of trust that could extend beyond COVID-19 vaccines to other vaccination programs,

**Table 4**

Descriptive data for all the predictors as a function of the group level of vaccine confidence (Low; Moderate; High).

| Variables (Min-Max)           | Low vaccine confidence<br>(N = 918; Scores 1 to 3) | Moderate vaccine confidence<br>(N = 894; Scores 4 to 6) | High vaccine confidence<br>(N = 1359; Scores 7 to 9) | F          | p      | R <sup>2</sup> |
|-------------------------------|----------------------------------------------------|---------------------------------------------------------|------------------------------------------------------|------------|--------|----------------|
|                               | Mean (SD)                                          | Mean (SD)                                               | Mean (SD)                                            |            |        |                |
| Vaccine Confidence (1–9)      | 1.80 (0.87) <sup>a</sup>                           | 5.16 (0.75) <sup>b</sup>                                | 7.91 (0.82) <sup>c</sup>                             | 15,449.259 | 0.000  | 0.907          |
| Age (16–73 Years Old)         | 45.98 (12.54) <sup>a</sup>                         | 44.59 (12.85) <sup>b</sup>                              | 47.61 (14.40) <sup>c</sup>                           | 13.904     | <0.001 | 0.009          |
| Nb of Comorbidities (0–4)     | 0.39 (0.68) <sup>a</sup>                           | 0.38 (0.68) <sup>a</sup>                                | 0.53 (0.80) <sup>b</sup>                             | 15.038     | <0.001 | 0.009          |
| Nb of Adverse Events (0–10)   | 1.13 (1.74) <sup>a</sup>                           | 0.57 (1.10) <sup>b</sup>                                | 0.32 (0.78) <sup>c</sup>                             | 121.775    | <0.001 | 0.072          |
| Fear of Covid (1–9)           | 1.90 (1.51) <sup>a</sup>                           | 2.85 (2.08) <sup>b</sup>                                | 3.68 (2.34) <sup>c</sup>                             | 204.138    | <0.001 | 0.114          |
| Conventionalism (1–9)         | 3.18 (1.82) <sup>a</sup>                           | 4.77 (2.04) <sup>b</sup>                                | 6.40 (1.86) <sup>c</sup>                             | 794.709    | <0.001 | 0.335          |
| Submission to authority (1–9) | 1.78 (1.10) <sup>a</sup>                           | 2.85 (1.44) <sup>b</sup>                                | 4.05 (1.60) <sup>c</sup>                             | 708.883    | <0.001 | 0.310          |
| Conspiracy level (1–9)        | 6.89 (2.05) <sup>a</sup>                           | 5.04 (2.05) <sup>b</sup>                                | 3.26 (2.14) <sup>c</sup>                             | 832.003    | <0.001 | 0.345          |

Note. On each line, superscript letters represent multiple Bonferroni pairwise group comparisons. Different letters represent significant mean difference at  $p < .001$ .

including those with well-established risk-benefit profiles, and more generally to the healthcare system. Furthermore, our findings suggest that perceived threat continues to play a motivational role even after vaccination, in line with broader discussions on the magnitude and interpretation of COVID-19 risk during the pandemic [18]. If confirmed, such patterns would have important implications for the sustainability of vaccination programs beyond the current pandemic context.

Second, in line with the WHO's recognition of vaccine hesitancy as one of the top ten threats to global health, our study highlights the urgent need to better understand and address the deeper psychological and experiential roots of distrust, both in vaccines and in government institutions. Notably, adverse effects, even when minor and transient, significantly undermine confidence, especially among those already predisposed to skepticism. This finding is particularly important in the context of repeated vaccination campaigns, where cumulative negative experiences may progressively erode confidence. It seems critical not to minimize these experiences but, instead, public health efforts must acknowledge and transparently address them to prevent long-term erosion of trust. Failure to do so may contribute to progressive drop-out from vaccination programs over time. A sustainable vaccination strategy, particularly in the face of future pandemics, requires psychological sensitivity: restoring and maintaining public confidence will depend not only on biological efficacy, but also on tailoring policy and communication to account for human variability in fear, trust, and interpretation.

## 5. Conclusions

These findings suggest that vaccine confidence is not fixed once the decision to take on a vaccine has been made, but remains associated with individual beliefs, perceived risk, and vaccine-related experiences, with socio-demographic factors playing a more limited role. Concerns about adverse effects remained a significant correlate of lower confidence in the vaccinated population. These findings suggest that vaccination strategies should prioritize trust-building efforts and transparent communication on individual vaccine safety, rather than relying solely on demographic targeting. Such approaches may be critical to sustain vaccine uptake in ongoing endemics and future public health crises.

