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Article

Predicting community attitudes towards alternative virus-management plans

Journal of Urban Management

Provided in Cooperation with:

Chinese Association of Urban Management (CAUM), Taipei

Suggested Citation: Wyatt, Ray (2021) : Predicting community attitudes towards alternative virus-management plans, Journal of Urban Management, ISSN 2226-5856, Elsevier, Amsterdam, Vol. 10, Iss. 2, pp. 125-138, <https://doi.org/10.1016/j.jum.2021.03.004>

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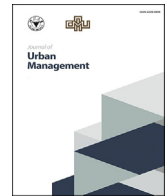
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Journal of Urban Management

journal homepage: www.elsevier.com/locate/jum

Research Article

Predicting community attitudes towards alternative virus-management plans



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ARTICLE INFO

Keywords:

Planning
Prediction
Community
Statistical significance
Regression
Neural network
Virus management
Urban management

ABSTRACT

In mid 2020 people vigorously debated which Corona virus-management strategy should be implemented – ‘total Lockdown’, ‘Partial Lockdown’ or ‘do Nothing’. For success, the chosen strategy would need considerable public support. So here we demonstrate how support, or otherwise, could have been predicted using our freely available *Planticipate* app. It self improves by sending its users’ judgements to the cloud, where learning routines formulate regression- and neural network-based relationships between thirteen, key, plan-evaluation criteria and overall plan desirability. Hence whenever any set of plans are scored on the criteria, these relationships generate forecasts of plan desirability according to a number of demographic groups of past users. Our app predicted that many community groups will regard the ‘do-Nothing’ option as statistically significantly inferior to the other two plans, and it also made several less-than-statistically-significant forecasts which were extremely thought provoking. Using innovative face charts to better interpret complicated, thirteen-dimensional data, *Planticipate* also suggested probable reasons for such forecasts. These included an apparent fixation upon only permissiveness and productivity by people living in North America and relative pragmatism amongst females. Such revelations immediately suggested possible modifications for making different plans more acceptable to certain community groups. Given that in reality several of these modifications were only implemented later on during the pandemic, an early application of our app would almost certainly have prompted faster, more creative and more empathetic urban management.

1. Introduction

This paper presents some innovative software that forecasts demographic groups’ attitudes towards alternative plans in an objective and rigorous way. The program is self improving in the sense that it becomes better at predicting as more and more people use it - it learns from the serious judgements made by its past users. It is known as the “Planticipate” app, and it is free for anyone to access at <https://www.planprediction.org>. To demonstrate the depth of the insights that it generates, we will here use it to address what was a burning question within most countries during 2020 – how to best manage the Corona virus pandemic.

Many words have been written about how COVID-19 might be changing the nature of urban planning and urban management, as reviewed by Sharifi and Khavarian-Garmsir (2020). For example, Ellis (2020) suggests that because emergency measures have been implemented to help the disadvantaged during the pandemic we are now well placed to continue initiatives like more public housing, encouragement of active mobility and medium-sized rather than mega-sized cities.

Similarly, Muggah and Ermacora (2020) suggest that post pandemic there will be an increase in online shopping, a reciprocal fall in

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<https://doi.org/10.1016/j.jum.2021.03.004>

Received 12 November 2020; Received in revised form 29 January 2021; Accepted 29 March 2021

Available online 26 May 2021

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conventional retailing, driverless cars, more personal surveillance, fewer human rights, a demand for cleaner air and a reduced demand for shared office spaces.

Such speculation is typified by the [International Society of City and Regional Planners' \(2020\)](#) suggestions about the possible demise of globalisation, a basic income for all citizens and a de-emphasis of supposedly efficient, high-density neighbourhoods in favour of suburbs' greater access to nature and locally produced resources. Indeed, there seems to be great optimism about improved, post-pandemic urban planning ([Boucher, 2020](#); [Patel & Shah, 2020](#)). Clearly, there already exists a substantial literature about the general problem addressed in this paper, post-COVID urban management.

But the approach that we will describe below fits only obliquely into any literature. It is difficult to find any research at all about what this paper seeks to do - predict different sorts of people's attitudes towards different urban-management plans in *any* situation.

Instead, urban management has made a lot of effort to solve specific problem(s) in particular places, often by gathering more and more information, and this has spawned several sub-disciplines like Geographic Information Systems ([Bolstad, 2016](#)), Expert Systems ([Hayes-Roth et al., 1983](#)), Decision Support Systems ([Rashidi et al., 2018](#)), Spatial Decision Support Systems ([Keenan & Jankowski, 2019](#)), Planning Support Systems ([Wang et al., 2014](#)) and various combinations of some or all of these.

Their usual tactic is to simulate alternative urban futures in classical “what if?” style ([Pettit et al., 2013](#)). That is, sophisticated software generates the probably effect of different plans and then communicates them as alternative scenarios to be evaluated. But rather than rigorous scenario-evaluation, emphasis has been more on scenario generation and visualization. Moreover, because the focus has been mostly on case studies, it has been difficult to find generic, urban simulation principles that can be applied anywhere. Urban Modelling has made some attempt, with [Keith Clarke's \(2018\) SLEUTH](#) model being a prominent example. Yet despite his heroic efforts to consolidate around 100 urban simulations from around the world into a single, common procedure, progress towards a universal urban-growth model has been difficult.

Perhaps this stems from the different case studies addressing different phenomena at different locations. If the *same* phenomena were always modelled in all locations and situations, then generic principles would possibly emerge. This is why we here use constant plan-evaluation criteria and constant stakeholder groups across different problem situations. We seek a generic indication of who will prefer which plan in *any* context.

We have not been helped very much by the Community Planning discipline ([Kelly, 2013](#)). It tends to be strong on theorizing (e.g. [Park & Rogers, 2015](#)), and it is fond of repeating conventional wisdoms like a need for methodological transparency, stakeholder involvement, information-rich discussion, social equity and an awareness of the dangers of easily-manipulated social media when trying to do it cheaply ([Hollander et al., 2020](#)).

It is true that this approach has usefully generated various kinds of normative planning aimed at some worthy goal like social justice or environmental sustainability ([Frederick et al., 2016](#)), and the latter have names like Advocacy Planning ([Angotti, 2007](#)) and Transactive Planning ([Friedman & Huxley, 1985](#)). Yet they are of limited value for what we seek in this paper – rigorous, scientific and generic specification of what sorts of people will prefer which plans.

At the other extreme, the Psychology literature has a lot to say about decision making and the choices that different sorts of people will make ([Yellott, 2001](#), pp. 9094–9097). But again, such research tends to be valid only within laboratories where very specialized conditions apply. There has been little attempt to simulate precise and rigorous prediction of real-world decisions that is applicable across all problem locations and domains.

