# Beliefs and preferences as predictors of prophylactic adherence and lockdown compliance in South Africa

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# Abstract

Much of the research on behavioural preferences as predictors of compliance with regulations aimed at reducing the transmission of COVID-19 has focused on developed countries, with very little consideration of African countries. We conduct an online survey (n=1503) considering beliefs, and individual and social preferences as predictors of compliance with prophylactic measures and lockdown regulations in South Africa. We use incentivized experimental measures of individual (risk and time) preferences and social preferences (cooperativeness and altruism). We also consider survey measures of risk tolerance, patience and trust. We find that beliefs about others' behaviour are highly predictive of reported behaviour. We also find that greater patience and cooperativeness are predictive of high compliance with prophylactic measures and lockdown regulations. Encouragingly, respondents report higher compliance at higher lockdown levels, suggesting responsiveness of behaviour to the level of risk of infection.



**Keywords**: COVID-19, individual preferences, elicited preferences, stated preferences, South Africa

**JEL classification**: C90, D90, I18


# 1 Introduction

The COVID-19 pandemic became an international public health emergency in 2020, with high infection levels, hospitalisations and deaths worldwide. As part of their efforts to reduce the spread of COVID-19, many governments around the world encouraged preventative strategies for hygiene behaviour, such as social distancing, hand washing and avoiding touching the face, as well as imposing lockdown regulations. Encouraging people to adopt these preventative behaviours was a central focus of public health policies in many countries. At the present time, amid relaxed and removed lockdown regulations, measures aimed at reducing the spread of COVID-19 are particularly important for African countries where vaccination rates are low and health systems are weak (Fitzpatrick et al. 2021). Further, the COVID-19 pandemic has highlighted the importance of broad adoption of preventative behaviours when faced with a new disease. For this reason, investigating ways to increase compliance with recommended and required behaviours to reduce disease spread has become an important focus of recent research.

The vast majority of research to date on compliance with preventative health measures has focused on developed countries (e.g. Li et al., 2022; Wu et al., 2022; Mukerjee, Chow and Li, 2021; Folmer et al., 2021; Kusnirova and Kacmar, 2022; Valenti and Faraci, 2021); with

less research considering developing country contexts (e.g. Mukhlis et al., 2022), and very little focusing on African countries (e.g. Omotoso et al. 2021; Hager et al. 2020; Amodan et al. 2020). Our research focuses on South Africa, a country that has been significantly impacted by the COVID-19 pandemic. The adherence to COVID-19 prophylactic measures in Africa is low (Omotoso et al. 2021). In a knowledge, attitude and practice assessment survey of Africa, only 12.3% of the study participants reported they adhered to all suggested preventative measures. In a binational study of Nigerians and Egyptians, only 36% of the 1437 respondents reported adhering to all the recommended measures (Hager et al. 2020), although 96% practised social distancing and self-isolation. In Uganda, only 29% of the 1726 respondents adhered to all the preventative measures (Amodan et al. 2020).

While the role of standard socio-demographic variables such as gender, age, income or education, in predicting compliance is relatively well understood (Breda-Albuquerque et al., 2008; Heemskerk et al., 2021; Choi et al., 2022; Algara et al., 2021), less is known about unobservable variables related to behaviour, such as individual (risk and time) and social (altruism and cooperativeness) preferences. Understanding which types of preferences best predict adoption of preventative measures may be useful to improve the effectiveness of communications and policies aimed at increasing compliance with public health measures. In addition to considering stated beliefs and individual characteristics, our research empirically tested four behavioural factors as predictors of compliance with government-mandated behaviours in South Africa: risk tolerance, time preferences (including present bias and patience), altruism, and cooperativeness.

We gathered data on beliefs, preferences and compliance behaviour using an online experiment with 1503 respondents in South Africa. Incentivized measures of risk and time preferences, as well as altruism (dictator game) and cooperativeness (public goods game) were used. We also included survey measures of risk and time preferences and trust. We asked about compliance with lockdown regulations and prophylactic measures and gathered details on beliefs about own risk of infection and about others' adherence to lockdown regulations.

Our main findings are the following. First, we observe a positive correlation between beliefs about others' compliance and own compliance. Although we do not find a significant association between higher reported risk of infection and stronger reported compliance, we note that compliance with lockdown regulations is higher when stricter government restrictions (associated with more infections) are in place. Second, we find that greater

patience and social preferences (particularly cooperativeness) are most predictive of high compliance with prophylactic measures to prevent the spread of COVID-19. Third, we find that compliance with various prophylactic measures is more strongly predicted by the stated preference measure for patience than by the incentivised preference measure for patience.

Our research sheds light on compliance behaviour, particularly in a developing African country where information on the topic is still scarce. The insights gained from our analysis can inform policy decisions and aid in effective communication with the public to increase compliance and prevent the spread of COVID-19 and other public health crises in South Africa. Furthermore, our use of both survey and experimental preference measures can contribute to the current literature that explores the potential of survey preference measures as an alternative to incentivized experimental preference measures.

