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Abstract: Airborne transmission of COVID-19 increased the need for health policies to reduce transmission in congregate settings associated with minimal risk before the pandemic. While a large literature estimates tradeoffs between policies designed to reduce negative health outcomes, no empirical research addresses consumer willingness to pay for health policies designed to reduce airborne virus transmission. Using survey data from 1,381 fans of professional sports teams, we estimate consumers' willingness to pay (WTP) for reduced likelihood of coronavirus transmission through mask and social distancing policies using a stated preference approach. The results indicate increased attendance likelihood if the venue requires masks and limits attendance, with significant heterogeneity in WTP across risk scenarios and sports. We characterize consumers as casual fans who prefer a mask requirement but are indifferent to capacity constraints, strong fans who are anti-maskers and prefer capacity constraints, and a second group of casual fans with positive WTP under both mask and limited capacity requirements. Casual fans' WTP for masking, $38 per NBA game attended, is more than double their WTP for capacity constraints only. Strong fans' WTP for attending capacity constrained NBA games was $490, more than 400% higher than the pre-pandemic average WTP of $105.

Keywords: Discrete choice experiment; Stated preferences; Willingness-to-pay; Health policy
JEL Codes: I12, M31, Q51, Z20

Introduction

The COVID-19 pandemic generated widespread, substantial impacts throughout the economy. Health risks increased substantially because of the pandemic. Many widely purchased consumer goods and services that entailed little pre-pandemic health risk, for example eating in a restaurant, going to a concert, or attending a sporting event, suddenly entailed much larger health risks due to the airborne nature of the virus. Health policies like social distancing and mask wearing requirements clearly reduce the spread of the virus (Karaivanov et al. 2021). Currently, enactment and enforcement of health policies designed to reduce COVID-19 spread falls on individual businesses, health care organizations, and school districts. No evidence exists on the value that customers or students place on health policies designed to mitigate virus spread.

A large literature exists valuing alternative health policies using discrete choice experiments. de Bekker-Grob, Ryan and Gerard (2012) survey this literature. Clear evidence of substantial willingness to pay for widely applicable public health policies to prevent and treat some illnesses exists (Bosworth, Cameron, and DeShazo 2015). Evidence of substantial consumer WTP for specific local health policies also exists. For example, Meenakshi et al. (2012) estimated substantial consumer WTP for food nutrition information in an environment with high rates of malnutrition-related disease, rural Zambia.

No evidence currently exists on the willingness to pay for health policies designed to reduce the spread of the COVID-19 virus, especially policies used by providers of consumer goods and services with increased health risks during the pandemic. This paper estimates consumer willingness to pay (WTP) for alternative health policies affecting people attending professional sporting events, a common congregate setting in cities around the world.

Sporting events represent an interesting setting for estimating WTP for alternative health policies. Millions of consumers attended professional sporting events each year in the pre-pandemic economy, providing them experience with an activity with low health risk before the pandemic. Detailed information exists on the price/WTP for attendance pre-pandemic, providing a convenient benchmark WTP for pandemic related health risk reduction. Focusing on consumers who expect to attend games mitigates the public good aspect of health policies present in other settings. Masking and social distancing policies can generate substantial reductions in the likelihood of transmission, reducing some of the income effects that influence WTP estimates for health policies aimed at illness reduction in other settings. We analyze attendance at multiple professional sporting events with different characteristics including indoor and outdoor venues, allowing for an analysis of heterogeneity in WTP in settings where the risk of transmission may vary considerably.

We estimate WTP for health policies designed to reduce virus spread at professional sporting events, based on survey data from a sample of 1,381 residents of five large US metropolitan areas who expected to attend a professional football, basketball, baseball, ice hockey, or soccer game when fans return to games. We conduct a discrete choice experiment with variation in multiple attributes under several hypothetical scenarios and asked whether respondents would be willing to buy a ticket for a game under stated conditions, including different ticket prices and two alternative health policies, social distancing and mask requirements. The results from latent class logit models uncover three distinct classes of consumers and show that mask requirements and reducing seating capacities increased the likelihood of attendance in all three of the latent groups. One group of consumers, dubbed strong fans, made up about 25% of the sample, exhibited low ticket price sensitivity, placed very high

WTP to attend games under the baseline scenario of no mask requirements and 25% venue capacity, and exhibited reduced WTP when a mask requirement was added to the 25% capacity constraint. However, this reduction in WTP was not large enough to deter attendance.

The other two groups, which likely represent casual fans, exhibited higher ticket price sensitivity and had strong, but differing, preferences for virus transmission mitigation strategies. One large group of casual fans, representing about 50% of the sample, would not attend games under the 25% capacity restriction, but would attend if a mask requirement was added to this restriction. Attendance decisions for members of this group of consumers were not sensitive to variation in capacity constraint policies. The third group of consumers accounted for about 25% of the sample. Preferences of these fans were difficult to determine in the baseline 25% capacity and no mask requirement scenario. Their attendance decision was very sensitive to stricter social distancing policies but were not sensitive to the presence of mask requirements. Ticket price had the predicted negative relationship with attendance in all three latent consumer groups.

In terms of specific WTP estimates for virus mitigation policies, our estimates can be compared to the pre-pandemic WTP (the average ticket price) and to the baseline scenario of a 25% capacity limit and no mask requirements in the pandemic era. We focus on results for consumers of National Basketball Association and National Hockey League games, since these two sports involve indoor play only in similar, and in many cases in our sample the same, venues. The large group of casual fans exhibited negative WTP for social distancing. Their WTPs to attend games under the baseline 25% capacity restriction was $32 and $24, respectively, compared to average pre-pandemic WTP of $105 and $75. However, consumers in this latent class exhibit large WTP for mask requirements. Adding a mask requirement to the

25% capacity restriction increased WTP by $38 and $24, respectively, more than doubling their overall WTP for a mask requirement.