Our tactics can be clarified if we contrast them with those of an apparently related sub-discipline known as Multiple Criteria Decision Making ([Zopounidis & Doumpos, 2017](#)). The latter involves assembling stakeholders, asking them what decision-evaluation criteria are applicable and how important each one is. It then implements a goals-achievement matrix ([Hill, 1968](#)) to calculate which alternative plan will be favoured by each stakeholder group. But because the stakeholder groups and their criteria keep changing across different case studies, it is impossible to build up generalized knowledge.

By contrast, in our approach both the stakeholder groups the decision-evaluation criteria are always identical. This makes it possible to build up, across many applications within many problem situations, group-specific knowledge about the importance or otherwise of different criteria in terms of how accurately they reflect plan desirability. This can then be used to predict perceived plan desirability, according to standard stakeholder groups, based only upon how the currently examined plans score on the demonstrably important criteria.

For this approach to work, definitions of both the universal stakeholder groups and the universal decision-evaluation criteria need to be generalized rather than tailored to exactly fit a particular case study's planning problem and location. But the advantage is that the size of the amassed knowledge base becomes sufficient to test for statistical significance. It becomes possible, in any planning situation, to generate testable, statistically significant intelligence about which type of stakeholder will prefer which alternative plan.

Hence our app is not decision making software that tells urban managers what to do. It follows more in the tradition of Decision-Aiding software ([Gregory et al., 2001](#); [Nagel, 1993](#)) by simply advising urban planners about the general types of person that are likely to accept or reject each of the plans being proposed. It should be regarded as just another member of the planning team and in no way should it become the final arbiter of planning decisions. It is a novel type of decision support which has the advantage of being scientifically rigorous, thereby exploiting the potential that some envisage whenever artificial intelligence is applied to community planning ([Havrda, 2020](#)).

2. Three alternative plans

At the time of writing, in 2020, millions of people around the world had been infected with the Corona virus and there had been at least one million deaths. In fact, numbers were accelerating in US, Brazil and India, and second- or even third-wave surges were being

experienced by many other nations.

This meant that people had experienced the pandemic long enough to become familiar with urban managers' standard mitigation strategies, and so this sections needs to describe them only briefly:

1. a complete community Lockdown (= 'Lockdown'),
2. a Partial Lockdown (= 'Partial'), or,
3. no Lockdown (= 'Nothing').

The severity of the *Lockdown* strategy varied from place to place, ranging from confinement to one's apartment in northern Italy and New York to other places' gentler versions that permitted some local travel for exercise, essential food shopping, caring duties and working within key industries.

Everywhere, however, *Lockdown's* consequences were drastic and long lasting. Economic sectors like tourism, hospitality, entertainment and sport were crippled, unemployment and financial hardship soared, governments ran up massive debts paying for relief measures, many people died, medical workers became stressed and natural human desire for social interaction was frustrated to the point where mental illness and domestic violence soared. The lack of people and vehicles on city streets and the transformation of formerly frenetic employment hubs into ghost towns will long be remembered, and forecasts of an upcoming global economic recession were dire.

This was why pressure grew for a second approach which we here refer to as the *Partial Lockdown* strategy. It involved relaxation of some of *Lockdown* rules in order to get the economy on the road to recovery. By allowing shops and restaurants to re-open under strict social-distancing rules, permitting non-essential shopping and letting limited numbers of people congregate for sporting, wedding, funeral, family, educational and other purposes it was hoped that some life could be pumped back into daily commerce, thereby

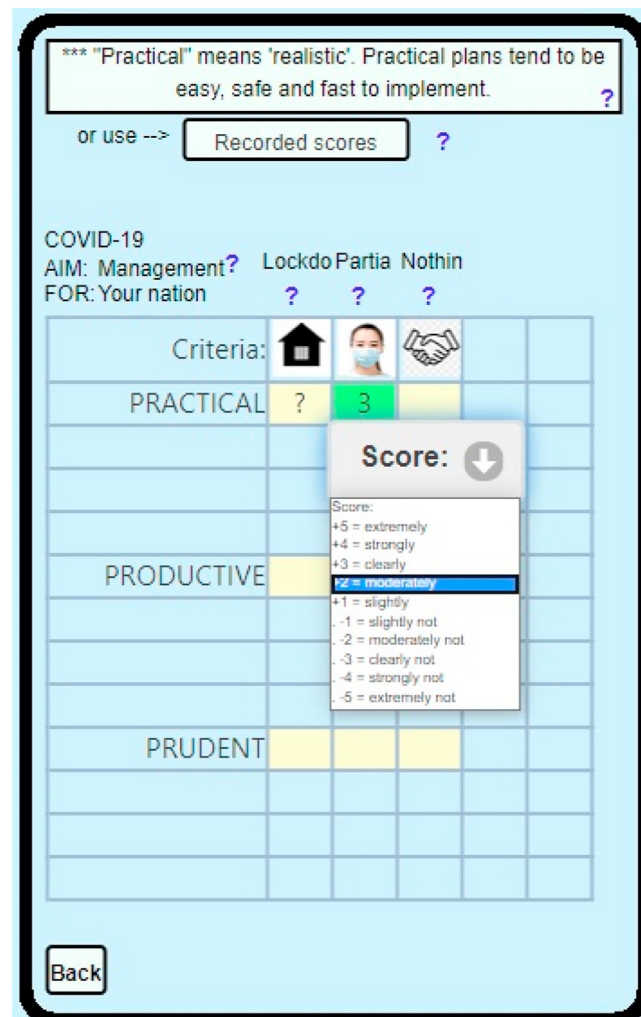


Fig. 1. Entering each plan's scores for plan-evaluation criteria.

minimizing permanent damage.

Finally, some countries chose to adopt a third plan which was to do *Nothing*. This involved treating the crisis like any other viral outbreak, and it was simply hoped that the virus would die out naturally. This approach may have sometimes been implemented in concert with minimal, precautionary health measures like hand washing, face masks, social distancing and recommendations against large gatherings, but only informally. Compared to the other two strategies, *Nothing* seems to be a fairly apt description of this plan.

3. The *Planticipate* app

Our app always begins by recording fourteen demographic details about each new user – age group, gender, country of residence, number of children and so on. This information is automatically stored in the cloud for instant retrieval whenever the same user accesses the app again.

Planticipate then asks the user to address a situation, either one that they have entered themselves or one of the example situations recorded within the software. Accordingly, for the purposes of this paper we submitted a new situation, labelled "COVID-19", and then addressed it. Its client was specified as "your nation"; "balanced management" was nominated as its overall aim and three alternative plans for achieving this aim were listed - *Lockdown*, *Partial* and *Nothing*.

The user is then asked, as shown in Fig. 1, to score each plan on each of the twelve plan-evaluation criteria described in Table 1.