# 2 Literature review and hypotheses

Predictors of compliance studied to date have included individuals' observable characteristics (e.g., gender, age, educational attainment, as in Breda-Albuquerque et al., 2008; Heemskerk et al., 2021; Choi et al., 2022; Algara et al., 2021); individuals' preferences (e.g. risk-taking behaviour and social preferences as in Keinan et al., 2021; Müller and Rau, 2021); ease of access to protective measures (e.g., face masks, running water and soap, hand sanitiser, as in Aranguren, 2022); and availability of alternative work and travel arrangements (e.g. Abdelrahman 2020).

In addition to tracking reported beliefs and observable characteristics, this study focuses on four possible behavioural predictors of compliance in South Africa: risk tolerance, time preferences, altruism, and cooperativeness. We therefore briefly discuss existing literature in each of these areas, together with our hypotheses based on the literature.

## 2.1 Risk tolerance

To date, much empirical research on risk attitudes in the health domain has focused on health-related behaviours such as smoking and uptake of preventative screening tests (e.g. Anderson & Mellor 2008; Picone et al. 2004; Harrison et al., 2018). A few studies have shown that risk attitudes predict behaviour related to the COVID-19 pandemic, where risk averse individuals practiced more social distancing, mask-wearing and compliance with

mobility restrictions (e.g. Keinan et al., 2021; Müller & Rau 2021; Chan et al., 2020). In line with these findings, we anticipate that individuals showing more risk aversion will also report higher compliance with preventative measures and lockdown regulations.

Risk perception and threat appraisal are core features of protection-motivation theory (Floyd et al. 2000; Rogers 1975) and as such, are known to be important determinants of the public's compliance with health-protective behaviours during pandemics. Thus, accurate risk perceptions are critical in effectively managing public health risks. Given this relationship, we expect that individuals' perceptions of risks would be associated with their compliance with preventative measures and lockdown regulations. The South African government changed the lockdown regulations at various times during the peak of the COVID-19 pandemic. Higher infections were associated with more restrictive regulations (and with greater policing of regulations). Since our data were gathered over different levels of lockdown restriction (where higher levels indicate more infections and, therefore more restrictive regulations), we anticipate greater compliance at higher lockdown levels.

## 2.2 Time preferences

Both standard economic theory and Behavioural Economics assume that individuals trade-off between immediate outcomes (costs and benefits) and expected future outcomes. Economic and psychological research found that peoples' intertemporal trade-offs involve present bias and time-inconsistency in the health domain (e.g. Cavagnaro et al. 2016; Wang & Sloan 2018) and other contexts such as addiction, saving, retirement decisions and job search (e.g. O'Donoghue & Rabin 1999). In some health applications, benefits are realised first, with the costs and consequences realized later. For example, alcohol and smoking have current benefits (immediate stress relief) and future costs (increased risk of lung or liver diseases). In the case of adherence to COVID-19 prevention and control regulations, some costs (preventative measures) have to be realised first, while the benefits (avoiding infection) come later in the future.

Such trade-offs between present costs and future benefits agree with Müller and Rau (2021)'s finding that more patient people were more likely to comply with COVID-19 regulations. In the case of COVID-19 these trade-offs occurred despite the potential future costs of ignoring preventative measures, including possible long COVID morbidity or Post-COVID Conditions (PCC). We measure both impatience and present bias (detailed in section 3.2). In line with Müller and Rau's (2021) findings, we hypothesise that both higher

impatience and present-bias will be associated with less adherence to preventative behaviours.

## 2.3 Altruism

Altruism refers to situations where one's own interests are set aside for the benefit of others. Evidence of altruism has been found in decision-making in the presence of externalities (e.g. Frey & Meier 2004). Bir & Windmar (2020) note that an altruistic individual might consider the likelihood of such externalities (e.g. being a spreader of COVID-19) when making a decision on whether to comply with prevention measures, resulting in greater compliance.

Research on vaccination prior to the COVID-19 pandemic has investigated altruistic behaviour (Hershey et al. 1994; Shim et al. 2012): considering vaccination for influenza, Shim et al. (2012) found that concern for others plays a role in vaccination decisions. Focusing on altruism has also been recognized as a public health strategy for promoting preventative behaviours such as the wearing of seat belts (Giubilini & Savulescu 2019) and masks during the COVID-19 pandemic (Cheng et al. 2020).

Campos-Mercade et al. (2021) found that altruistic individuals were more likely to follow physical distancing, stay home when sick, and buy face masks. Altruistic individuals were also more likely to engage in COVID-19 protective behaviours, even when the individual's susceptibility to the disease was low (Jørgensen et al. 2021). Based on these findings, we hypothesise that individuals showing higher altruism will be more compliant with preventative measures.

## 2.4 Cooperativeness

Adherence to preventative guidelines and lockdown regulations in COVID-19 involves a trade-off between individual and collective interests (Hirama et al., 2022, Blayac et al., 2021). Public health campaigns widely emphasise how one's actions impact the well-being of others (Van Bavel et al. 2020).