The smaller group of strong fans exhibit large WTP for social distancing. Their WTP to attend games under the baseline 25% capacity constraint and no mask requirements were $489 and $162, respectively, compared to a pre-pandemic average WTP of $105 and $76. These represent roughly 200% to 400% increases in WTP for social distancing policies. However, WTP for mask requirements for this group of consumers was negative. Adding a mask requirement to the 25% seating capacity restriction reduced WTP by $160 and $53, respectively. Consumers in this group strongly dislike mask restrictions, although they would still attend games with these restrictions.

Overall, the results indicate substantial heterogeneity in WTP across the three latent classes of consumers. The results are nuanced, and members of the latent classes respond to social distancing and masking requirements in very different ways. Members of the two casual fan latent classes, accounting for 75% of the sample, do not find social distancing alone to be an adequate virus mitigation policy and require mask requirements in addition to social distancing. Members of the strong fan latent class find social distancing alone to be an adequate virus transmission policy. These heterogenous responses appear to mirror actual outcomes in the pandemic era and illustrate the difficulties in establishing health policies with broad appeal.

We contribute to the literature by developing the first empirical estimates of WTP for health policies designed to reduce virus spread at a popular consumer activity impacted by the pandemic. In the spirit of the approach used by Cameron and DeShazo (2013), we focus on generic risk reduction policies -- social distancing in the form of reductions in venue seating

capacity and masking requirements -- so our results likely apply to other pandemic affected consumer activities like eating and drinking in restaurants and bars, attending concerts, and going to the movies. This complements evidence developed by Oreffice and Quintana-Domeque (2020) on estimates of WTP for personal protective devices like masks and gloves.

The paper also contributes to the growing literature analyzing the role played by attendance at sporting events on the spread of the COVID-19 virus. Evidence suggests that attending sporting events facilitated the spread of COVID-19 (Ahammer, Halla, and Lackner 2020; Olczak, Reade, and Yeo 2020; Carlin et al. 2021; Fischer 2021) increasing the importance of understanding how consumers value health policies designed to reduce virus transmission. Other evidence links staging of sporting events to the spread of seasonal influenza prior to the pandemic (Stoecker, Sanders and Barreca 2016; Cardazzi et al. 2020). The evidence developed here places health policies designed to reduce virus spread at public events in the post-pandemic economy in context. It also informs businesses, health care providers, and schools facing difficult decisions about how to trade off demands by consumers or students with the costs of implementing and enforcing health policies to reduce virus spread in congregate settings.

Survey Methods and Data

Data collection used an online Qualtrics questionnaire. The survey targeted fans of professional sports teams in the Chicago, Dallas, Los Angeles, Miami and New York City metropolitan areas, five metropolitan areas home to the largest number of professional sports teams in the US. The survey ran from August 24 to September 12, 2020. During this period the number of COVID-19 cases were in a trough after the July 2020 peak in the United States. For example, in Dallas County, Texas the weekly case rate per 100,000 residents peaked at 348

during the week of July 11 (source: https://www.dallascounty.org/covid-19/). Between the weeks of August 22 and September 12 the weekly case rate was between 66 and 83. COVID-19 cases began increasing again soon after the survey closed.

Following the lifting of stay-at-home orders in the U.S. Major League Baseball (MLB) played games with no fans in attendance, Major League Soccer (MLS) played a tournament in a "bubble" in Orlando, Florida with no fans in attendance, the National Basketball Association (NBA) played regular season and playoff games in a "bubble" in Orlando, Florida with no fans in attendance, and the National Football League (NFL) played preseason games with no fans in attendance in summer 2020. The NFL played one regular season game on 10 September at 22% capacity (16,000 fans) in a metro not in our sample, Kansas City. FC Dallas, Real Salt Lake and Sporting Kansas City in the MLS, played home matches at 25% capacity or less. FC Dallas played two home matches before or during the survey period: 16 August (222 fans) and 29 August (3,212 fans). Unless a respondent attended the NFL game in Kansas City or one of the MLS games in Dallas, participants had no experience attending games in the pandemic era.

The survey used target quotas in gender (50/50), age (18-34, 30%, 35-54 35%, 55+ 35%) and race (62% non-Hispanic white, 12% non-Hispanic black, 17% Hispanic and 8% Asian/other). 3,682 people responded. The average age was 47. Sixty percent were white and forty-three percent male. Twenty-nine percent were married. Average years of schooling was 15. 56% were employed and average household income was $91,000.

Survey Screening

A screening question identified respondents who attended a professional team sports

game or match played in seven professional leagues in one of the five sample cities closest to their home prior to the start of the pandemic. The leagues included MLB, MLS, the NBA, the NFL, the NHL, the National Women's Soccer League (NWSL) and the Women's National Basketball Association (WNBA). Of the 3,682 respondents, 3,042 answered the screener question.[1] Sixty percent of those who answered the screener question had attended a professional sports game or match and were eligible for the remainder of the survey (n=1,819). The pool of eligible respondents who had attended a professional sports game or match were more likely to: be unmarried, be male, be younger, have more education, be employed and have higher income. Household size and race were not factors that affected attendance.

We excluded 438 respondents for various reasons including item nonresponse on key variables and data quality issues. For example, twenty-one respondents were dropped because they did not plan to attend a game in the future (7 of these did not answer the question). We dropped respondents who stated that they would next attend a game in the two women's leagues. Only 21 respondents stated that they would next attend a game in the NWSL yielding a sample too small for analysis. Two-hundred and nine respondents stated that they would attend a game in the WNBA but only 6 of these has most recently attended a game in that league. For the men's leagues, at least 66% of those who would attend a game in that league had most recently attended a game in that league. Forty-three responses were dropped because they did not answer questions about the typical price they pay for a ticket and the number of miles and minutes that it takes for them to get to the stadium or arena. We drop 12 additional respondents who did not answer the

[1] Eight percent of the sample (n=285) were not presented the screener question because they did not live in one of the five sample cities. Three hundred fifty-five respondents were presented the screener question and did not answer. We assume they recognized the screener question as such and did not answer because they were not eligible.

questions about mask use and their intentions about getting the COVID-19 vaccine.