Such criteria have been extracted from the last sixty years of urban planning literature and collectively they cover all of the considerations which planning textbook writers believe people consider whenever they plan. All of them have been defined, developed and justified in depth by Wyatt (2017), and they are essentially a more detailed elaboration of Ajzen's (2011) Theory of Planned Behaviour. They sometimes overlap in meaning, but given that the author has not heard of any suggested, additional criterion for many years, they probably straddle fairly well the full gamut of people's concerns whenever they evaluate plans.

Note that all of our criteria are fairly abstract, umbrella type concepts. For example, one might ask whether safety means freedom from financial disaster, minimization of injury amongst construction workers or whatever. The answer is that safety, as it is being used here, is in fact all of these things. Some plans are simply riskier than other plans and so each plan needs to be scored for "overall safety". Similar comments apply to all of the other criteria.

For the purposes of this paper the author fed to *Planticipate* some reasonably-sounding scores for each plan on each criterion, as shown in Fig. 2. In practice, considerable debate always swirls around such scores. Yet despite our app having been used at many stakeholder workshops, the author has invariably found that, with persistence, a set of consensus scores can always be generated. Never has it ever been necessary to split workshop participants into two or more groups with each having their own version of the criterion scores.

So although one could argue about Fig. 2's scores' validity, they are probably reasonable overall. For instance, the most practical plan is surely the *Nothing* plan – it might be risky but it is usually very easy and quick to simply do "Nothing". To take another example, the most effective plan is probably *Partial* - the *Nothing* plan was not going to be effective in mid 2020 because it was likely to lead to an unmitigated public health disaster, and the *Lockdown* plan lost a lot of its effectiveness because of its damage to the economy. The *Partial* plan, at least in mid 2020, seemed to more effectively balance public health with economic prosperity.

Once a user has scored each plan on each criterion, as shown in Fig. 2, the app's screen goes blank and the user is asked to rate each plan, again on a scale from -5 to +5, for overall plan desirability, as shown in Fig. 3. Once the user has made such judgements, provided that they have reported that they have sincerely estimated plans' criterion scores and their overall desirability, all such information is automatically and instantly uploaded to databanks in the cloud.

Cloud software then slightly modifies, for each demographic group to which the current user belongs, its consensus relationships between plans' scores for criteria and for overall plan desirability. Such relationships are stored as straight-line regression equations, and their accuracy is assessed for statistical significance at the 95% confidence level.

It is these relationships which give *Planticipate* its generic, predictive power. If a subsequent user inputs a set of criterion scores for any plan in any situation, such scores are entered into each statistically significant criterion's regression equation to forecast overall plan

Table 1
Planticipate's plan-evaluation criteria.

Criterion:	Explanation:
PRACTICAL	realistic - safe and easy and fast
Safe	free from risk or danger; secure from harm
Easy	proposing no difficulty; requiring little effort
Fast	ability to be accomplished in relatively little time
PRODUCTIVE	fruitful - effective and efficient and timely
Effective	able to accomplish a purpose
Efficient	without wasting time or effort or expense
Timely	occurring at a suitable or opportune time
PRUDENT	wise - acceptable and permissive and independent
Acceptable	capable or sure of being accepted or received with pleasure
Permissive	granting or inclined to grant permission
Independent	not controlled by others or by outside forces

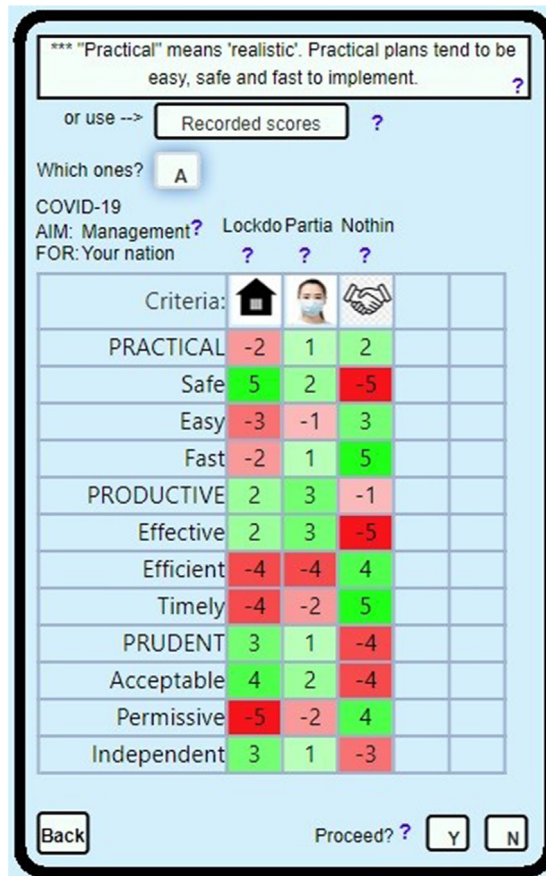


Fig. 2. Each plan's estimated score (-5 - +5) for twelve, key plan-evaluation criteria.

desirability and these forecasts are averaged. And since each group of past users has its own set of regression equations stored in the cloud, the app is able to do this on behalf of many demographic groups.

4. Results

Based upon the scores in Fig. 2 and what it had learned from its past users, *Planticipate* forecasted what desirability scores each community group will assign to each plan. For example, plan desirability levels according to males and according to females are shown in Fig. 4.

4.1. Forecasted scores

Note how the app, rather than show forecasted plan scores as a point, shows them as a margin of error around a point. This margin is the average standard error of the group's regression equations and it is a guide to the consistency of judgements. For example, the average standard error for males' forecasts is +/- 1.6 whereas for females it is higher at +/- 2.1, possibly because female users of our app have so far been less consistent.

Also, unless two plans' forecasts are at least two standard errors apart they are not statistically significantly different at the 95% confidence level. That is, if their Fig. 4 error margins overlap, then their forecasted desirability levels are not statistically significantly different - any contrast shown is merely preliminary, suggestive and possibly not likely to be replicated.

Hence Fig. 4 instantly shows that because all the error margins overlap, our app has forecasted that females will see no significant differences between plans' desirability levels. For males, by contrast, the error margin around the *Nothing* plan's forecasted score does not overlap the error margin of *Lockdown*'s forecasted score, so *Nothing* is forecasted to be statistically, significantly inferior to *Lockdown*.

This means that for males we can:

- tentatively conclude that they will see *Lockdown* as the best plan, with a score of 1.9, followed by *Partial* at 1.4
- be 95% confident that they will see *Lockdown* as statistically significantly better than the *Nothing* plan whose desirability score will be -1.5.

Click the yellow squares to rate each plan for overall desirability according to YOU.

COVID-19
 AIM: Management ? Lockdown Partial Nothin
 FOR: Your nation ? ? ?

