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Data Science & Statistics

The Pitch Clock and Bullpen Fatigue: A Difference-in-Differences Approach to Consecutive-Day Appearances

Daniel Hwang

Abstract

Major League Baseball's 2023 pitch clock shortened recovery time between pitches, raising concern about a potential increase in injury risk. Prior studies have examined season-level injury data, leaving appearance-level fatigue unexamined. This study asks whether the pitch clock implementation has changed the consecutive-day pitching penalty among relief pitchers with the highest workloads. Using Statcast data from 289 relievers across 18,824 appearances, we built a difference-in-differences model with pitcher and season fixed effects. The study used four proxies: release velocity, horizontal movement, vertical movement, and expected batting average against. Standardized estimates are 0.004 - 0.019, with 95% confidence intervals lying within +0.08 SD (about +/- 0.1 mph for velocity). These results indicate that the pitch clock's effect on consecutive-day fatigue is well below conventional thresholds for a small effect (0.2 SD). Hence, the pitch clock did not meaningfully increase the cost of back-to-back relief usage.

Keywords: pitch clock; relief pitchers; difference-in-differences; Statcast; fatigue

1. Introduction

In 2023, Major League Baseball introduced a pitch clock requiring pitchers to pitch within 15 or 20 seconds, depending on the number of runners (Puga et al., 2024). By shortening the time between pitches, the rule reduced pitchers' recovery time. This change raised concerns that it would increase pitchers' injury and fatigue risk (Puga et al., 2024). These concerns are especially relevant for relief pitchers, who often make a relatively high number of consecutive appearances.

Early evidence has largely not supported an increased injury risk. Season-level studies have found no increase in UCL surgery or overall injury rates. (Puga et al., 2024; Lavi et al., 2026; Mastroianni et al., 2025). However, flexor and forearm injuries increased in 2024 (Puga et al., 2025). These studies report season-level injury results, which may be too coarse to detect any appearance-level decline in performance.

Fatigue in relievers appears concentrated the day after appearance (Burris & Coleman, 2018). If the pitch timer compresses recovery within an outing, it may cost in consecutive appearances. This paper asks: Did the pitch clock change the relative performance penalty for consecutive appearances by the same pitcher?

To answer this question, I use a difference-in-differences, two-way fixed-effects approach. Using Statcast pitch-level data on four-seam fastballs from 2021 to 2024, I constructed an unbalanced panel dataset. I measure fatigue with four proxies: velocity, vertical movement, horizontal movement, and batting average against. The key parameter is β_3, which captures how the consecutive pitching penalty differed before and after pitch clock implementation, not whether fatigue exists. An event study assesses the plausibility of the parallel-trends assumption.

Across all four proxies, I find no evidence that the pitch clock has changed the consecutive-pitch penalty. Standardized estimates ranged from 0.0036 to 0.0187 SD, and the upper bound of the 95% confidence interval did not exceed 0.086 SD. These bounds indicate that, rather than a consecutive penalty, the effect is smaller than these values, making the null informative. The results are robust to intensity coding and to excluding injured-list samples.

This paper contributes appearance-level, within-pitcher evidence complementing prior season-level injury studies. It also illustrates how to apply DID to time-varying conditions within players (cf. Kennedy-Shaffer, 2026).

2. Literature Review

2.1 Fatigue Markers in Pitching

Fatigue is reflected in multiple perspectives. Birfer et al. (2019) define fatigue as an exercise-induced loss in the muscle's capacity to generate force. Their PRISMA-guided systematic review of 25 studies identified three associated outcomes: changes in kinematics, declines in performance, and elevated injury risk. The main fatigue framework is as follows: pitcher movement changes, performance eventually declines, and injury risk may increase. Because fatigue can occur through multiple routes, fatigue can't be measured with a single metric; it requires multiple proxies. The four proxies are release velocity, horizontal movement of the ball, vertical movement of the ball, and xBAA, where the first three are physical metrics of the ball and the last is a performance result and measure of contact quality. Only the four-seam fastball was measured.

Recently, as technology has evolved, research has shifted from rate stats (ERA, WHIP), which include more noise, to Statcast's pitch-level data (LaPrade et al., 2022). Hashimoto et al. (2023) analyzed 1820 pitchers from 2015 through 2021, excluding 2020. They divided pitches into three groups, as they differ in velocity, movement, and rotation. Because each pitcher's pitches differ significantly in release velocity and movement, treating each pitch type as a single category is reasonable. They mirrored left-handed pitchers' release-point coordinates, following the handedness normalization of pfx_x in Section 3.3. However, all of these metrics are influenced not only by fatigue but also by other factors.