Respondents were also dropped from the analysis because they did not pass additional quality screens, a known problem with opt-in panel data (Kennedy et al. 2020). Sixty-four respondents were dropped because they provided unreliable responses to questions about the number of miles they lived from the stadium or arena and the number of minutes it took for them to get to the stadium or arena from their home. Before these respondents were dropped the correlation between miles and minutes was r=-0.001. After dropping these respondents, the correlation is r=0.38 ($p < 0.0001$). We asked respondents a question about the number of games they typically attend and several open-ended questions about the number of games that they expect to attend in the next season under different circumstances. Sixty-eight of these respondents provided a number greater than the number of home games and are dropped. These decisions leave a sample of n=1,381 for analysis. The survey completion rate, 37.5%, is calculated as the number of completions divided by the number of initial contacts (Callegaro and DiSogra 2008).

Table 1 contains summary statistics for the final analysis sample (n=1,381). The average household income in the sample was $99,000 and age was 46. Forty-nine percent were male, and sixty percent were white. Twenty-eight percent were married with an average household size of 2.90. The average number of years of schooling was 16. Sixty-five percent of the sample reported being employed.

Respondents were then asked questions about the typical game or match that they attend. The typical number of games attended in a season is 4.6, the typical ticket price is $67 and the typical size of the party that attends games is 3.7. Twenty-one percent are season ticket holders.

The average distance to the stadium or arena is 27 miles and the trip takes an average of 62 minutes. Thirty-six percent of respondents describe their typical seats as “very good” and 42% describe them as “good”.

The discrete choice experiment focused on the decision to attend a game in the future. Forty-seven percent expected to attend a MLB game, 19% an NFL game, and 18% an NBA game. Only 7% and 8%% expect to attend an MLS or NHL game. Twenty-three percent of these respondents reside in the Chicago area, 20% are in Dallas, 23% are in Los Angeles, 15% are in Miami and 19% are in New York City.

COVID-19 Experiences

Respondents were also asked about their experience with the COVID-19 pandemic. Sixty-one percent had been following the news about COVID-19 “very closely.” Sixty-seven percent were “very concerned” about the effects of the pandemic on the economy and 45% were very concerned about their own finances. Sixty-one percent were “very concerned” about the spread of COVID-19 in their home city. At the end of the survey respondents are asked about their behavior related to COVID-19. Seventy-eight percent report wearing face masks “always” during the past week. Forty-four percent are “extremely likely” to get a COVID-19 vaccine.

Discrete Choice Experiment

The survey presented respondents with several detailed scenarios describing specific game attendance conditions: “In the next several questions we are going to ask you about whether or not you would buy a ticket and plan to attend a [MLB / MLS / NBA / NFL / NHL] game in [Chicago / Dallas / Los Angeles / New York / Miami].” The survey then described a

detailed situation that would exist inside the venue and instructed respondents that no vaccine for COVID-19 would be available when they attend[2], that they should consider their typical seat quality in the venue, that they will attend the game with the number of people in their usual party size, and that they should expect the home team to win.

The survey then specified detailed attendance characteristics in terms of mask policy in place, facility capacity, and ticket price paid. The mask policy described was: "The stadium may require that you wear a cloth mask over your nose and mouth. If the game is played in an outdoor stadium you must wear the mask when you are not able to social distance (in other words, stay 6 feet apart from people who are not in your seating area)." Stadium capacity was described as: "Due to social distancing policy, the number of tickets sold will be [10% / 25% / 50%] of stadium capacity. This will allow for social distancing because the available seats will be spread out." The ticket price is described as "You have been offered a ticket, or block of tickets for the number of people you typically attend a game with, from a reseller or acquaintance. The price of each ticket will range from $Minimum to $Maximum." Then respondents are told that "In each situation you will be asked if you would buy the ticket(s) that have been offered to you." Table 2 summarizes the scenarios presented in the discrete choice experiment.[3]

[2] The Pfizer-BioNTech, Moderna, and Johnson & Johnson COVID-19 vaccines were approved for emergency use in the U.S. in late 2020 and early 2021, after our data collection. Herd immunity is not expected to be reached and vaccinated individuals can still become infected with the virus.

[3] The survey asked "How closely did you read these instructions?" Eighty-six percent answered "very closely," 14% answered "somewhat closely" and less than 1% answered "not very closely".

The experimental design included five ticket price levels tailored to each league playing games in the five sampled metropolitan areas, based on the observed distribution of average ticket prices in the 2018 and 2019 seasons (Table 3). We calculated the mean and standard deviation of ticket prices in each league based only on the average ticket prices charged by teams playing in the sampled metropolitan areas. 378 respondents in a pretest were presented with the mean league-specific ticket price and prices plus and minus one and two standard deviations rounded to the nearest final 0 or 5 digit. Results from this pretest suggested that responses to the lowest ticket price listed were non-informative, so we replaced the minus two standard deviation price with the mean price plus three standard deviations for each league.[4]

Efficient design elements, including the total number of choices, attribute levels for each choice, and the specific blocking of the final design, were determined using efficient design macros in SAS (Kuhfeld 2003). This produced an experimental design with 24 discrete choices organized into 6 blocks of 4 elements each. Each respondent received one of the six blocks of questions. The estimated D-efficiency of this experimental design was 98%.

The survey asked respondents "would you buy the ticket in this situation?" This question used three possible responses: "yes", "no" and "don't know." Overall, 49% responded "yes", 43% "no", and 7% "don't know." We combined the "no" and "don't know" responses for the empirical analysis. An example of a choice question is presented in Appendix 1. Table 4 summarizes respondents' attendance intentions for each league. [5] Slightly more than 60% of the

[4] We also conducted a pretest with 159 respondents attracted through a Facebook ad to test whether the Qualtrics programming was free of major mistakes. The pretest observations were not included in the final data set.