DESIRABLE	2	?			

Please answer honestly: ?

Score ↓

- Score
- +5 = extremely
- +4 = strongly
- +3 = clearly
- +2 = moderately
- +1 = slightly
- 1 = slightly NOT
- 2 = moderately NOT
- 3 = clearly NOT
- 4 = strongly NOT
- 5 = extremely NOT

Back

Fig. 3. Entering the app user's estimate of each plan's overall desirability.

For females, we can conclude that they are likely to score *Lockdown* and *Partial* as equally desirable, with a score of 1.2 each, but we cannot be 95% confident of this or, indeed, that either of these plans will be regarded as significantly superior to the *Nothing* plan. It is disappointing that we cannot be more precise, but with only 15 males and 14 females having used *Planticipate* so far, its error margins are still relatively large and so confidence in its forecasts is low.

Experience has so far shown that when more people seriously use our app the error margins (standard errors) around our regression equations decrease in size. Hence they should shrink substantially if the number of app users grows, and this will boost the chances of non-overlapping, forecasted scores.

Meanwhile, we have also incorporated into the app a simulated neural network for each large group. This is because networks can often be more accurate forecasters than straight-line regression equations. But neural networks are extremely hungry for input data to train on, and so all of our networks are currently so underdeveloped that they fail to forecast many differences in plans' expected desirability scores.

The current neural network-based forecasts are actually shown by the small purple bars in Fig. 4 and they reveal very little except, perhaps, that females might ever so slightly rate the *Lockdown* plan as superior to the *Partial* plan despite regression analysis suggesting they will be rated equally. But any such conclusions will only be confirmed or confounded once a larger number of serious users have input much more training data into *Planticipate*.

4.1.1. Possible reasons for forecasted scores

For better urban management it would seem sensible to ponder why our plan-desirability forecasts turned out the way that they did. Yet doing this conventionally requires one to compare each plan's score on each plan-desirability criterion according to one group with the corresponding scores of another group and then noting the difference between their forecasted, plan-desirability scores.

This is an Herculean process which is almost guaranteed to generate hopeless confusion, especially since *Planticipate* actually constructs a thirteenth variable, "serendipity", which is a measure of how much each plan's set of criterion scores synchronizes with the group's pattern of criterion-importance levels.

Accordingly, our app uses the innovative "face chart" method to help make its 13-dimensional comparisons clearer and more succinct. Examples are shown in Fig. 5, which was generated by clicking on the males' and the females' respective "Why?" buttons in Fig. 4 above.

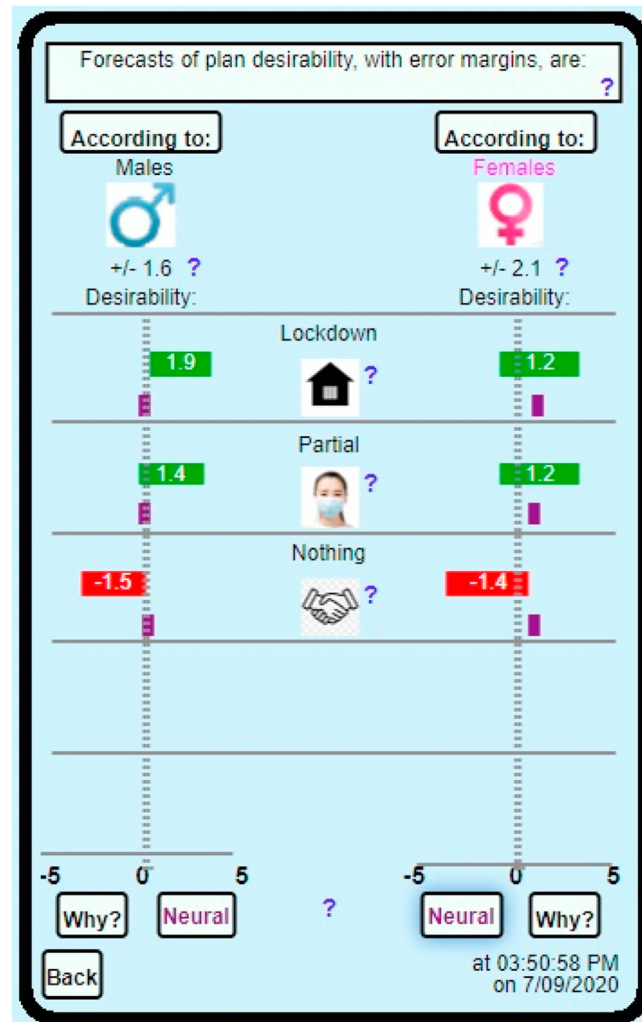


Fig. 4. Forecasted plan-desirability scores (-5 to +5) according to male app users on the left and female app users on the right.

The rationale behind face charts has been well documented - it is much harder to remember where a dimension is located within a conventional diagram, such as a bar chart, a histogram or a star plot, than it is to remember where it is located on a human face. One knows instantly where the eyes, the nose, the mouth and other features are, and so when they are used as positions to show criterion scores, face charts can be interpreted much faster than conventional charts can.

Moreover, the precursor to face charts, face diagrams, has a long and distinguished history since they were first developed by Herman Chernoff (1973). Hood and Dunsire (1981) used them extensively to succinctly compare different departments within the British civil service and Dorling (1994) spectacularly used them to show UK voting behaviour, along with several causal attributes, all on one map.

The author then claimed to have largely removed racial, ageist and emotional impediments to the interpretation of face diagrams by standardising all facial features to circular shapes only, thereby converting face diagrams to face charts (Wyatt, 2008). More recently, he has produced preliminary evidence that face charts are far more efficient than either histograms or star plots for communicating many-dimensional data (Wyatt, 2020).

Nevertheless, it is difficult to fit more than about 10 distinct locations on a human face, and so in Fig. 5 the three macro criteria - practicality, productivity and prudence, are represented by circles on the collar. Only the ten, more detailed criteria are represented by circles on the face itself.

Circles on the larger faces at the top of Fig. 5 are proportional to the importance levels of criteria, according to males on the left and according to females on the right. Importance is assumed to be proportional to the slope, either positive or negative, of that group's linear regression line which plots how a criterion's score is related to plan desirability. If the slope is steep, a change in criterion score is associated with a strong change in plan desirability and so that criterion must be important. By contrast, if the slope is shallow, then that criterion must not be sufficiently important to change plan desirability very much. In other words, a large circle in the large face chart means that the criterion is important for the group, and a small circle indicates that the criterion is not important.