We expect that people who are more willing to cooperate with others, e.g. by providing a larger contribution in a voluntary contribution game, would also be more aware of the impact of their decisions on others. Therefore, we anticipate a positive association between cooperation and compliance with preventative measures and lockdown regulations. Further, people are more likely to cooperate when they believe that others are also

cooperating (Fischbacher et al. 2001), i.e. apparent cooperation is most often "conditional" cooperation. This is true also when social norms are at stake (Traxler and Spichtig, 2011). This suggests that a method to encourage and increase worldwide cooperation during a pandemic is to make cases of cooperative behaviour more publicly observable (Van Bavel et al. 2020). Based on these findings, we hypothesise that beliefs about others' compliance with lockdown regulations, seen as cooperative behaviour, would predict own compliance with these regulations.

# 3 Data and methods

## 3.1 Data collection

We conducted an online experiment using a sample of 1503 respondents in South Africa. Respondents were recruited by South African online research provider *Nudge Now* (now trading as *IQ Business)*.[1] This company has a panel of respondents from which they recruit participants according to the quotas provided by the research team. Where necessary, they recruit additional participants through social media in order to supplement quotas not filled by their panel. We requested quotas so that the sample would reflect the South African population's broad demographic splits in terms of race, gender and household income as closely as possible.

Respondents started by reading an informed consent document online, following which they could indicate their willingness to participate. Respondents were then directed to the survey itself, which was administered online using the *Nudge Now* platform. Payments for incentivised decisions were made after respondents had completed the survey, in the form of vouchers which could be redeemed at a wide range of retailers. As detailed in the survey, one of the incentivised tasks was randomly selected for payment. That is, each respondent was paid for one of the tasks involving money decisions.

During the peak of the COVID-19 pandemic, South Africa used a lockdown scale from level 1 (very mild restrictions) to level 5 (very strict restrictions, for example, all citizens were restricted to their place of residence except for movement related to obtaining or providing essential services). Government revised lockdown levels as the number of infections in the country changed. As infections were increasing during the time of data collection, increased lockdown levels (with associated increased restrictions) were

[1] Since internet access is limited in rural areas of South Africa, the online sample means that most respondents would be in urban parts of the country.

announced. The survey was administered in June and July 2021. South Africa started its third wave of the pandemic in early June, meaning that our data collection period coincided with this wave. The country was on level 2 when data collection started. This included fairly limited restrictions: social gatherings were permitted with some limits on numbers, a curfew was in place from 11pm to 4am; and restaurants and other establishments were required to close by 10pm. South Africa moved to level 3 (curfew hours increased to 10pm to 4am; smaller numbers were permitted in gatherings; establishments had to close by 9pm) on 16 June 2021; and to level 4 (schools closed for in-person teaching, curfew from 9pm to 4am, no social gatherings permitted other than funerals) on 28 June 2021.[2]

Table 1 summarises demographic details of the respondents in our sample.[3]

**Table 1** – Demographic Summary

| | **Percent of sample** |
|---|---|
| Gender: Male/Female | 42.9/56.7 |
| Race: Black | 73.6 |
| Race: White | 13.5 |
| Race: Coloured | 10 |
| Race: Indian/Asian | 2.0 |
| Low HH Income: ZAR 2000 or less monthly | 25.8 |
| HH income between ZAR 2000 and ZAR 8900 | 38.3 |
| High HH Income: more than ZAR 8900 monthly | 28.9 |
| Age: 30 and under | 40.9 |
| Age: between 30 and 60 | 51.8 |
| Age: 60 and over | 7.3 |
| Children 14 and under in home: Yes | 63.8 |
| Comorbidities: Yes | 25.8 |
| Has had COVID-19: Yes | 20.3 |

[2] Details of South Africa's lockdown level system can be accessed at https://www.gov.za/covid-19/about/about-alert-system.

[3] 1% of respondents chose not to indicate race, and 7% of respondents chose not to report household income. Census 2011 data reports gender splits of 51% Female and 49% Male; and race splits of 79% Black, 9% Coloured, 2% Indian/Asian and 10% White. Household income details from the South African Labour Force Survey (2017) adjusted for inflation suggest that 25% of South African households have income below ZAR 2,000 (approximately USD 150 at the time of data collection) per month; while 25% have income above ZAR 8,900 per month.

## 3.2 Measures from questionnaire

### 3.2.1 Compliance and beliefs measures

**i. Compliance with preventative measures:**

In the questionnaire, included in the online appendix, we asked respondents to report their compliance with a variety of COVID-19 prophylactic measures, both at the time of responding to the survey ("present time") and at the time of the intensified lockdown regulations imposed during South Africa's second COVID-19 wave (December 2020 and January 2021). In total, respondents were asked about 7 specific preventative measures for each of these two time periods. Compliance with each measure was reported on a 4-point scale, with options, "never", "sometimes", "most of the time" and "all the time". The measures included were, keeping a 1.5m distance from others; washing hands regularly; coughing or sneezing into an elbow; avoiding touching the face; wearing a face mask when leaving home; avoiding social contact, and isolating if COVID-19 symptoms were experienced or after being in contact with an infected person.

We used these responses to create 2 measures of prophylactic compliance, a **high compliance** dummy variable and a **compliance index**. The high compliance dummy variable is used to identify respondents with a high level of compliance across all elicited prophylactic measures. This dummy variable takes the value of 1 for respondents who report "all the time" for all measures at both time periods; and 0 otherwise. The index measure uses the detailed responses to the 14 prophylactic questions (7 questions at each time period). Responses of "never" add 0 to the total compliance index, responding "sometimes" on a measure adds a value of 1, responding "most of the time" adds a value of 2, while answering "always" adds a value of 3. This gives an index ranging from 0 (answering "never" to all measures at both periods) to 42 (answering "all the time" to all measures at both periods).