[5] After the set of discrete choice questions described here, the questionnaire also included a section where respondents were asked the total number of games in a season that they expected

respondents overall chose to attend a game at the minimum and mean ticket prices. The percentage of "yes" responses were 42%, 39% and 30% at one, two and three standard deviations above the mean ticket price. "Yes" responses fell as the offered ticket price increased, as predicted, in each league ($p < 0.01$). The imposition of health policies on attendees mattered. 57% of respondents predicted attendance under a required mask policy and 37% without a mask requirement ($p < 0.01$). 54%, 46% and 40% of the respondents predicted attendance at 10%, 25% and 50% venue capacity restrictions respectively ($p < 0.01$).

Attribute non-attendance and respondent certainty represent two important issues for the validity of stated preference questions. In terms of attribute non-attendance, respondents were asked "When you were answering the hypothetical questions about buying tickets how closely did you pay attention to the different parts of each situation?" Sixty-eight percent, 88% and 73% of respondents answered "very closely" to the price, mask and capacity attributes.[6] Respondents were also asked how certain they were when they answered the hypothetical questions. The question was framed by a scale that ranged from zero ("not very certain") to 100 ("very certain") with the middle described as "somewhat certain." The mean certainty response is 80 with a median of 85 and a mode of 100.[7]

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to attend under different mask and capacity scenarios. These responses will be analyzed in future research.

[6] Stated and inferred attribute non-attendance issues lie outside the scope of this paper. Future research will estimate models analyzing attribute non-attendance issues along the lines of Lew and Whitehead (2020).

[7] The certainty question was framed as a scroll bar where respondents could drag the cursor to provide their certainty level on a continuous scale. The starting point for the cursor was randomly assigned at 0, 50 or 100. The conditional mean of certainty from a regression is 82. The starting point of 0 reduces the mean by 2.76 ($p=0.04$). There is no difference between the certainty values with starting points of 50 and 100.

Empirical Analysis

We first develop a model motivating the empirical analysis. Consider the indirect utility derived from the purchase of a single unit of a risky consumer good. Suppose that $v(p, y, r)$ represents an indirect utility function decreasing in price, p, increasing in income for normal goods, y, and decreasing in an exogenous health risk,

$$v(y - WTP, r) = v(y - p, r = 0) \quad (1)$$

where WTP is the willingness to pay that makes the consumer indifferent between purchasing the product with a health policy in place and not purchasing. If the price is a randomly assigned dollar amount, A, then the consumer problem becomes

$$v(y - A, r) \gtrless v(y) \quad (2)$$

where $p = r = 0$ is suppressed on the right-hand side of the inequality.

The consumer will choose to purchase the product if $WTP \geq A$. Suppose that indirect utility is random with mean zero error term, $v(y, p, r) + \varepsilon$. The probability that the product will be purchased is

$$\Pr(purchase = 1) = \Pr\left(\Delta v + \varepsilon^* \gtrless 0\right) \quad (3)$$

where $\Delta v = v' - v^o = v(y - A, r) - v(y)$ and $\varepsilon^* = \varepsilon' - \varepsilon^o$. If the utility function is linear in income and risk, $v = \beta_0 + \beta_1(y - A) + \beta_2 r + \varepsilon, \beta_0 > 0, \beta_1 > 0, \beta_2 < 0$, then

$$\Delta v = \beta_0 + \beta_1(y - A) + \beta_2 r + \varepsilon' - (\beta_1 y + \varepsilon^o) \quad (4)$$

$$\Delta v = \beta_0 - \beta_1 A + \beta_2 r + \varepsilon^*$$

As the price increases the change in utility is negative, $\frac{\partial \Delta v}{\partial A} = -\beta_1 < 0$, and the consumer is less likely to purchase the product. As the health risk increases, $\frac{\partial \Delta v}{\partial r} = \beta_2 < 0$, the consumer is less likely to purchase the product.

Willingness to pay is estimated by setting $\Delta v = 0$ (and $\varepsilon^* = 0$) and solving for A:

$$WTP = \frac{\beta_0 + \beta_2 r}{\beta_1} \quad (5)$$

A policy designed to decrease the health risk, $\Delta r = r' - \bar{r} < 0$, where $\bar{r}$ is baseline risk, will lead to an increase in the willingness to pay for the product.

We estimate the utility function parameters using a binary logit model. Preference heterogeneity may be important in this setting. We account for preference heterogeneity using a latent class model containing separate fixed parameter vectors estimated over $c > 1$ consumer classes (Hensher, Rose & Greene 2015):

$$\Pr(\Delta v > 0) = \sum_c \frac{\exp(\boldsymbol{\beta_c}' x_{it})}{1 + \exp(\boldsymbol{\beta_c}' x_{it})} \quad (6)$$

where $i = 1, \ldots, 1{,}381$ individuals and $t = 1, \ldots, 4$ stated preference choice questions. We allow the constant term, β_0, to vary across different game attendance characteristics in each consumer class. We also interact attributes in the choice experiment with professional league indicator variables to investigate heterogeneity across sports. In this model the constant term represents the numerator in the WTP equation with the baseline risk (no mask policy, 25% capacity):

$$WTP|mask = 0, capacity = 25\% = \frac{\beta_0 + \beta_2 \bar{r}}{\beta_1} \quad (7)$$

The change in willingness to pay with an attendance policy change is

$$\Delta WTP = \frac{\beta_2 \Delta r}{\beta_1} \quad (8)$$

The standard errors are estimated using the Delta method (assuming symmetric confidence intervals).