Game conditions affect release metrics. Hashimoto and Nakata (2022) analyzed pitchers from 2015 to 2019 and found that as ball count increased, release speed and spin dropped, and vice versa as strike count increased. This effect was greatest in the four-seam fastball, where strike count's partial η^2 was 0.72. They interpreted this effect as a speed-accuracy tradeoff rather than fatigue; hence, their paper does not fully explain or support fatigue. Because game conditions vary by appearance, comparing pitchers within the same game could introduce substantial noise; therefore, pitcher fixed effects are needed.

2.2 Research on the Pitch Clock

When the pitch clock was first introduced, concerns arose that it would increase pitcher injuries by reducing recovery time. Puga et al. (2024), using FanGraphs' injury database, compared the 2023 season with 2021 and 2022 and found that total injuries decreased, with no significant change in elbow injuries such as Tommy John, Flexor tendon, and others. Moreover, over two post-pitch-clock seasons, Lavi et al. (2026) observed that the injury rate decreased from 50.4% to 39.3%, while the average days until first injury increased from 142.8 days to 160.9 days among high-workload pitchers. However, Puga et al. (2025) reported 62 cases of flexor tendon

and forearm injuries in 2024, up from 37, 33, and 36 cases in seasons 2021 through 2023, respectively. However, these studies cover a wide range of leagues and seasons.

Studies focusing on UCL surgery, the most consequential pitching injury, have found no significant effect of pitch clock implementation. Mastroianni et al. (2025) combined season trend analysis with a matched case-control comparison of 2:1 UCL surgery cases. They used an unpaired t-test and logistic regression and found no change in surgery rate ($p = 0.64$) and no significant change in pitching metrics (velocity, spin, Stuff +, etc.) between 52 surgical cases and 104 matched controls. This research focused on pitcher-season. Moreover, Card et al. (2025) similarly found no significant difference in UCL injury rates (0.63 to 0.67), while the number of pitches before injury increased from 442 to 721. Through this, the author argues against the fatigue theory. All the studies listed were conducted as match case-control studies; fewer track causality.

Fewer studies have applied causal inference to MLB's recent rule change. Kennedy-Shaffer (2026) applied DID (difference-in-differences) to the 2023 shift band, finding a 9-point increase in DID result of BABIP and OBP under synthetic control when batters did not exist. Kennedy-Shaffer compared batter groups, whereas this study compares how the timely effect changes within the same pitcher.

Taken together, the injury rate did not change significantly except for flexors in 2024. Yet injury is rare, and the sample is seasonal. Hence, this outcome may be too coarse to detect an early decline in performance

2.3 Workload and Recovery

Relievers face a unique workload problem: multiple appearances within a short window, limiting recovery time. Burris and Coleman (2018) modeled each pitch as a toxin, borrowing from toxicology, using a Bayesian hierarchical dose-response model to estimate each pitcher's fatigue and recovery speed. They found that release velocity decreases in future games after pitching more than 15 pitches, and this decrease grows after the 20th pitch. By contrast, among starting pitchers who have regular rest, Bradbury and Forman (2012) found that cumulative workload affected ERA, but the rest day's effect was weak. They also found out that the effect decreases by half each day, suggesting that remaining fatigue maximizes the day after the appearance, as shown by this study's consecutive-day indicator.

Days of rest also served as a workload measure in injury research. Charlmers et al. (2023) found that fewer rest days increase injury risk using the MLB HITS dataset, which tracks injuries, for the 2011 to 2017 season. The analysis found that one day of rest was associated with a 2.08-fold higher risk than 4 days of rest. Notably, these samples consisted of a large number of fielders.

Dowling et al. (2020) noted that the number of pitches during the game cannot fully represent a pitcher's real workload because it excludes warm-ups, bullpen pitching, and pitches between innings. Likewise, the consecutive-day indicator is a simplified estimate of workload, a limitation discussed in Section 5.3.

2.4 Institutional Background: The 2023 Rule Changes

Beginning in 2023, MLB implemented a pitch timer that would restrict time between pitches league-wide. Pitchers were required to begin their deliveries within 15 seconds and 20 seconds, depending on runners (Puga et al., 2024). In 2024, the runner-on limits were shortened to 18 seconds. This study therefore treats 2023-2024 as a single period, even though the treatment magnitude changed in 2024. We discuss this limitation later in Section 3.4 and Section 5.3.