**ii. Compliance with lockdown regulations:**

Respondents were asked to report their adherence to lockdown regulations at the time of responding to the survey ("present time") and for two earlier points in time: the original level 5 lockdown in March/April 2020; and the level 3 lockdown in December 2020/January 2021. Adherence to lockdown regulations was answered on a scale from 0 ("not at all") to 10 ("followed regulations all the time").

**iii. Beliefs about others' compliance:**

In addition to asking about their own compliance, we asked respondents about their expectations of the adherence to lockdown regulations of "most people in your area" using the same 0 to 10 scale for the same two points in time.

**iv. Beliefs about the risk of contracting COVID-19:**

Respondents were asked to report their own believed risk of contracting COVID-19. Again, this used a scale from 0 ("I have no risk") to 10 ("I think it's very likely that I will contract it").

### 3.2.2 Experimental measures of preferences

Our primary tool for eliciting preferences was a series of incentivized experimental measures.

**i. Risk tolerance:**

A portfolio choice task (similar to Gneezy & Potters 1997) was used for the risk tolerance measure. Respondents could choose an amount to invest in a risky asset between ZAR 0 and ZAR 200 (a coin flip determined whether investments were doubled or forfeited). Our risk tolerance measure took a value of -1 (risk aversion) where respondents did not invest in the risky asset; and a value of +1 (risk tolerance) when respondents invested the full amount in the risky asset. Partial investment took the value of 0.

**ii. Time preference measures:**

A time preference task (similar to Andreoni & Sprenger 2012) gave respondents the option to allocate an endowment of ZAR 200 between a sooner date and a later date. The amount at the sooner date was multiplied by one, while the amount invested at the later date was multiplied by a coefficient larger than one, to reflect the interest bearing nature of this choice. Two such decisions were made sequentially, one for which the sooner date was "today" (the day of the experiment) and the later date in one month; and a second decision for which the sooner date was in one month (front end delay) and the later date in two months. The second allocation allows to identify impatience and the comparison between the two allocations is used to identify present bias: a present (future) biased individual allocates more (less) at the sooner date in the first decision than in the second decision. In this way, we could identify the two components of time preference, present bias and impatience, in line with the widely used model of Laibson (1997).

**a. Present bias:**

The difference in the amount allocated at the earlier date when the sooner option is paid immediately and in one month measures present bias. A greater (positive) difference between these amounts indicates more present bias (that is, more willingness to forego interest if the smaller amount would be paid immediately).

**b. Patience:**

The decision with the front end delay was used for this measure to avoid confounding impatience with present bias. Higher invested amounts (to be received with interest on the later date) were taken to indicate greater patience.

**iii. Altruism:**

The amount transferred to the counterpart in the dicator game (Forsythe et al. 1994), between ZAR 0 and ZAR400, was taken as a measure of altruism. Higher transfers indicated greater concern for another person.

**iv. Cooperativeness:**

Since it captures some essential features of real-life situations requiring cooperation, a four player linear public goods game was included to measure cooperativeness (e.g., Karlan, 2005; Hauser, Hilbe, Chatterjee & Nowak, 2019; Pereda, Capraro, & Sánchez, 2019). Each player could contribute up to ZAR200 to a group account that paid ZAR2 per rand contributed to each group member. Given that the sub-game perfect equilibrium for these games is to contribute nothing, any non-zero contribution is taken to indicate some cooperativeness, with higher contributions indicating greater cooperativeness (our measure is simply the amount contributed).

Participants were told that one of the experimental tasks would be selected randomly for payment following the experiment. The payment mechanism for each task was detailed in the task instructions, and each task is explained in more detail in the supplementary appendix.

### 3.2.3 Survey measures of preferences

Given recent research considering experimentally validated survey measures as alternatives to standard experimental measures of preferences (e.g. Dohmen et al. 2011, Vieider et al. 2015, Falk et al. 2018), we also included a series of self-report measures, where preferences were elicited using Likert-scales ranging from 0-10. These included a

question on willingness to take risk in general, and in the domains of finance and health (Dohmen et al. 2011); a question on patience (Vischer et al. 2013); and questions about trusting behaviour based on the General Social Survey (GSS). The trust questions included an 11-point Likert scale, aligning with the other self-reported preference measures used. Although several of these survey measures have been experimentally validated by Falk et al. (2023), that validation was realised with German student subjects. It is an open question whether the survey measures of risk tolerance and patience are highly correlated with experimental measures in other samples, such as our South African general population sample.