Regression Results

Table 5 contains results for a 3-latent class binary logit attendance demand model.[8] The price attribute enters the model as a level. The mask variable is binary with mask = 1 if there is a mask policy in place and mask = 0 if there is no mask policy present. The three facility capacity level variables enter the model as two dummy variables, capacity = 10% and capacity = 50%, with capacity = 25% the omitted category. In the initial models, each of the attribute variables are interacted with a binary variable equal to 1 for the professional sports league that the consumer is in the hypothetical market for. The main effects for the attribute coefficients are for MLB. The interaction effects test for differences between the MLB and the other leagues. We find no statistically significant differences across leagues for the mask and capacity attributes once we estimate the 3-class model and exclude those variables from the model. There is a 47% probability that a consumer will belong to class 1, a 27% probability that a consumer will belong to class 2 and a 26% probability that a consumer will belong to class 3. In the results that follow,

[8] All models were estimated using NLOGIT (www.limdep.com). The 3-class model statistically outperformed the 2-class model according to the AIC statistic.

statistical significance is at the p=0.05 level unless otherwise noted.

As expected, higher ticket prices significantly reduce the probability a respondent would purchase a ticket. Across different classes, consumers in class 1 and 3 exhibit significantly more price sensitivity than class 2 consumers. We interpret this as reflecting the idea that class 1 and 3 consumers are more casual fans who view attending a game as an entertainment activity with many other local substitutes, while class 2 consumers are strong fans who exhibit more attachment to the team and the game day experience and see other local entertainment options as weak substitutes.[9]

There are also some notable differences across consumer class in terms of their preferences for mitigation measures. For example, relative to a baseline capacity of 25%, class 2 and 3 consumers are significantly more likely to attend if capacity is limited to 10% (all else constant).[10] Consumers in class 1 are indifferent to the more stringent capacity restriction relative to the baseline of 25% capacity. Similarly, relative to a no masking requirement, consumers in classes 1 and 3 are significantly more likely to attend when face coverings are required, while consumers in class 2 are significantly less likely to attend under this scenario. Class 2 consumers strongly dislike mask requirements. In situations with lax enforcement of mask mandates, they

[9] Restricting the main effect price coefficients in classes 1 and 2 to be equal results in an inferior model based on a likelihood ratio test (χ^2=19.94 [1 df]). An additional restriction for class 3 is marginally significant (χ^2=3.56 [1 df], $p < 0.10$).

[10] For example, based on the 10% capacity coefficient for class 2 consumers, the average class 2 consumer is 9.3 times more likely to attend a game if the capacity limit is lowered from 25% (the baseline case) to 10%, all else equal (9.3 = exp(2.2285)). The t-statistic on the 10% capacity indicator for class 1 casual fans (-0.27) indicates that they are indifferent to this mitigation measure relative to the baseline restriction of a 25% attendance limit.

would be likely to not comply.

These findings should extend to mitigation strategies in other congregate settings such as health care facilities, restaurants, government and office buildings, public transportation, and others. The heterogeneity in responses to mitigation measures like masking and capacity across the three latent classes reveals how challenging it may be for private establishments or elected officials to institute policies with broad appeal to reduce the risks associated with transmission of an airborne virus. Class 1 consumers, who make up about 47% of the sample, prefer masking to social distancing, class 2 consumers (27% of our sample) prefer social distancing to masking and strongly dislike masking, and class 3 consumers (26% of our sample) place positive value on both mitigation measures.

Willingness to pay estimates

We estimate WTP and changes in WTP for various attendance policies as described above (Table 6). The top panel on Table 6 contains the baseline (or Gross) WTP estimates, which reflect consumer preferences under the baseline health policies aimed at reducing virus spread when attending games caused by the pandemic (no mask, 25% capacity).[11] The baseline WTP estimates for class 3 consumers were not significantly different from zero but we include them to provide a basis for evaluating changes in other mitigation strategies.[12]

[11] Major League Baseball (MLB) is the omitted league in Table 5. For class 1 consumers, the baseline willingness to pay for MLB is 14.20 = -(0.9246/-0.0651). For class 1 consumers of Major League Soccer (MLS), their baseline WTP is 21.42 = -(0.9246/(-0.0654 + 0.0220)).

[12] The baseline willingness to pay for class 3 consumers in Major League Soccer (top panel of Table 6) is estimated at -4.85. The negative value indicates that MLS consumers in this latent

These baseline estimates can be compared to WTP to attend games in the pre-pandemic era, as reflected by the average ticket prices for each sport in the 2018 and 2019 seasons, shown in Table 3. Economists typically treat professional sports teams as monopolists in the provision of games played at the highest level in each sport in each metropolitan area. The price charged should reflect a monopolists' profit maximizing price based on the local demand curve, reflecting WTP.

The baseline WTP estimates for class 1 and 3 consumers (top panel of Table 6) are lower than the pre-pandemic mean ticket prices (Table 3) for each league. These consumers would not attend a game under the baseline scenario because their willingness to pay is less than the average pre-pandemic ticket price. Both classes of consumers are also somewhat price sensitive (based on the results in Table 5), so they are likely casual fans and the baseline mitigation measures are not stringent enough for them to purchase a ticket.

Interestingly, class 2 consumers exhibit strong opposing behavior in terms of their WTP when compared to class 1 consumers. Recall that class 2 consumers are much less sensitive to ticket prices and thus may be more attached to their team or the game day experience (strong fans). Across all leagues, class 2 consumers have WTP equal to at least *twice* the mean pre-pandemic ticket price to attend a game under the baseline scenario. The WTP is highest for consumers of National Basketball Association (NBA) games at $489.09, which is almost 5 times higher than the mean pre-pandemic price.

class did not fit the data well. We therefore omit discussion of the class 3 MLS consumers in this section.