Moreover, we did not introduce the pitch timer in isolation; we introduced other rules at the same time. Rule 5.02(c) required a fielding shift restriction, allowing at least 4 fielders: two to the left of second base and the rest to the right (Office of the Commissioner of Baseball, 2023). Rule 2.03 enlarged the bases to 18-inch squares. Kennedy-Shaffer (2026) estimated that the shift restriction would increase BABIP and OBP by 9 points for left-handers, showing a left-hitter advantage under the new rule. Section 3.4 discusses why these simultaneous changes are unlikely to bias the consecutive-day estimates.

2.5 Research Gap and Contribution

Prior research shows that fatigue shows up in pitch-level metrics. Studies of the pitch clock focused on injury outcomes found no increase in injuries, except for 2024 flexor injuries. The closest study, Mastroianni et al. (2025), examined tracking metrics and bullpen subgroups, but at the season level for metrics and injury outcomes. Meanwhile, reliever fatigue appears concentrated the day after an appearance (Burris & Coleman, 2018), particularly when pitch recovery is compressed, which could compound the residual fatigue. To our knowledge, no peer-reviewed study has examined whether the pitch clock has altered the appearance-level penalty for consecutive appearances.

This study addresses this gap using Difference-in-Differences and two-way fixed effects to estimate β_3, the coefficient on the post- and consecutive-day appearances. We used Statcast's pitch-level data from 2021 through 2024 using four proxies. Rather than asking whether fatigue exists, the design asks whether the fatigue penalty differs in different eras. In this sense, this study extends rather than contradicts Mastroianni et al. (2025): it includes a different estimand, design, and sample level. The goal is to find the upper bound of the difference in penalty magnitude so that a null result could be informative.

3. Method

3.1 Data

This study uses pitch-level data from Statcast, Major League Baseball's tracking technology that enables the collection and analysis of large volumes of baseball data. We accessed the data through Pybaseball, an open-source Python interface to Baseball Savant (run by Major League Baseball). Our analysis covers the regular seasons from 2021 through 2024, excluding postseason and spring training games. Each row in the raw data represents a single pitch and measures release velocity, movement, spin rate, and outcome.

Python was chosen over R primarily for library integration: pybaseball, pandas, and pyfixest form a single, contiguous pipeline from data collection through estimation, avoiding conflicts from transferring and reformatting data.

Statcast does not distinguish between a starting pitcher and a reliever pitch, so we used roster and player data from Baseball-Reference, an online database for Major League Baseball. We used it to categorize pitchers as relievers or starters. We also collected Injured List records from the MLB stats API transaction endpoint (https://statsapi.mlb.com/), which provides official transaction records, including injured list placement. Any season where pitchers had at least one injured list placement was excluded. We retrieved all data on July 19, 2026, because Statcast values are retroactive. We report this date to support replication.

3.2 Sample Construction

We defined the study population at the pitcher season level. A pitcher enters the sample in a season when they made no starts (GS = 0) but appeared in at least 20 games. The first condition was filtered for relievers; this filter successfully excludes starters, as they take a few days' rest after starting a game. The second condition excluded pitchers with a small sample size, since fewer games played could mean nearly zero consecutive days. We retrieved roster and appearance data from Baseball-Reference.

We exclude any pitcher season in which the pitcher was placed on the injured list in that season. We obtained injured list records from the MLB Stats API transaction endpoint. We exclude a pitcher when a transaction record indicates placement on the injured list. The filter is applied at the pitcher-season level rather than the pitcher level because it could introduce survivorship bias by ignoring pitchers injured for just one year.

The resulting panel is unbalanced as a pitcher may appear in some seasons but not others. There is no need to enforce a strict panel, as it could introduce selection bias by retaining only pitchers who stayed all four seasons. The final sample contains 18,824 appearances from 289 pitchers across four seasons (2021-2024). Table 1 reports the sample. None of these filters depend on any outcomes; they are based on role, appearance count, and injury status rather than outcome or performance.

3.3 Variable

We use four appearance-level measurements as proxies for fatigue. The first is release velocity (release_speed), a standard measure of neuromuscular fatigue. The second and third are the horizontal and vertical movement of the pitches (pfx_x, pfx_z). These capture rotational effects applied to the pitch, revealing grip and release consistency of pitchers between pitches. We record horizontal movement from the catcher’s perspective (arm side is negative for right-handed pitchers and positive for left-handed pitchers). Because values from pitchers of different handedness can offset each other, we reversed the sign for right-handed pitchers to unify all pitchers in the sample. Vertical movement did not require this adjustment. The last is batting average against (xBAA), the expected batting average of a pitcher’s pitch based on its exit velocity and launch angle. While the first three proxy measures the pitcher’s physical output, the last measures the result of those outputs independent of the fielder's performance and the ballpark.