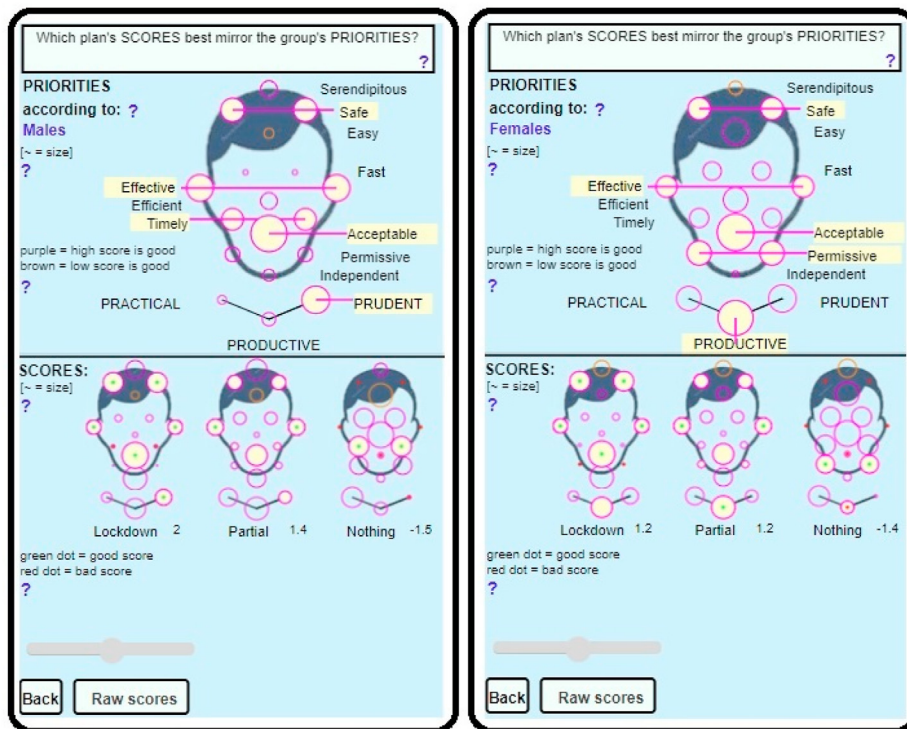


Fig. 5. Suggested reasons for males' forecasted plan scores on the left, and suggested reasons for females' forecasted plan scores on the right.

However, even though a slope might be large, we still do not know whether the criterion concerned is genuinely important. It could be that the group's size and, consequently, the number of data points used to build its regression line, is so small that the equation does not attain statistical significance. In such circumstances it would be unwise to assume that steep slope indicates genuine criterion importance; the relationship between criterion score and plan desirability might simply be random and unlikely to be replicated.

So in the interests of statistical rigor, only those criteria whose relationship with plan desirability is statistically significant at the 95% confidence level are ever considered when forecasting plan desirability. Such criteria are shown as yellow circles in Fig. 5 and the other circles have simply been ignored. Again, we believe that in the future, when groups comprising many more individuals have contributed their judgements to *Planticipate*, the number of criteria that attain statistical significance will increase.

Since the size of circles in the smaller faces along the bottom of Fig. 5 are proportional to how strongly each plan scored on each criterion, it follows that whenever any plan's face chart looks like the large face chart at the top, then that plan will tend to score strongly on those criteria which the group regards as genuinely important. Therefore, that plan will usually have a high forecasted score for desirability.

It is no surprise, therefore, that the two favoured plans, *Lockdown* and *Partial*, which are forecasted to be rated by both males and females as positively desirable, both have faces that resemble the top face showing group priorities. The same cannot be said for the face of the non-favoured, negatively desirable *Nothing* plan.

To make this more understandable a green dot appears on each yellow criterion in a plan's face if it scores 80% or more up through the range of scores for that criterion scores across all three plans (provided that the range itself is 4 points or more). Conversely, a red dot appears in the yellow criteria's circle on a small face chart if that plan's score for that criterion is 20% or less up the range of that criterion's scores. In short, a green dot indicates a particularly strong score on a statistically significantly important (to the group) criterion whereas a red dot identifies a particularly weak score on such a criterion.

For males the top-scoring *Lockdown* plan has four green dots - for safety, effectiveness, acceptability and prudence, and this is why it is forecasted to top score even though it has a weak score for timeliness. *Partial* is expected to come second because it has strong but not absolutely top scores for all four of the important criteria. *Nothing* is predicted to score lowly for desirability because, while it is a timely plan, the red dots indicate that it is neither safe, nor effective, nor acceptable nor prudent.

It is similar for females. They are forecasted to score *Nothing* as disastrous despite this plan being very permissive, and they are predicted to rate *Lockdown* and *Partial* more highly, albeit equally. This is probably because although *Lockdown* has more green dots, *Partial* is more productive than *Lockdown* is. Also, timeliness is not important to females whereas permissiveness is, and *Partial* is more permissive than *Lockdown*.

It needs to be cautioned that what we are trying to do here is fraught with unsolved difficulties. The human process of assigning desirability scores to proposed plans is a very cerebral and mysterious process which is imperfectly understood. It almost certainly involves a lot more than simply aggregating regression-based estimates. Hence this paper's findings, especially when they are not

statistically significant, are in no way definitive. They are suggestive only.

4.2. Simultaneous forecasts

Perhaps the most powerful feature of *Planticipate* is its ability, whenever a user clicks the “All scores” button, to simultaneously show every group’s forecasted plan-desirability scores as in Fig. 6. This figure only lists forecasted, plan-desirability scores according to those fifteen groups which were predicted to score *Nothing* as statistically, significantly inferior to at least one of the other two plans (as evidenced by any difference between scores being smaller than the “required gap”, of two standard errors, which is shown in yellow on the right).

Fourteen out of these fifteen groups were forecasted to score *Lockdown* as (non-significantly) better than *Partial*. This means that we have suggestive evidence that *Lockdown* will easily be the most popular plan. Only one group – people aged 20–29, were predicted to favour *Partial* as the best plan (the top-scoring plan’s desirability is always shown in bold font).

Note also that for each plan the groups are listed in descending order of their forecasted desirability for that plan. Hence we can instantly deduce that the staunchest advocates of the *Lockdown* plan will probably be the very poor, Catholics and the very young. By contrast, several other groups were forecasted to rate *Lockdown*’s desirability as much closer to that of *Partial*.

In an attempt to explain why any group scored plans in the way that it did, clicking on that group’s line in Fig. 6 prompts the app to show the relevant face charts. For example the left hand side of Fig. 7 suggests why those earning less than \$600 per week were forecasted to score *Lockdown* so strongly, and the right hand side indicates why people aged 20–29 were forecasted to rate *Partial* as the top plan.