## 3.3 Estimation strategy

To investigate the association between beliefs and compliance with COVID-19 prophylactic measures and lockdown regulations, we estimate the following model:

$$compliance_i = \alpha_0 + \beta_1 BeliefsOthers_i + \beta_2 BeliefsRisk_i + \beta_3 LockdownLevel + \gamma \mathbf{X} + \epsilon \quad (1)$$

Here $compliance_i$ is the reported compliance of individual $i$. As discussed in Section 3.2, we use 3 measures of compliance: (i) respondents who reported always complying with all prophylactic measures included in the questionnaire are coded as high compliers; (ii) a compliance index constructed using the detailed responses to the 14 prophylactic questions; and (iii) reported compliance with lockdown regulations (this used a scale from 0 to 10). Given the differences between these measures, we use different estimators for each: for our dummy variable indicating high compliance, we use logit regressions; for our compliance index, we use OLS regressions with robust standard errors; and for reported lockdown regulation compliance we use Tobit regressions for truncated data.[4]

Our beliefs-related research questions are investigated by considering the coefficients related to our main predictor variables. $BeliefsOthers_i$ indicates the reported beliefs by respondent $i$ about other people in their area's level of compliance with lockdown regulations (recall that this was reported on a scale of 0 to 10). $BeliefsRisk_i$ refers to the individual's beliefs about their own likelihood of contracting COVID-19, also reported on a

[4] Almost 50% of the probability mass was at the upper limit for this question. We therefore report the Tobit measure in our results. As a robustness check, we also ran Ordered Logit regressions for this measure, with very similar results. These results are available from the corresponding author on request.

scale from 0 to 10. Finally, *LockdownLevel* indicates the level of lockdown prevailing in South Africa at the time that the individual responded to the survey. Since lockdown levels in June/July 2021 were increased in South Africa as the number of COVID-19 cases in the country rose, this would give a proxy for the number of cases at the time of responding. The matrix of control variables **X** includes demographic variables for individual *i*: whether the respondent has a household income less than ZAR2000 per month, whether the respondent is young (under 30) or old (60 or older), the respondent's race and gender, whether the respondent reported having had COVID-19, whether the respondent reported any comorbidities, whether the respondent has children under 14 living in the home, and whether the respondent has an elderly person living with them. We also account for the density of the home (the ratio between the number of people sharing the home and the number of rooms in the home).

To investigate individual and social preferences, we use 2 approaches: because of some correlations between the experimental preference measures, we first follow Müller and Rau (2021) in using a Principal Components Analysis to identify preference components to use in our regression analysis. We also consider the regressions with the disaggregated individual incentivised preference measures. We estimate the following regression:

$$compliance_i = \alpha_0 + \beta_j Preference_{ij} + \gamma \mathbf{X} + \epsilon \quad (2)$$

$Preference_{ij}$ indicates preference $j$ for individual $i$. Note that regressions either contain the components whose eigenvalues are above one from the Principal Components Analysis, or the 5 separate experimental preference measures. We also include demographic controls **X** as in equation 1. We again control for the lockdown level in the country at the time of the survey response. The same three compliance measures are used for these regressions.

# 4 Results

## 4.1 Beliefs and compliance

In Table 2, we investigate the interaction between beliefs about other's compliance with lockdown measures and respondents' own reported compliance. On average, people believe that others are less compliant with lockdown regulations than their own reported compliance, possibly reflecting either overconfidence in their own good behaviour, or overreporting of compliance due to social image concerns and experimenter demand effects (Zizzo, 2010). These differences are highly significant for all lockdown levels.

**Table 2** – Reported compliance with lockdown measures

| | **Own mean (sd)** | **Other mean (sd)** | **Wilcoxon test (z)** |
|---|---|---|---|
| Level 5 | 8.95 (1.49) | 6.47 (2.51) | 29.35*** |
| Level 3 | 8.48 (1.78) | 5.90 (2.62) | 29.84*** |
| Current level | 8.72 (1.85) | 6.20 (2.73) | 29.08*** |

In Table 3, we consider whether beliefs predict compliance: column (1) considers the high compliance dummy in a logit regression; column (2) estimates the compliance index (ranging from 0, where respondents answered "never" to all measures at both periods to 42, where respondents answered "all of the time" to all measures at both periods) in an OLS regression; and column (3) uses the Likert-scale reported compliance with current lockdown measures in a Tobit regression.

As anticipated, we note significant positive relationships between beliefs about others' lockdown compliance and all three measures of own reported compliance. However, contrary to our expectations, reported beliefs about own likelihood of infection with COVID-19 do not predict compliance.

As a more objective measure of risk, we considered the lockdown level in the country at the time of responding to the survey (since government altered these levels in line with infection incidence). The lockdown level at the time of responding to the survey does predict compliance with lockdown regulations but is not a significant predictor of compliance with prophylactic measures. This might be because compliance with prophylactic measures such as hand washing and mask wearing became habitual for many people, regardless of the specific lockdown regulations in place. Higher levels of lockdown regulations were associated with greater policing in South Africa, which might also explain the increased compliance. Further, the announcements of changes to lockdown levels made these changes to the lockdown restrictions very salient to South Africans.

Our demographic controls predict compliance in the expected directions: men are less compliant than women and the young are somewhat less likely to report being highly compliant with all prophylactic measures. Low-income people are more likely to report very high compliance with all prophylactic measures. These findings are largely in line with the COVID-19 literature documenting a gender effect and an age effect for compliance with various prophylactic measures (e.g. Blayac et al., 2021).