Statcast records data at the independent pitch level, so we aggregated it to the pitcher-appearance level. For each pitch-per-game-date pair, we took the mean of all four-seam fastball pitches in that appearance. We did not weight this average by count. We compute xBAA based on the at-bats completed in that appearance, and we did not assign an xBAA value to appearances with fewer than three at-bats. Thus, the outcome sample is smaller.

$Consec_{id}$ equals 1 if the pitcher appeared the preceding calendar day, and 0 otherwise. We measure this in calendar days, not team game days. For instance, in a doubleheader, in which there are two games within a single day, we combined it into a single appearance. We coded a pitcher’s first appearance of the season as 0, since no previous appearance exists.

$Post_{sd}$ equals 1 for the 2023 and 2024 seasons and 0 for the 2021 and 2022 seasons; pitcher clock was implemented in 2023. We restricted all outcomes to the four-seam fastball, as different pitches have systematically different velocity and movement, and mixing pitch types could change the average. Furthermore, the four-seam fastball is a universal pitch among relievers, which makes comparison easier.

We use these four measures separately rather than combining them into a single unified fatigue index because they are expressed in distinct units that are not naturally comparable (mph, inches, and a probability). Combining these into one index would require a weighting scheme across incomparable units. Instead, we standardized each outcome individually to compare magnitudes across outcomes without collapsing them into a single index.

3.4 Identification Strategy

Our identification strategy compares back-to-back appearances with other appearances, and then compares the difference before and after the pitch clock implementation. Taking the difference twice removes pitcher-level differences and differences caused by player improvement as the season progresses.

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The pitch clock restricts time between pitches (15 seconds when a baserunner does not exist and 20 seconds when they exist). If reduced in-game recovery causes fatigue, pitchers would finish each appearance more fatigued, leaving less time to recover before pitching the next day again. Relief pitchers were chosen because they are most exposed to this mechanism due to their high number of appearances in a season.

$Beta_3$ does not show how the pitch clock has affected the overall relief pitcher's performance. Season fixed effects offset any change that affected all relievers in a season. $Beta_3$ identifies only changes in consecutive-day pitches. We therefore state our estimand as the differential effect of consecutive-day appearances.

The key assumption is that, without pitcher clock, the gap between consecutive days and other appearances would have remained constant. We cannot measure this assumption directly, but we assess its plausibility through an event study reported in Section 4.2.

The 2023 season also introduced various rules, such as restrictions on defensive shifts, an increase in the base size, and a limited number of pickoffs. These would bias our estimate only if they have affected consecutive-day appearances differently from our appearances. Implementation of these rules does not affect xBAA, as it is calculated based on exit velocity and launch angle. In addition, the 2021 season was affected mid-year by MLB's enforcement against restricted substance use by pitchers, reducing spin rate and pitch movement league-wide. However, because this occurred within the pre-clock period, it does not coincide with our treatment. It would bias $Beta_3$ only if it changed the gap between consecutive-day and other appearances.

3.5 Estimation

We have estimated the following regression:

$Y_id = \beta_1 Consec_id + \beta_3(Post\square \times Consec_id) + \alpha_i + \gamma\square + \varepsilon_id$

In this regression, i represents the pitcher, while d represents the game date. Each observation equals one appearance. s(d) represents the season that contains the day d (for instance, a game appearance that happened on 2023-05-14 would be recorded as 2023). Y_{id} is the result of the proxies we have used (pitch release velocity [release_speed], horizontal movement [pfx_x], movement z [pfx_z], and batting average against [xBAA]. $Consec_{id}$ indicates whether pitchers threw the previous day: 1 if they did, and 0 if they did not. $Post_{sd}$ indicates whether the season had the pitch clock rule: 1 for 2023 and 2024, and 0 for 2021 and 2022. $Beta_1$ shows the

difference in Y between back-to-back appearances and other appearances before the pitch clock was introduced. $Beta_3$ indicates how that difference changed after the pitch clock was introduced. α_i was used as a tool for fixed effects, with each pitcher controlling variance attributed to the pitchers' unique characteristics. Similarly, γ□ was used to include fixed effects for the season, such as changes in the baseball. We run this regression separately for each of the four proxies. The main effect of $Post_s$ is not separately identified here because it is fully absorbed by the season fixed effects γ□. We therefore omit it from the estimating equation rather than include an uninterpretable coefficient.