It can straight away be seen that poor people regard safety, acceptability and prudence as important; *Lockdown* has green dots for these three criteria; *Partial* has no green dots and so the former is expected to outscore the latter for desirability by $3.8 - 2.3 = 1.5$. By

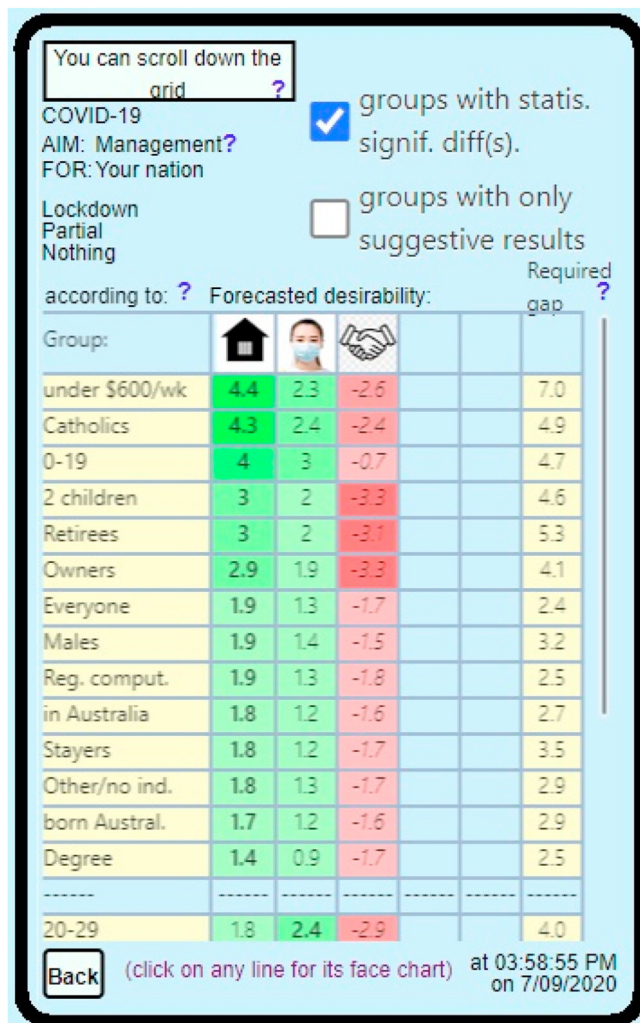


Fig. 6. Forecasted plan-desirability scores for those groups which ranked the *Nothing* plan as statistically, significantly inferior to the other two.

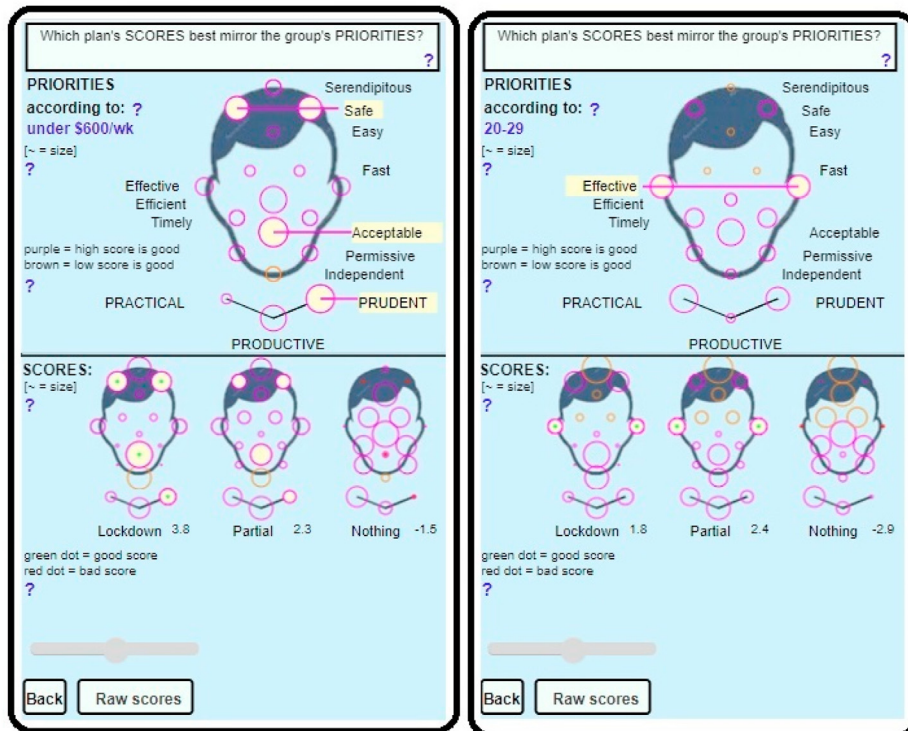


Fig. 7. Possible reasons why poor people were forecasted to score *Lockdown* as very highly desirable and why people aged 20–29 were anticipated to prefer *Partial*.

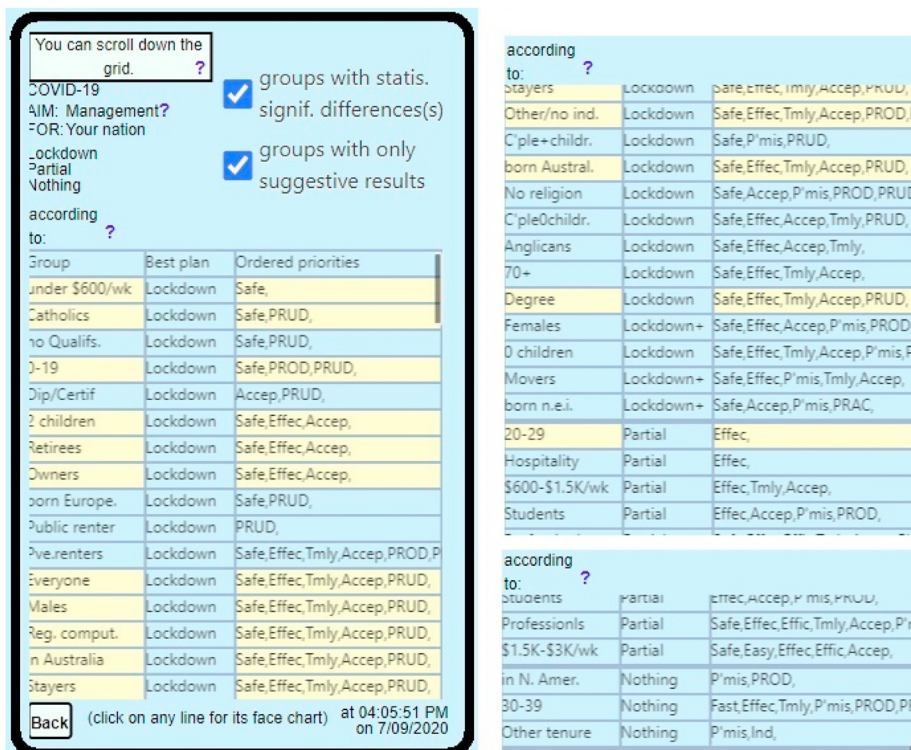


Fig. 8. Predictions of each group's favourite plan and the criteria which it thinks are important.

contrast, people aged 20–29 think that only effectiveness is important, and the most effective plan is *Partial*. But *Lockdown* also has a green dot for effectiveness, and so *Partial* is predicted to only outscore *Lockdown* for desirability by $2.4 - 1.8 = 0.6$. Compared to these definite and rather extreme-scoring groups, other groups tend to evaluate plans in a more nuanced manner, and so untangling reasons behind their forecasts is more complicated.