**Table 3** – Demographics and beliefs as predictors of compliance

| | (1) | (2) | (3) |
|---|---|---|---|
| | High compliance | Index Compliance | Lockdown Compliance |
| Beliefs: others' compliance | 0.246*** | 0.573*** | 0.511*** |
| | (0.0454) | (0.0588) | (0.0355) |
| Beliefs: own likelihood of infection | -0.00646 | -0.0431 | 0.00677 |
| | (0.0257) | (0.0449) | (0.0252) |
| Lockdown level at time of response | 0.0308 | 0.257 | 0.318** |
| | (0.144) | (0.245) | (0.130) |
| Male | -0.281* | -1.713*** | -0.864*** |
| | (0.169) | (0.303) | (0.164) |
| White | -0.514* | -0.564 | -0.191 |
| | (0.309) | (0.504) | (0.288) |
| Low income (<ZAR 2000 pm) | 0.440** | 0.562 | 0.0930 |
| | (0.178) | (0.345) | (0.189) |
| Had covid | -0.0493 | -0.601 | -0.239 |
| | (0.211) | (0.389) | (0.201) |
| Young (under 30) | -0.456** | -0.557* | -0.241 |
| | (0.181) | (0.315) | (0.172) |
| Old (60+) | 0.456 | 0.261 | 0.460 |
| | (0.342) | (0.738) | (0.387) |
| Comorbidities | -0.103 | -0.168 | 0.305 |
| | (0.195) | (0.356) | (0.193) |
| Live with elderly person | -0.0706 | -0.0198 | -0.00105 |
| | (0.177) | (0.312) | (0.168) |
| People per room at home | -0.144 | -0.0903 | 0.0213 |
| | (0.0935) | (0.148) | (0.0873) |
| Live with children under 14 | 0.0676 | 0.409 | 0.266 |
| | (0.190) | (0.337) | (0.184) |
| Constant | -3.260*** | 32.09*** | 5.739*** |
| | (0.635) | (1.048) | (0.558) |
| N | 1501 | 1501 | 1501 |
| F (Chi-squared for logit) | 51.66*** | 12.20*** | 20.24*** |
| (Pseudo) R-squared | 0.066 | 0.11 | 0.069 |

Standard errors in parentheses. The reference group is non-white, female, with income greater than R2000 per month, aged between 30 and 60, not suffering from comorbidities and not having had covid, with no children under 14 or elderly people at home.

* p<0.10 ** p<0.05 *** p<0.010

In Table 4 we investigate in more detail how reports of past compliance vary with lockdown level, as well as how present reported compliance differs with the lockdown level prevailing at the time of the survey response. In the first part of the table, we see that better

adherence to lockdown regulations was reported for the question about the initial Level 5 lockdown in March/April 2020 than for the same question about the Wave 2 level 3 lockdown level in December 2020 and January 2021.

In the second part of the table, since our surveys took place across three "current" lockdown levels, depending on the response date, we also investigate respondents' sensitivity to the lockdown level prevailing at the time of responding to the survey. We note higher reported adherence when the lockdown level was higher. Where we compare level 4 to level 3, we also note higher reporting of current compliance with prophylactic measures. Although we do find differences in the demographic composition of the sample at different times, we note in Table 3 that the lockdown level predicts lockdown compliance even after controlling for a range of individual differences. This finding suggests that individuals do respond to changes in the lockdown level (and likely to the associated higher risks of infection when the lockdown level is higher). It seems from this result that voluntary enforcement under lesser restriction might be a good strategy to improve compliance. One explanation for our result is that uncertainty about the consequences of the pandemic under adjusted restrictions may make it difficult for individuals to assess the extent of the risk accurately.

**Table 4** – Compliance with lockdown regulations by lockdown level

| | **Reported adherence to Lockdown regulations (0-10)** | | | **Index of compliance (0-21)** | |
|---|---|---|---|---|---|
| | **n** | **Mean (sd)** | **Difference** | **Mean (sd)** | **Difference** |
| Level 3 (Dec 2020/Jan 2021) | 1503 | 8.48 (1.78) | z=11.83, p<0.01 | | |
| Level 5 (March-April 2020) | 1503 | 8.95 (1.49) | | | |
| *Current level of lockdown* | | | | | |
| Level 2 | 121 | 8.12 (2.26) | z=1.95, p=0.05 | 17.01 (3.15) | z=0.29, p=0.77 |
| Level 3 | 270 | 8.61 (1.79) | z=2.34, p=0.02 | 17.26 (2.85) | z=3.062, p<0.01 |
| Level 4 | 1112 | 8.81 (1.80) | | 17.74 (2.95) | |

## 4.2 Preferences and compliance

In Table 5, we once again report our 3 measures of compliance, this time considering preferences as our independent variables. The same control variables that were used in

Table 3 were also included in these regressions, although these are not shown in Table 5 because of space constraints.