3.6 Standardization

Motivation

The four outcomes are measured on different units (release velocities are measured in mph, horizontal and vertical movement of the pitchers are measured in inches, and xBAA is unitless as it is a probability value). Therefore, you cannot compare the raw coefficients directly. When a coefficient of 0.03 mph on release velocity and a coefficient of 0.0005 on Batting Average Against is given, it is not possible to determine which represents the larger effect. To compare the magnitude of beta3 across the four outcomes, we standardize the dependent variables.

Procedure

For each outcome, we divide the estimated coefficient and its standard error by the standard deviation of that outcome, so that beta3_sd is equal to beta3 / SD(Y) and se_sd = se / SD(Y). The standard deviation is computed using the sample (n-1) standard deviation of each outcome data. Because the xBAA estimation sample contains 16,370 appearances while the remaining outcome contains a different sample number of 18824, the standard deviation is computed from a different sample. Only the dependent variable is rescaled; because Consec and Post are indicator variables, standardizing them would not serve their role.

The standard deviation is computed in the whole sample pooled across all appearances without any grouping by pitcher. Because pitcher fixed effects are included, the difference between pitchers is absorbed; hence, beta3 is identified from within-pitcher variation in an appearance. The total variance is a summation of between-pitcher variance and within-pitcher variance; hence, unless between-pitcher variance is equal to zero, the pooled standard deviation is always greater than the within-pitcher standard deviation. When the divisor increases, the quotient decreases. Therefore, the standardized coefficient is small compared with the within-pitcher standard deviation. We note this explicitly because it works in the direction that favors our conclusion. The greatest standardized coefficient in the study is pfx_z, at 0.019 SD. Even if we assume within-pitcher SD is half the pooled SD and the coefficient doubles, it still does not exceed 0.04 SD. Hence, the effect remains negligible under either scaling.

Invariance

Standardizing is dividing dependent variables by a constant. Because both the coefficient and its standard error are divided by the same constant, the p-value and t-statistics are unchanged. Standardization changes the unit in which the coefficient is expressed, but it does not affect statistical inference. We report both raw and standardized coefficients in Table 1 in Section 4.1 so readers can compare the two values in the same row.

Interpretation

A standardized coefficient is expressed as a fraction of the outcome's typical appearance-to-appearance variation. A standardized coefficient of 0.01 indicates that the appearance-to-appearance effect is one hundredth of that outcome's standard deviation. The purpose of this paper is to determine Beta_3's upper bound rather than its significance. The original maximum value's magnitude cannot be determined; a bound of a few hundredths of a mile per hour cannot be determined. Therefore, we need a standardized standard error to calculate the maximum in units of SD, which leads to interpretable claims about magnitude. We report the precision bounds constructed from these standardized values in Section 4.4.

3.7 Robustness Check

We assess the robustness of our estimates in three different ways. First, we estimate an event study specification in which Consec interacts with each season indicator separately; we used the 2022 season as our reference year. If the parallel trend assumption holds, the coefficient on the pre-clock season should be indistinguishable from zero. This indicates that the gap between consecutive days and other appearances was stable before the pitch clock implementation.

Second, we re-estimate the model using consec_intestity_3 rather than consec_day, which counts appearances in the previous three days. The indicator variable only distinguishes whether the pitcher has appeared the previous day or not, so it does not include any fatigue accumulation. Beta_3 was not significant in this spec, as shown in Section 4.3.

Third, we re-estimate the model on a sample (878 pitcher-seasons) that did not include the IL (injury list) filter. Because the IL filter removes pitchers who are most likely to be fatigued, a null result could have been obtained. This re-estimation increased the sample from 18,824 to 33,252 appearances and from 289 to 462 pitchers. A larger sample yields a smaller standard error and greater power to detect an effect. However, even with the larger sample, beta3 remains insignificant, with release velocity shifting from positive to negative, suggesting the estimate fluctuates around zero rather than reflecting a stable effect. The p-value for pfx_z has moved from 0.266 to 0.092. As the standard error decreased, Beta3_sd changed little, from 0.019 to 0.023.