Masking

The second panel in Table 6 shows the change in WTP (relative to the baseline) when a masking requirement is in place. The change in WTP for implementing a mask policy is an estimate of the value of a risk reduction, $r' < \bar{r}$. The change in WTP estimates are positive and statistically different from zero among class 1 and 3 consumers, except for MLS fans in class 3. These consumers place a high positive value on mask policies. For instance, class 1 consumers (across all leagues) are willing to pay double to attend a game with masking and a 25% capacity compared to just a 25% capacity limit.[13] With the exception of Major League Baseball, the WTP for all class 1 consumers exceeds the mean pre-pandemic ticket price with masking and a 25% restriction. Since class 1 consumers might be described as price-sensitive, causal fans, these results imply that a combination of masking and capacity restrictions are sufficient to attract these individuals to return to pre-pandemic activities in congregate settings. In contrast, sports fans in class 2 can be described as anti-maskers. Willingness to pay falls by 32% (across all leagues) in class 2 consumers with a required mask policy relative to the baseline case of 25% capacity and no masking. For these consumers, they place a strong negative value on masking requirements that holds regardless of whether the event is held in an indoor or outdoor arena.

Social Distancing

We next explore WTP for stronger social distancing policies that take the form of lower facility capacity limits. The change in fans' WTP for a reduction in capacity to 10% from 25% is

[13] As noted in Footnote 11, the baseline willingness to pay for MLB is 14.20 for class 1 consumers. If the change in their WTP is 16.56 with a mask requirement, their total WTP under a mask requirement and 25% capacity is 30.76 (14.20 + 16.56). Thus, these consumers are willing to pay 116% more to attend a game when a masking policy is in place, all else equal.

an estimate of the value of a risk reduction, $r' < \bar{r}$. Only fans in class 3 have strong preferences for capacity limits, and these WTP differences are economically significant. Based on the baseline willingness to pay, class 3 consumers (across all leagues) are willing to pay roughly 450% more to attend a game if the capacity is lowered to 10% (relative to the baseline capacity of 25%).[14] These consumers were unwilling to attend with 25% capacity and no masking, so their willingness to pay more than pre-pandemic prices with 10% capacity may reflect their interest in sharing the experience of watching a live game with other fans relative to the desire to maintain some social distancing to reduce the risk of virus transmission.

Finally, we develop estimates of the willingness to accept (WTA) health policies at public events, in the form of weaker social distancing policies that increase facility capacity to 50%, roughly a fan in every other seat. The WTA for an increase in stadium capacity to 50% from 25% is an estimate of the value of a risk increase, $r' > \bar{r}$. Estimates of the change in the WTA, relative to the baseline scenarios, are presented in the bottom panel of Table 6.

Class 3 casual fans are the only group of consumers who place positive value on additional capacity constraints below the baseline scenario of 25%. As expected, this class of fans requires compensation to accept a less stringent virus transmission mitigation policy. Based on the baseline willingness to pay estimates for class 3 consumers (top panel of Table 6), these fans would require compensation equal to roughly 300% of their baseline WTP to raise the

[14] The baseline willingness to pay for class 3 consumers in the National Hockey League (top panel in Table 6) is $19.22. If reducing the capacity to 10% changes the WTP of class 3 NHL consumers by $87.46, their total WTP increases to $106.68. This represents an increase of 455%, all else equal.

capacity restrictions to 50% from the baseline scenario.[15]

Conclusions

We exploit uncertainty about future attendance policies at professional sporting events in late summer 2020 to conduct a stated preference discrete choice experiment about airborne virus mitigation policies. The survey was conducted during the period between the first and second U.S. COVID waves. During this period state COVID-19 policies were in flux and professional sports leagues uniformly kept fans out of games with very few exceptions. Major League Baseball was playing games without fans, the NBA was playing games without fans in a bubble, and the NFL was playing preseason games without fans while trying to determine whether and how to open the regular season to fans. If the NFL did allow fans, it was unclear how many they would allow to attend. Our scenarios reflect the uncertainty about whether teams would allow fans, require masks, and limit facility capacity. This uncertainty also existed in the NBA and NHL, which planned to begin their seasons early in 2021 but had not announced attendance policies. While the temporal context of the survey should not go unnoticed, given uncertainty about variants and herd immunity with vaccines, these scenarios remain relevant for all professional sports leagues going forward.

We estimate latent class models to account for heterogeneous preferences across different probabilistic groups of consumers. Substantial heterogeneity in WTP exists across fans and

[15] For example, the average class 3 fan has a baseline willingness to pay $27.65 to attend a NFL game under a 25% capacity restriction and no masking. If attendance is increased to 50% capacity (all else equal), their average WTP decreases by $82.29 to -$55.24. Thus, a typical class 3 (casual) fan would require compensation equal to 300% of their baseline WTP in order to attend a game or match in this scenario.

sports, likely reflecting differences in factors like game timing and frequency, and other game attendance characteristics.

Sports fans clearly have a positive willingness to pay for environmental health reductions, in the form of mask requirements and social distancing policies that reduce facility capacity, in the COVID-19 pandemic era. We can characterize the types of professional sports fan that existed at the time period of the survey as casual fans who prefer a mask requirement (class 1), strong fans (i.e., high WTP) who are anti-maskers and strong fans only when there is a mask requirement and low capacity. There is a 46% probability that a respondent will be in class 1. This class is characterized by price sensitive, casual fans (i.e., low WTP) that prefer safety in the form of a mask requirement but are indifferent towards capacity restrictions. There is a 27% probability that a respondent will be in class 2. In class 2 are the strong fans are anti-maskers who are also indifferent to capacity. There is a 26% probability that a fan will be in class 3. These fans are not willing to pay anything unless there is a mask requirement and then are willing to pay more if there is a capacity restriction to 10%.

Our results show that some fans who plan to attend professional sporting events in the pandemic era are willing to pay substantially higher ticket prices to attend games with policies that reduce the risk of virus spread relative to WTP for tickets before the pandemic. Fans appear to place the highest value on health policies that balance social distancing with preferences to have some others present in the venue. A social distancing policy equivalent to 25% of capacity seems to strike that balance, although this would need to be combined with a mask policy.

In general, the WTP estimates for health policies aimed at reducing virus spread in congregate settings resemble existing estimates in the literature. Estimated WTA for a relaxation

of a social distancing policy appears smaller than WTP for a stricter health policy, suggesting that behavioral issues like uncertainty avoidance present in other settings also affect consumer preferences in this setting.