Since some of our experimental measures might include similar underlying factors, we start this analysis with a Principal Components Analysis (PCA). Since the PCA shows that only 2 components have eigenvalues greater than 1, we use these for our analysis. To define these components, we follow Müller & Rau (2021) in retaining factors with loading of 0.3 or more. The resultant model has a Kaiser-Meyer-Olken measure of sampling adequacy of 0.55, exceeding the benchmark of 0.5 and suggesting an acceptable model fit. The 2 resulting components are a "social preferences" component[5], including altruism (dictator game giving), cooperativeness (public goods game contributions) and risk tolerance; and a "patience" component[6], including our present bias and patience measures. These 2 components are our main independent variables of interest in columns (1) to (3). We then disaggregate our experimental measures in columns (4) to (6). Finally, in columns (7) to (9), we consider the survey measures instead of the experimental measures. These final 3 columns are not directly comparable with the first 6 columns as they use different measures. We therefore take them as different analyses, which take into account different variables, to provide a consistent overall picture.

Both of our components from PCA show positive associations with our 3 measures of compliance, although not all are statistically significant (columns 1 to 3). This suggests that, as anticipated, social preferences and patience are both positively associated with higher compliance. When we break these down into the individual measures (columns 4 to 6), we see that none of the measures significantly predict lockdown compliance.[7] However, patience and cooperativeness are, as anticipated, significant predictors of compliance with prophylactic measures (using both the index and high compliance measures). For the high compliance measure, we also see marginally significant associations with present bias and altruism, both in the expected directions (being more present biased is associated with lower likelihood of being a high complier, while being more altruistic is associated with higher likelihood of being a high complier with preventative measures).

[5] For the Social Preferences component, the factor loadings are: Risk tolerance, 0.55; Altruism, 0.53, Cooperativeness, 0.63.

[6] For the Patience component, the factor loadings are: Present bias, 0.71; Patience, 0.70.

[7] As a robustness check, we also consider the continuous measure of risk tolerance (where the amount invested in the risky option is captured on a scale from 1 to 11). The results do not change from those reported in Table 5.

When we consider the survey measures as alternatives to the experimental measures (columns 7 to 9), we note that the self-report survey measure of patience shows the expected positive association with all three measures of compliance. Interestingly, the associations are stronger than those from the experimental measure of patience. The more statistically significant link with compliance might point to better validity of the survey measure, perhaps due to less potential noise with the simpler measures. However, it is also possible that this more consistent relationship might reflect socially desirable reporting among our respondents (Zizzo, 2010). Our current design does not allow us to exclude this explanation for the data.

The survey measures of risk tolerance, on the other hand, show some expected relationships and other surprising ones. While the measure of health risk tolerance shows the expected negative association with lockdown compliance, the general measure of risk tolerance does not show this expected negative association. Instead, there is a surprising positive association between self-reported risk tolerance and the index measure of compliance with preventative measures. Further, the health risk tolerance measure shows a marginally significant positive association with the likelihood of being a high complier. The money risk tolerance measure and the self-reported trust measure are not significantly associated with any of our outcome measures.

**Table 5** – Preferences and compliance

| | Index measures from PCA | | | Disaggregated experimental measures | | | Self report measures | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| **Dependent variable:** | **Lockdown compliance** | **Index compliance** | **High compliance** | **Lockdown compliance** | **Index compliance** | **High compliance** | **Lockdown compliance** | **Index compliance** | **High compliance** |
| pc1 (Social preferences) | 0.155** | 0.0609 | 0.147** | | | | | | |
| | (0.0661) | (0.110) | (0.0703) | | | | | | |
| pc2 (Patience) | 0.0894 | 0.279** | 0.0501 | | | | | | |
| | (0.0744) | (0.121) | (0.0668) | | | | | | |
| Present bias (experiment) | | | | -0.0000965 | -0.00151 | -0.00274* | | | |
| | | | | (0.00180) | (0.00287) | (0.00157) | | | |
| Patience (experiment) | | | | 0.0377 | 0.141*** | 0.0690** | | | |
| | | | | (0.0280) | (0.0490) | (0.0303) | | | |
| Risk tolerance (experiment) | | | | 0.141 | -0.167 | -0.230 | | | |
| | | | | (0.160) | (0.258) | (0.144) | | | |
| Altruism (experiment) | | | | 0.00141 | -0.000861 | 0.00193* | | | |
| | | | | (0.00112) | (0.00187) | (0.00104) | | | |
| Cooperativeness (experiment) | | | | 0.00125 | 0.00524* | 0.00394*** | | | |
| | | | | (0.00159) | (0.00276) | (0.00139) | | | |
| Patience (self-report) | | | | | | | 0.186*** | 0.360*** | 0.133*** |
| | | | | | | | (0.0363) | (0.0598) | (0.0484) |
| Risk tolerance general (S-R) | | | | | | | 0.0486 | 0.168** | 0.0477 |
| | | | | | | | (0.0455) | (0.0762) | (0.0518) |
| Risk tolerance health (S-R) | | | | | | | -0.0895*** | -0.0662 | 0.0446* |
| | | | | | | | (0.0260) | (0.0443) | (0.0231) |
| Risk tolerance money (S-R) | | | | | | | 0.0475 | 0.0284 | 0.0315 |
| | | | | | | | (0.0402) | (0.0677) | (0.0412) |
| Trust (self-report) | | | | | | | -0.0248 | 0.00213 | 0.0304 |
| | | | | | | | (0.0282) | (0.0464) | (0.0251) |
| Lockdown level | 0.701*** | 0.656*** | 0.153 | 0.702*** | 0.670*** | 0.165 | 0.674*** | 0.615** | 0.149 |
| | (0.144) | (0.251) | (0.142) | (0.144) | (0.251) | (0.143) | (0.143) | (0.247) | (0.147) |
| Demographics included | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Constant | 7.600*** | 33.95*** | -2.145*** | 6.984*** | 32.48*** | -3.376*** | 6.118*** | 30.35*** | -3.949*** |
| | (0.579) | (1.012) | (0.557) | (0.660) | (1.125) | (0.637) | (0.655) | (1.161) | (0.754) |
| N | 1501 | 1501 | 1501 | 1501 | 1501 | 1501 | 1501 | 1501 | 1501 |
| F (tobit)/ R^2 (OLS) / chi^2 (logit) | 4.98*** | 0.04 | 27.28** | 4.18*** | 0.044 | 40.33*** | 6.25*** | 0.074 | 48.7*** |