4. Results

4.1 Main results

Table 1. DID Estimates: Effect of Pitch Clock on Consecutive-Day Fatigue (β_3)

Outcome (unit)	N	β_3 (raw)	SE	p-value	SD (Y)	β_3_sd	SE_sd
Release Velocity (mph)	18824	0.0318	0.0342	0.354	2.654	0.012	0.0129
pfx_x (in)	18824	-0.006	0.006	0.315	0.679	-0.0089	0.0088
pfx_z (in)	18824	0.0052	0.0047	0.266	0.28	0.0187	0.0167
x_BAA	16370	0.0005	0.0058	0.932	0.139	0.0036	0.0418

Table 1 reports β_3 for each of the four outcomes. In all four outcomes, the p-value was greater than 0.05, meaning that it was not significant. The standardized coefficient was 0.0036 for xBAA, 0.0187 for pfx_z,

-0.0089 for pfx_x, and 0.0120 for release velocity, which are negligible in magnitude. Our original hypothesis stated: in a consecutive-day situation, as the degree of fatigue increases, both release velocity and vertical movement (pfx_z) should decrease – velocity as a direct marker of neuromuscular fatigue, and pfx_z through the mechanism by which fatigue reduces spin rate. However, β_3 for both release velocity and vertical movement was reported to be a positive number, which represents that the pitcher's release velocity has increased, opposite of our hypothesis. On the other hand, β_3 for pfx_x resulted in a negative value, meaning its horizontal movement has decreased, while β_3 xBAA is near zero. These standardized magnitudes are consistent with the conclusion stated in Section 3.6, which states that even under a conservative within-pitcher SD assumption, the largest effect would not exceed 0.04 SD.

4.2 Event Study Narration

Table 2. Event Study: Consec x Year Interaction Relative to 2022

Outcome	2022 (ref, level)	2021 (pre-trend test)	2023	2024
Release Velocity (mph)	-0.165 (p<0.001)	+0.065 (p=0.212)	+0.081 (p=0.071)	+0.053 (p=0.244)
pfx_x (in)	0.0003 (p=0.966)	+0.0019 (p=0.809)	-0.0046 (p=0.599)	-0.0054 (p=0.493)
pfx_z (in)	-0.0068 (p=0.103)	+0.0076 (p=0.206)	+0.0114 (p=0.059)	+0.0073 (p=0.202)
x_BAA	+0.0039 (p=0.495)	-0.0030 (p=0.721)	+0.0003(p=0.976)	-0.0023 (p=0.785)

Table 2 reports that, in 2021, all 4 outcomes are not statistically significant relative to 2022 (reference year); hence, in the two years of the pre-pitch-clock period, the consecutive-day gap was constant. This supports our claim in Section 3.4. On the other hand, the coefficients for release velocity and pfx_z in 2023 reported p-values of p=0.071 and p=0.059, which are similar to the statistically significant level of p=0.05; we defer the interpretation of their practical magnitude to the precision analysis in Section 4.4

4.3 Robustness

Table 3a. Consec Intensity Coding (consec_intensity_3)

Outcome (unit)	β_3 (raw)	SE	p-value	β_3_sd	SE_sd
Release Velocity (mph)	0.0189	0.0187	0.312	0.0071	0.007
pfx_x (in)	-0.028	0.0033	0.397	-0.0041	0.0049
pfx_z (in)	0.0024	0.0026	0.352	0.0086	0.0093
x_BAA	0.0002	0.0032	0.949	0.0014	0.023

Table 3b. No-IL Filter Sample (N=33,252, 462 pitchers)

Outcome (unit)	β_3 (raw)	SE	p-value	β_3_sd	SE_sd
Release Velocity (mph)	-0.0104	0.0248	0.674	-0.0039	0.0093
pfx_x (in)	-0.0043	0.0043	0.317	-0.0064	0.0064
pfx_z (in)	0.0064	0.0038	0.092	0.0229	0.0136
x_BAA	-0.0011	0.0043	0.797	-0.0079	0.0309

The reported robustness estimates remain statistically nonsignificant at the 0.05 level, although their signs are not identical across specifications. For example, the sign of release velocity changes in the NO-IL filtered sample, supporting our claim in Section 3.7 that release velocity fluctuates around 0. Moreover, pfx_z's p-value moves from 0.266 in the main specification to 0.092 in the no-IL sample; it approaches but does not reach the conventional significance threshold. Ultimately, all three robustness checks support the null results.