## CRedit authorship contribution statement

**Nicolas Vermeulen:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Olivier Servais:** Writing – review & editing, Validation, Project administration, Methodology, Investigation, Conceptualization. **Boris Jidovtseff:** Writing – review & editing, Validation, Project administration, Methodology, Investigation, Conceptualization. **Elisabeth Paul:** Writing – review & editing, Validation, Project administration, Methodology, Investigation, Conceptualization.

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## Declaration of competing interest

The authors declare that they have no known competing financial

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jvacx.2026.100880>.

## Data availability

The datasets are available from the corresponding author as a SPSS file.

## References

- [1] World Health Organization. Coronavirus disease (COVID-2019): situation report-54. Available at: <https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200314-sitrep-54-covid-19.pdf>; 2020 (Accessed March 16, 2020).
- [2] Paul E, Brown GW, Kalk A, Ridde V. Playing vaccine roulette: why the current strategy of staking everything on Covid-19 vaccines is a high-stakes wager. *Vaccine* 2021;39(35):4921–4. <https://doi.org/10.1016/j.vaccine.2021.07.045>.
- [3] Rasmussen AL. Vaccination is the only acceptable path to herd immunity. *Med* 2020;1(1):21–3. <https://doi.org/10.1016/j.medj.2020.12.004>.
- [4] Mehmood Q, Ullah I, Hasan MM, Kazmi SK, Ahmadi A, Lucero-Prisco 3rd DE. COVID-19 vaccine hesitancy: Pakistan struggles to vaccinate its way out of the pandemic. *Ther Adv Vaccines Immunother* 2022. <https://doi.org/10.1177/25151355221077658>.
- [5] World Health Organization. Ten threats to global health in 2019. 2019 (<https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019>. opens in new tab).
- [6] Larson HJ, Gakidou E, Murray CJL. The vaccine-hesitant moment. *N Engl J Med* 2022;387(1):58–65. <https://doi.org/10.1056/NEJMr2106441>.
- [7] Sturgis P, Brunton-Smith I, Jackson J. Trust in science, social consensus and vaccine confidence. *Nat Hum Behav* 2021;5(11):1528–34. <https://doi.org/10.1038/s41562-021-01115-7>.
- [8] Ofri D. The emotional epidemiology of H1N1 influenza vaccination. *N Engl J Med* 2009;361(27):2594–5. <https://doi.org/10.1056/NEJMp0911047>.
- [9] Steinert JI, Sternberg H, Prince H, Fasolo B, Galizzi MM, Büthe T, et al. COVID-19 vaccine hesitancy in eight European countries: prevalence, determinants, and heterogeneity. *Sci Adv* 2022;8(17):eabm9825. <https://doi.org/10.1126/sciadv.abm9825>.
- [10] World Health Organization. Understanding the behavioural and social drivers of vaccine uptake WHO position paper-May 2022. *Wkly Epidemiol Rec* 2022;97(20):209–24.
- [11] Norman G. Likert scales, levels of measurement and the “laws” of statistics. *Adv Health Sci Educ* 2010;15:625–32. <https://doi.org/10.1007/s10459-010-9222-y>.
- [12] Carifio J, Perla R. Resolving the 50-year debate around using and misusing Likert scales. *Med Educ* 2008;42:1150–2. <https://doi.org/10.1111/j.1365-2923.2008.03172.x>.
- [13] Pazhoohi F, Kingstone A. Associations of political orientation, xenophobia, right-wing authoritarianism, and concern of COVID-19: cognitive responses to an actual pathogen threat. *Personal Individ Differ* 2021;182:111081.
- [14] Kroencke L, Geukes K, Utesch T, Kuper N, Back MD. Neuroticism and emotional risk during the COVID-19 pandemic. *J Res Pers* 2020;89:104038. <https://doi.org/10.1016/j.jrp.2020.104038>.
- [15] Halstead IN, McKay RT, Lewis GJ. COVID-19 and seasonal flu vaccination hesitancy: links to personality and general intelligence in a large, UK cohort. *Vaccine* 2022;40(32):4488–95. <https://doi.org/10.1016/j.vaccine.2022.05.062>.
- [16] Vermeulen N. Neuroticism predicts national vaccination rates across 56 countries. *Curr Psychol* 2024;43:113–8. <https://doi.org/10.1007/s12144-023-04234-8>.
- [17] Holford DL, Fasce A, Costello TH, et al. Psychological profiles of anti-vaccination argument endorsement. *Sci Rep* 2023;13:11219. <https://doi.org/10.1038/s41598-023-30883-7>.
- [18] Ioannidis JPA. Infection fatality rate of COVID-19 inferred from seroprevalence data. *Bull World Health Organ* 2021;99(1). <https://doi.org/10.2471/BLT.20.265892>. 19–33F.