Standard errors in parentheses

* p<0.10; ** p<0.05; ***p<0.01

As noted in Table 5, we investigated survey as well as experimental measures of preferences. Recent literature has investigated whether survey measures of preferences can be used as an alternative to experimentally elicited, incentivised revealed preferences (e.g. Dohmen et al. 2011, Vieider et al. 2015, Falk et al. 2018). Survey measures are a less expensive and a logistically simpler method of investigating preferences, but lack the incentive compatibility of experimental measures. In a perspective of exploratory research, and to contribute to the previous literature advocating survey measures, we consider the correlations between our experimental preference measures and the associated survey

measures in Table 6. Although we note statistically significant correlations between our experiment and survey measures on most of the preference dimensions considered, the correlation coefficients are very small, suggesting that the experiment and survey measures might not be measuring the same underlying construct. This is in line with the argument of Avdeenko & Gilligan (2015) that observed behaviours in an experiment and self-reported retrospective behaviours do not capture the same dimensions. Although these authors argue that observed behaviours in the lab represent the better measure, it is still an open question whether experimental and survey measures are complements or substitutes.

**Table 6** – Correlations between experimental measures and self-report (survey) measures

| **Measures** | **rho** |
|---|---|
| Experiment Risk and SR general risk: | 0.17*** |
| Experiment Risk and SR health risk: | 0.02 |
| Experiment Risk and SR finance risk: | 0.14*** |
| Experiment Cooperation and SR trust: | 0.09*** |
| Experiment Patience and SR patience: | 0.05** |

# 5 Discussion

We conducted a survey including a series of incentivised tasks to investigate whether behavioural preferences impact compliance with government mandated lockdowns and other measures to reduce the spread of COVID-19 in South Africa.

We found some demographic differences in compliance: men were less likely to comply than women (in line with similar findings in Chen and Farhart, 2020, as well as in Lin et al., 2021), lower income people were more likely to comply than higher income people, and younger people were less likely to comply (again, as in Lin et al., 2021). The income effect is at odds with others' findings (e.g. Papageorge et al. 2021, who observed that poor people were less compliant). Our result that poor people are more compliant might be a specificity of developing countries, or might be specific to South Africa, where heavy-handed policing in the initial lockdown focused particularly on poorer areas, likely intimidating many poor people into greater compliance.

We found that stronger social preferences predicted greater compliance with both preventative measures and lockdown regulations. This finding supports similar results from Bir & Widmar (2020) and Branas-Garza et al. (2022). The other consistent predictor of compliance in our data was patience: like findings from Müller and Rau (2021), more patient respondents were more likely to report high compliance.

We do not find strong evidence that risk preferences predict compliance based on our experimental risk tolerance measure. As noted earlier, other studies have found clearer links between risk attitudes and preventative behaviours (e.g., Chan et al., 2020 find that risk-averse respondents were more likely to adjust their behaviour following the declaration of a pandemic even before official government lockdowns were implemented).

Encouragingly, respondents report higher compliance at higher lockdown levels, suggesting that people adapt their behavioural responsiveness to the level of risk of infection. Finally, we note that beliefs about others' compliance with lockdown are strongly predictive of respondents' own reported compliance, although respondents consistently report higher compliance for themselves than for others. The link between beliefs about others' behaviour and own behaviour cannot be interpreted in a causal way: it is possible that individuals predict others' behaviour at a given time simply by adjusting down from their own remembered behaviour. It is, however, also possible that some individuals are conditional cooperators, conditioning their behaviour around beliefs about others' actions. Social norms messaging noting positive behaviours of others is widely used in communications in the hopes that individuals will be more compliant if they believe that others are also complying (Traxler and Spichtig, 2011).

Our findings suggest a few possible communication strategies that policy makers could use to increase compliance. Highlighting the importance of concern for others in society might encourage people to behave more altruistically in their adoption of preventative measures. Increasing the salience of future benefits of compliant behaviour might help to increase compliance among less patient people. Finally, messaging pointing out social norms of high compliance might encourage respondents to increase their own compliance. Respondents' willingness to adjust their behaviour with the lockdown level (indicative of the level of infection risk) suggests a possible role for less restrictive policies along with appropriate communication of risk.

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