This study has several limitations. First, our results are based on stated preference data. Since we conducted our survey, several professional leagues have opened to fans and cities have imposed various mask and capacity restrictions. A revealed preference study based on actual attendance data should be pursued. Second, our survey was conducted at a point of time during the COVID-19 pandemic before vaccines were developed and before the Delta and Omicron waves. It would not be surprising if attendance demand was different at different points in time in response to masking and capacity requirements. Finally, our results are based on a simple latent class binary logit model. The latent class model allows preference heterogeneity for a fixed set of consumer groups. The random parameter model assumes a continuous distribution of heterogeneity across the sample. Preliminary random parameter model estimates suggest the presence of considerable heterogeneity in responses to each of the attributes. Also, we have explored "full preservation" models in the context of attribute non-attendance in this paper (Lew and Whitehead 2020). In other words, we assume that respondents do not engage in attribute non-attendance behavior. Attribute non-attendance exists if respondents ignore some attributes when making their choices which can significantly affect willingness to pay estimates. We have some evidence that respondents engage in attribute non-attendance with the attribute non-attendance statements. These statements could be used to estimate stated attribute non-attendance models and compare these to inferred attribute non-attendance latent class models.

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Table 1. Summary statistics, five-U.S. city survey of pro sports attendees data (n=1,381)

		Mean	SD
Income	Household income ($1000s)	98.90	56.56
Age	Age of respondent, in years	45.72	15.58
Gender	Male = 1, 0 otherwise	49%	
Race	White = 1, 0 otherwise	60%	
Marital status	Married = 1, 0 otherwise	28%	
House	Household size	2.90	1.31
School	Years of schooling	15.56	2.53
Employment status	Employed = 1, 0 otherwise	65%	
Games	Games attended in a typical season	4.58	5.60
Miles	Distance from stadium/arena	26.72	24.71
Minutes	Time to get to the stadium/arena	61.58	44.98
Party	Party size that attends games	3.63	1.54
Price	Typical ticket price	67.43	51.96
Season	Season ticket holder	21%	
Very good seats	"Very good" seats	36%	
Good seats	"Good" seats	42%	
MLB	Major League Baseball fan	47%	
MLS	Major League Soccer fan	7.1%	
NBA	National Basketball Association fan	18%	
NFL	National Football League fan	19%	
NHL	National Hockey League fan	7.6%	
Chicago	Chicago resident	23%	
Dallas	Dallas resident	20%	
Los Angeles	Los Angeles resident	23%	
Miami	Miami resident	15%	
New York	New York city resident	19%	

The professional sports leagues are Major League Baseball (MLB), Major League Soccer (MLS), National Basketball Association (NBA), National Football League (NFL) and the National Hockey League (NHL).

Table 2. Discrete choice experiment attribute variables

Attribute	Survey Questionnaire Descriptive Text	Levels Presented to Survey Respondents
Mask Requirement	The stadium may require that you wear a cloth mask over your nose and mouth. If the game is played in an outdoor stadium you must wear the mask when you are not able to social distance (in other words, stay 6 feet apart from people who are not in your seating area).	Required Not required
Stadium/arena capacity	Due to social distancing policy, the number of tickets sold will be either 10%, 25% or 50% of stadium capacity. This will allow for social distancing because the available seats will be spread out.	10% 25% 50%
Ticket price	You have been offered a ticket, or block of tickets for the number of people you typically attend a game with, from a reseller or acquaintance. The price of each ticket will range from $[minimum] to $[maximum].	Mean - $(1 \times \sigma)$ Mean Mean $+ (1 \times \sigma)$ Mean $+ (2 \times \sigma)$ Mean $+ (3 \times \sigma)$

Table 3. Ticket prices used in the discrete choice experiment

	MLB	MLS	NBA	NFL	NHL
Mean $-(1 \times \sigma)$	20	20	60	90	45
Mean	35	35	105	115	75
Mean $+(1 \times \sigma)$	50	50	150	140	100
Mean $+(2 \times \sigma)$	60	60	195	165	130
Mean $+(3 \times \sigma)$	75	75	235	195	160

Notes: Average ticket price across all teams playing in cities in the survey sample in 2018 and 2019. Standard Deviation (σ) for all teams. The professional sports leagues are Major League Baseball (MLB), Major League Soccer (MLS), National Basketball Association (NBA), National Football League (NFL) and the National Hockey League (NHL).

Table 4. Respondents who would attend a professional sports game by attribute level

	Percentage that would attend the game (number of choice occasions)					
Ticket Price	Combined	MLB	MLS	NBA	NFL	NHL
Mean - $(1 \times \sigma)$	61.3 (1163)	61.8 (555)	76.0 (79)	59.5 (215)	56.8 (227)	62.1 (87)
Mean	60.0 (1145)	62.5 (536)	73.0 (89)	50.9 (210)	61.4 (223)	50.6 (87)
Mean + $(1 \times \sigma)$	42.2 (1148)	42.9 (546)	66.7 (81)	35.7 (210)	39.0 (223)	38.6 (88)
Mean + $(2 \times \sigma)$	38.8 (918)	42.6 (435)	52.9 (68)	32.9 (170)	33.7 (175)	28.6 (70)
Mean + $(3 \times \sigma)$	30.2 (1150)	32.9 (548)	50.6 (79)	26.1 (207)	25.5 (224)	18.5 (92)
χ^2 (4 df)	339.73***	147.35***	18.10***	64.81***	83.81***	43.39***
	Percentage that would attend the game (number of choice occasions)					
Mask Requirement	Combined	MLB	MLS	NBA	NFL	NHL
Required	56.7 (2762)	59.3 (1310)	72.7 (198)	50.6 (506)	54.1 (536)	47.2 (212)
Not required	36.9 (2762)	37.9 (1310)	56.1 (198)	32.4 (506)	34.4 (536)	32.6 (212)
χ^2 (1 df)	217.53***	119.79***	11.99***	34.45***	46.71***	9.46***
	Percentage that would attend the game (number of choice occasions)					
Stadium/Arena Capacity	Combined	MLB	MLS	NBA	NFL	NHL
10%	54.4 (1847)	57.7 (876)	68.4 (132)	46.5 (338)	51.1 (360)	48.9 (141)
25%	46.0 (1830)	47.9 (862)	61.4 (139)	40.1 (337)	44.2 (353)	36.7 (139)
50%	40.2 (1847)	40.4 (882)	64.6 (125)	37.4 (337)	36.8 (359)	34.0 (144)
χ^2 (2 df)	75.47***	52.83***	1.47	5.86*	15.03***	7.47*