4.3. Predicting favourite plans

To help users better understand such complications, *Planticipate* can generate a summary prediction of which groups will favour which plan along with what criteria each group thinks are important. The user simply clicks on the “All predictions” button, and a typical result is shown in Fig. 8. This shows all thirty six groups, both those that were forecasted to see the *Nothing* plan as statistically significantly inferior (shown in yellow) and those forecasted not to (shown in blue).

The order of the groups favouring each plan still goes downwards from the one forecasted to assign the highest score, and so it seems that those forecasted to most strongly favour the *Lockdown* or the *Partial* plan tend to be those which think only one or a few plan-evaluation criteria are important. By contrast, as we move downwards in Fig. 8 towards groups whose forecasted desirability score for their favourite plan is lower, the number of criteria that they regard as being important increases.

Yet this is not an immutable rule. Notice for example those living in public rental housing. Although they are about half way down the order in terms of how strongly they are expected to rate the desirability of their favourite, *Lockdown* plan they believe that just one plan-evaluation criterion, prudence, is important. Moreover, just one place above them are people born in Europe; people who think that only two criteria are important - safety and prudence.

Fig. 8 shows that there are twenty seven groups forecasted to score *Lockdown* as the most desirable plan although three groups are expected to score *Lockdown* and *Partial* as equal best. Then there are five groups expected to score *Partial* as the best plan and three

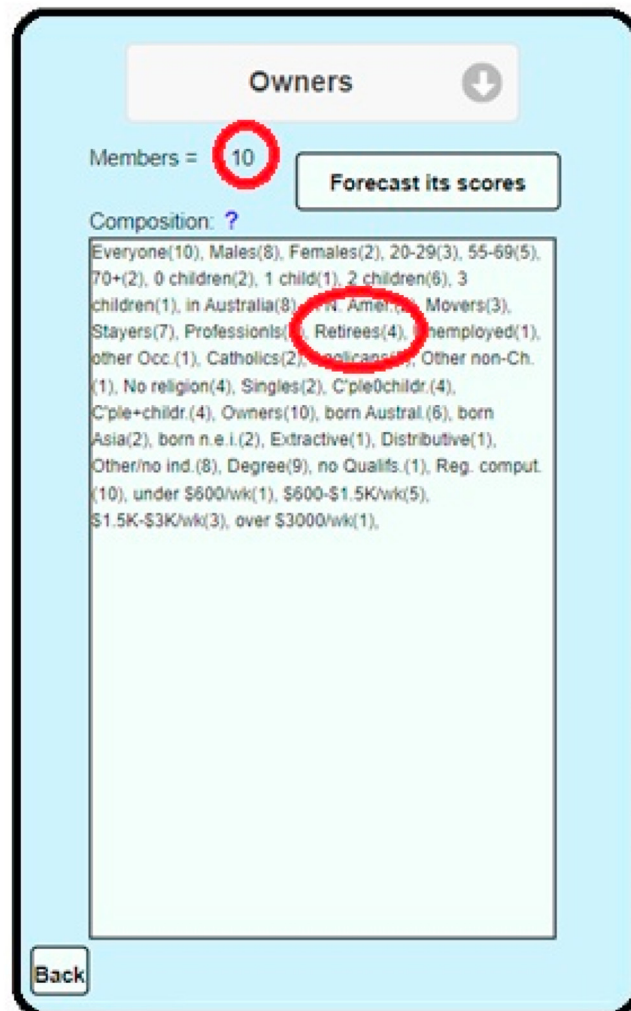


Fig. 9. Composition of the home owners group which indicates that six of the ten homeowners are *not* retirees.

groups forecasted to favour the *Nothing* plan. Although most of these results are non-significant they still probably contain some useful information.

For instance, broadly speaking it can be said that the groups predicted to favour *Lockdown* tend to believe that plans should be safe, effective, timely, acceptable and, sometimes, prudent. And, although *Lockdown* was not timely because most cities had already implemented this plan in some form or other by mid 2020, it was certainly safe, effective, acceptable and prudent.

By contrast, the six groups forecasted to favour *Partial* – young adults, hospitality workers, students, low-income earners, middle-income earners and professionals, usually do not regard safety as important at all. Instead, their priorities are other considerations like permissiveness, independence and productivity. In other words, their desire is less for a safe, public-health strategy and more for a riskier, economically productive plan.

Finally, there are three groups forecasted to actually score the *Nothing* plan as the most desirable one – people living in North America, people aged 30–39 and people living in unconventional accommodation such as with parents or within a group household. Fig. 8 suggests that these groups' priorities are concepts like speed, permissiveness, productivity and independence. That is, rather than being conservatively focussed upon safety like those forecasted to prefer *Lockdown*, or upon productivity like those anticipated to prefer *Partial*, their preference is expected to be for plans that have maximum flexibility and an ability to stay out of the way of other policies, and the *Nothing* plan epitomises such a *laissez faire* attitude.

4.4. A cautionary note

It is important to avoid taking away two wrong messages from Fig. 8. Specifically, it should never be assumed that some groups are either composed of the same individuals, and/or, use exactly the same set of criteria in identical fashion.

It certainly looks like, say, the retirees group comprises identical individuals to the home owners group. They have the same criteria designated as important and intuitively they would seem to overlap. But users of *Planticipate* can check any overlaps by focussing upon one group and noting the group composition which always appears whenever any group is selected.

An example is shown in Fig. 9 which indicates there are ten people within the home owners group but only four of them are retirees. That is, six of the home owners are NOT retirees; the two groups obviously comprise different collections of individuals. In fact, in *Planticipate*'s current groups there are no pairs that contain exactly the same set of individuals.

Also, although it looks like the set of groups near the bottom left corner of Fig. 8 evaluate plans in identical fashion, with their important criteria being identical, Fig. 7 above indicates that these groups were forecasted to assign *different* desirability scores to plans. This happens because, whereas the slope/importance levels of the criteria might be similar, such slopes are still slightly different for each group. Hence estimates of plan desirability based upon these slopes will differ, albeit slightly.