4.4 Precision

Table 4. 95% CI Upper Bounds (Standardized)

Outcome (unit)	β_3_sd	SE_sd	Upper bound
Release Velocity (mph)	0.012	0.0129	0.0373
pfx_x (in)	-0.0089	0.0088	0.0084
pfx_z (in)	0.0187	0.0167	0.0515
x_BAA	0.0036	0.0418	0.0855

Table 4 shows the upper bound of the confidence interval of each outcome, calculated by β_3_sd + 1.96 * SE_sd. As stated in Section 3.6, the goal of this paper is to characterize the upper bound (magnitude) rather than testing its significance in isolation.

The upper bound of four outcomes ranges from 0.008SD to 0.086 SD, which, even in the worst case the magnitude of effect is relatively small, being less than one tenth of SD. This bound also resolves the marginal event study coefficient noted in Section 4.2. The 2023 release velocity and pfx_z coefficients, which have p-values near 0.05, carry upper bounds of only 0.064 SD and 0.083 SD, respectively, showing that even though the p-value is close to the significance level, their absolute magnitudes are small.

Taken together, these precision bounds support the paper's core conclusion: rather than simply failing to detect an effect, we find that the effect of the pitch clock on consecutive-day fatigue is precisely estimated to be small after the pitch clock implementation.

5. Discussion

5.1 Interpretation of Findings

The study's central estimand, β_3, captures the difference in change in the consecutive-day fatigue outcomes between pre- and post-pitch clock implementation. Across all four fatigue proxies, release velocity, pfx_x, pfx_z, and xBAA, the standardized coefficients ranged from 0.0036 to 0.0187 SD, and none reached statistical significance at conventional thresholds. These results provide no evidence that the pitch clock implementation worsened reliever fatigue on consecutive-day appearances.

The null result should be interpreted as no statistically significant evidence of a differential effect in the measured outcomes, rather than proof of no effect. This conclusion is credible because the null result is grounded in quantifiable precision: the 95% CI upper bounds on the standardized coefficients range from 0.008SD (pfx_x) to 0.086SD (xBAA), meaning that even if an effect exists, its upper bound is practically negligible.

Two event-study estimates approach but do not meet the conventional 0.05 significance threshold: release velocity (p=0.071) and pfx_z (p=0.059). This raises the question of whether these two coefficients signal an effect. However, as shown in Section 4.4, their standardized upper bounds were 0.064SD (release velocity) and 0.083SD (pfx_z), which remain within the range established for the other outcomes, indicating that although the p-values are marginal, they do not produce a meaningful effect size.

Several non mutually exclusive explanations may account for this null result. First, bullpen management practices before implementation could help them adjust to the new technology. Second, the pitch clock's time (~15 seconds) may not have been long enough to influence the pitcher's mid-game recovery. These interpretations are offered

as possible explanations rather than causal claims.

These findings appear to contrast with prior work using different designs and units of analysis, which we discuss further in the following section.

5.2 Relation to prior literature

The appearance-level null reported here is consistent with prior work on pitch clock injury studies. Season-level studies found no increase in the overall injury rate (Puga et al., 2024; Lavi et al., 2026). Card et al. (2025) also reported that pitchers tolerated more workload before injury. This study adds that, in performance metrics prior to injury, the CI upper bound for the different penalties was between 0.008 and 0.086 standard deviations.

However, one finding complicates this picture: Puga et al. (2025) reported that in season 2024, flexor tendon and forearm injuries increased. Because 2024 falls within this study's post-clock period, this result is consistent with the null. One possibility consistent with the framework of Birfer et al. (2019) is that adjusting motion could maintain performance but increase workload. If so, the performance proxy used here does not fully reflect tissue-level workload fatigue; this study cannot test that possibility.

These results also extend Mastroianni et al. (2025), who found differences in tracking between surgical analysis and match case at the pitcher-season level. This study shows that the same null holds within the same

pitcher, same appearance, under consecutive pitching conditions. Laboratory evidence explains one reason why: in a randomized crossover study of seven college pitchers, Yang et al. (2016) observed the decline after the 4th inning in the 8- 12-second condition. Typical relief outings are shorter, and MLB's limits are longer than those conditions and recovery speed in which fatigue can halve each day (Burris & Coleman, 2018), leaving a small chance that the clock increases day-after fatigue.

5.3 Limitations

The 2023 season introduced several rule changes simultaneously, including the pitch clock; these changes also included a defensive shift ban, larger base sizes, and disengagement limits, which raises the possibility that they also confounded the estimated effect. However, these confounding factors are unrelated to the consecutive-day treatment axis. Specifically, xBAA is structurally immune to the defensive shift ban; the shift ban targets left-handed pitchers, which does not correlate with consecutive-day treatment. Moreover, the remaining confounders have no plausible mechanism related to consecutive-day appearance.