Notes: ***, **, * indicates statistical significance at p = 0.01, 0.05, 0.10 The professional sports leagues are Major League Baseball (MLB), Major League Soccer (MLS), National Basketball Association (NBA), National Football League (NFL) and the National Hockey League (NHL).

Table 5. Latent class binary logit model with panel survey data (dependent variable = 1 if respondent will attend the game)

	Class 1 (Casual fan 1)			Class 2 (Strong fans)			Class 3 (Casual fan 2)		
	Coeff.	SE	t-stat	Coeff.	SE	t-stat	Coeff.	SE	t-stat
Constant	0.9246	0.2520	3.67	3.0769	0.4935	6.23	0.4900	0.5473	0.90
Ticket Price	-0.0651	0.0067	-9.79	-0.0189	0.0065	-2.93	-0.0448	0.0089	-5.03
× MLS	0.0220	0.0058	3.81	-0.0100	0.0092	-1.09	0.1457	0.0432	3.37
× NBA	0.0365	0.0051	7.09	0.0126	0.0048	2.60	0.0254	0.0065	3.90
× NFL	0.0428	0.0053	8.04	0.0094	0.0046	2.06	0.0271	0.0062	4.35
× NHL	0.0264	0.0060	4.38	-0.0001	0.0046	-0.02	0.0193	0.0064	3.02
Mask Requirement	1.0780	0.1802	5.98	-1.0063	0.3184	-3.16	4.0191	0.5759	6.98
10% Capacity	-0.0508	0.1860	-0.27	0.5195	0.2447	2.12	2.2285	0.4379	5.09
50% Capacity	-0.2355	0.1755	-1.34	0.2193	0.2206	0.99	-1.4686	0.3871	-3.79
Class probability	46.7%			27.4%			25.9%		
Ending Log-L					-3094.96				
Beginning Log-L					-3499.81				
χ^2					809.72				
McFadden's R^2					0.116				
AIC					6247.9				
Sample size					5524				
Individuals					1381				
Periods					4				

Notes: The professional sports leagues are Major League Baseball (MLB), Major League Soccer (MLS), National Basketball Association (NBA), National Football League (NFL) and the National Hockey League (NHL). Each of the 1,318 individuals in the sample was presented with four alternative price/restriction combinations. Table reports Logit model coefficients. Class probability identifies the fraction of the sample in each of the 3 latent classes.

Table 6. Willingness to pay estimates

Gross WTP | no mask requirement, 25% capacity

	Class 1			Class 2			Class 3		
	WTP	SE	t-stat	WTP	SE	t-stat	WTP	SE	t-stat
MLB	14.20	3.13	4.53	162.95	42.06	3.87	10.94	10.88	1.00
MLS	21.42	4.95	4.33	106.38	32.87	3.24	-4.85	6.55	-0.74
NBA	32.27	7.43	4.34	489.08	148.57	3.29	25.23	25.88	0.97
NFL	41.40	9.58	4.32	324.19	81.15	3.99	27.65	27.93	0.99
NHL	23.87	5.98	3.99	162.29	24.28	6.68	19.22	19.73	0.97

Change in WTP with a mask requirement

	Class 1			Class 2			Class 3		
	ΔWTP	SE	t-stat	ΔWTP	SE	t-stat	ΔWTP	SE	t-stat
MLB	16.56	3.05	5.43	-53.29	24.03	-2.22	89.74	16.76	5.36
MLS	24.98	5.28	4.73	-34.79	14.67	-2.37			
NBA	37.62	7.16	5.25	-159.96	76.55	-2.09	206.98	35.29	5.86
NFL	48.27	8.73	5.53	-106.03	47.20	-2.25	226.85	44.54	5.09
NHL	27.82	5.69	4.89	-53.08	17.94	-2.96	157.72	31.57	5.00

Table 6. Continued

Change in WTP with 10% Capacity relative to 25%

	Class 1			Class 2			Class 3		
	ΔWTP	SE	t-stat	ΔWTP	SE	t-stat	ΔWTP	SE	t-stat
MLB							49.76	10.79	4.61
MLS									
NBA							114.77	25.25	4.55
NFL							125.78	28.21	4.46
NHL							87.46	21.53	4.06

Change in WTP with 50% Capacity relative to 25%

	Class 1			Class 2			Class 3		
	ΔWTP	SE	t-stat	ΔWTP	SE	t-stat	ΔWTP	SE	t-stat
MLB							-32.79	8.20	-4.00
MLS									
NBA							-75.63	18.67	-4.05
NFL							-82.89	22.11	-3.75
NHL							-57.63	15.21	-3.79

Notes: Table reports only the change in WTP estimates that are statistically significant at the 95% confidence level in a two-tailed test. All the changes in the WTP estimates for class 3 consumers in Major League Soccer (MLS) are not reported because the baseline WTP estimate is -4.85, indicating a poor model fit for this type of consumers in Class 3.

Appendix 1: Elicitation Scenario

Consider the following situation.

Suppose you have a chance to buy a ticket (or block of tickets) to a [league] game in [city] at the beginning of the season.

You are required to wear a mask.

The number of tickets sold is 50% of arena capacity.

The price of the ticket is $100.

Would you buy the ticket in this situation?

- ○ Yes
- ○ No
- ○ Don't know