5. Practical implications

We will close by outlining just a few of the many policy suggestions that flow naturally from the above findings. Many were, in fact, implemented later during the pandemic. .

5.1. Modifying the Lockdown plan

To the extent that *Planticipate*'s twenty nine users properly represent the “community”, it is clear that most demographic groups within the population at large will probably prefer the *Lockdown* plan. This is because *Lockdown* meets many groups' need for:

- safety, effectiveness, acceptability and prudence

It follows that *Lockdown* could have been made even *safer* by mandating that masks be worn whenever residents have to travel to essential services jobs. Some Asian cultures tolerate mask wearing and their successes in containing the virus are well known, but some European and Anglophone societies are more resistant to it. The latter insist that they are sufficiently civilised to expect that all sick individuals will stay at home, which was not always true, as tragic outcomes in places like Sweden and the US demonstrated. Hence the need for mandatory rather than voluntary mask wearing.

Also, *Lockdown* could have been more *effective* if it had been imposed quickly and decisively. Once the general public had been convinced of this plan's efficacy when implemented firmly, there would have been less resistance to having to conform to its dictates.

Moreover, *Lockdown* could have been made more *acceptable* if extra government services and grants to the most inconvenienced citizens were targeted sensitively rather than bluntly, as observed in some jurisdictions. Although cash subsidies, lower utility charges and rent relief for unemployed people and struggling businesses achieved much within rich nations, *Lockdown* would have been far more widely accepted had the planning of such interventions been more incisive.

Finally, *Lockdown* could have been made to seem more *prudent* if authorities had convinced citizens of the virus' seriousness by more vigorously publicizing the death and suffering being experienced within the community. Urban managers could have demonstrated that they were not being half hearted by increasing fines for those breaking curfew rules, and politicians could have been more honest with the public about what public health officers did, and did not know about the virus' spreading mechanisms. Instead, they simply trumpeted early predictions from unreliable, assumptions-based modelling that was later shown to be inaccurate, thereby decreasing the public's faith that *Lockdown* was prudent.

5.2. Modifying the partial plan

Urban managers might have also wanted to change the minds of the six groups who were forecasted to rate *Partial* as the best plan. If so, they could have noted how most of these six groups saw *Partial* as being more effective and then set about convincing them that *Lockdown* was more effective still. More exactly, they could have painted *Partial* as less *effective* by arguing it would inflict considerable long-term economic damage if the pandemic were not controlled with maximum haste, via a full *Lockdown* strategy, rather than through a *Partial* one.

Alternatively, urban managers might have later come to believe that *Partial* was the best plan, and if so, in order to convince people of this they would have needed to make *Partial*:

- safer, more effective, more acceptable and more prudent.

Partial would have been made *safer* if the return to almost normal operation in cafes, restaurants, cinemas, gyms and families had been made conditional upon enforcement of social distancing rules, and it could have been made more *effective* through better containment of infection hot spots. One way to do this would have been to develop a more trustworthy and hence more widely downloaded contacts-tracing 'phone app – one which respected people's privacy by not uploading their recorded movements to centralized and vulnerable Google servers.

Also, *Partial* could have been made more *acceptable* to those worrying about the dangers of the virus' spread by insisting that hand sanitizers be ubiquitous on public transport and near door handles at workplaces.

Finally, *Partial* might have been made to look more *prudent* if pandemic mitigation had been clearly framed as seeking a balance between reduced deaths on the one hand and economic survival on the other.

5.3. Modifying the nothing plan

In some jurisdictions there might have been a need to convert some community groups, like the three groups shown in Fig. 8, away from their favoured *Nothing* plan to one of the other two. Urban managers might have achieved this simply by highlighting infection and death statistics in places where a *Nothing* type plan had been embraced.

Also, given that these groups favour plans which are:

- fast and permissive,

people in them could probably have been converted to supporting *Lockdown* and/or *Partial* by making one or both the latter *faster*, that is, quicker to implement. This could have been achieved by more closely copying plan implementation in countries which had experienced the pandemic earlier, thereby facilitating more rapid and more resolute lockdown policies.

Moreover, both the *Lockdown* and *Partial* plans could have been modified by allowing many activities to be partly resumed, thereby *permitting* urban activity to return to a level closer to normal. For instance, less working from home and more travelling to work might have been achieved by incorporating into *Lockdown* and *Partial* some strong directives like compulsory face masks on public transport, mandatory virus tests akin to alcohol- and drug-affected driving tests, and seriously deep cleaning of public and vocational facilities.

5.4. The correct tactics?

It is only in hindsight that the wisdom of many of these policies has become obvious. They were less popular early in the pandemic because many authorities seemed to be implementing plans in a panic mode with little or no disciplined thinking about deep attitudes existing amongst different community groups. It is as if urban managers adopted a "design" approach by recommending a plan and then intermittently modifying it to make it a "winner". Such an approach has been identified in the commercial management literature (Wyatt, 2017, pp.193–195) but it is not really suitable for public management.

A better tactic would have been for urban managers to adopt a "planning" rather than a design approach (Wyatt, 2004). As demonstrated above, *Planticipate* could have been used to reveal key priorities of different community groups quickly, objectively and scientifically rather than subjectively, vaguely and belatedly. This would have facilitated generic and valid predictions about people's probable responses to planning proposals, thereby prompting beneficial measures to be incorporated into intended plans from the start. This would have been far preferable to waiting for such initiatives to emerge, often too late, during the course of the crisis.

Alternatively, one might argue that compared to scientifically rigorous yet generalized predictions of groups' plan preferences case study-based, detailed analyses tailored to reveal how local idiosyncrasies can be accommodated might have been more effective. But if this is true, it will probably only remain so in the short term. Case studies are rather subjective and of untested validity, and so urban managers might eventually find that few people are willing to listen to their situation-specific and possibly dubious advice. By contrast, generic prediction of plan preferences eventually generates a strong discipline whose advice will always be listened to by the general public.

6. Conclusion

The software-based method described above makes a concerted effort to forecast different community groups' attitudes along with

possible reasons for them. It constitutes a genuine effort to unearth the different intrinsic priorities that exist within any constituency by predicting, with statistical rather than subjective accuracy, what each group's plan preferences will be.

Even if such forecasting is, and possibly will remain largely suggestive rather than definitive, there is little doubt that it stimulates a rich array of practical and eminently plausible suggestions either for enhancing the quality of the most popular plans or for manipulating the less popular ones into versions that will be more palatable to different groups.

There is little doubt that early on during the Corona virus pandemic cities would have benefitted from such a nuanced and empathetic approach. As such, rigorous prediction of community groups' plan preferences, along with the possible reasons behind them, is important. It draws urban managers' attention to many interventions about which they would not have otherwise thought.

Declaration of competing interest

There are no conflicts of interest.

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