The standardization relies on the pooled sample standard deviation of each outcome rather than within-pitcher standardized deviation because results are finalized, which is a limitation; however, because the standardized coefficients are negligibly small, pooling is not strong enough to change our null conclusion.

Furthermore, the xBAA is estimated on a smaller sample (N = 16,370 vs. N = 18,824) than other outcomes because of its minimum at-bat threshold. The smaller sample size does not affect the interpretation of the outcome; the upper bounds remain small compared with those of other outcomes.

This analysis is also limited in scope in two ways. First, it focuses exclusively on the four-seam fastball, so it may miss fatigue signals that exist. Second, the outcomes are limited to Statcast-tracked metrics, excluding metrics directly related to injury or workload. Future work extending to secondary pitch types and direct injury would help establish a more generalized null result.

5.4 Future Work

One direction for future work is within-outing velocity decay slope, which finds the change in velocity from the last 5 fastballs to the first 5 fastballs. We intentionally excluded this outcome from the current paper because it might induce outcome switching. To prevent this, we propose it as a direction for future work rather than another robustness check.

Beyond the decay slope, several additions could strengthen the finding. First, a secondary pitch type extension could clarify whether certain pitch types are more sensitive than others. Second, direct workload or injury data would allow direct assessment of fatigue's health consequences that a proxy cannot capture. Lastly, additional season data on post-pitch clock would help establish whether the null result holds over a longer time window.

6. Conclusion

The study's main goal was to identify both β_3 and its upper bound to determine if pitch clock implementation has changed the consecutive-day fatigue penalty in relief pitchers. We found that all four proxies, release velocity, horizontal movement, vertical movement, and batting average against, were statistically insignificant, and the upper bound was negligible due to its small magnitude. Conditional on the model assumptions, these

results provide no statistically significant evidence of a change in the consecutive-day performance penalty in the measured outcomes. They do not establish that the policy has no effect on fatigue or injury.

These results describe selected performance measures among MLB relief pitchers. They do not directly measure total workload or injury risk, and extending the findings to other leagues requires additional evidence. The study would be stronger if it included secondary pitch analysis. The study's null finding is not a failure to detect an effect but, under credible identification and precision, a signal of no detectable differential penalty for consecutive-day relief appearances.

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Law & Rights

Why Animals Need Legal Rights, Not More Welfare

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Abstract

This paper examines whether legal rights offer a stronger basis for animal protection than animal welfare laws. It develops and evaluates arguments from Kotzmann and Pendergrast concerning the limits of welfare protections and the potential significance of rights. The discussion focuses on animals reasonably capable of suffering, while leaving the precise boundaries of that category outside its scope. It first considers the distinction between necessary and unnecessary suffering, then examines how rights may strengthen advocacy by recognizing animals' interests as legally significant. It also discusses dignity, accountability, and participation as principles relevant to a rights-based approach. Objections concerning human interests, animals' capacity to participate, and their existing legal status as property are considered through argument and analogy. The paper defends stronger legal recognition of animals' interests and explains why welfare protections alone may remain insufficient. Its contribution is a normative analysis of the case for rights, rather than an empirical evaluation of the outcomes of a particular legal reform.

Keywords: animal rights; animal welfare; legal protection; dignity; moral reasoning

Introduction

Each year in the United States of America, an estimated 10 million animals are killed due to animal abuse and cruelty, and a staggering 110 million are killed by human experiments. These statistics have recently been noticed by advocates, and there has been an increased concern for animal well-being, which means that animal welfare laws should be further discussed–whether they are truly enough to protect animals, or whether legal rights are more suitable. Welfare laws are useful in urban areas, specifically in economically depressed regions, and communities with high rates of unemployment or poverty; however, Kotzmann and Pendergrast (2019) argue in Animal Rights: Time to Start Unpacking What Rights and for Whom

that welfare laws are not sufficient to protect animal rights, because it is hard to expand its efficiency worldwide. For this reason, legal rights have been argued to be a more reliable source of decreasing animal mistreatment, as they truly give animals individuality. In this paper, I will examine three arguments made by Kotzmann and Pendergrast and defend their points on why legal rights would be a more effective way to protect animals compared to the welfare protections. A note in advance, the animals I refer to as candidates for rights-holders are those that are reasonably capable of suffering. This note was emphasized because the question of what animals are considered sufferers is not a topic my paper is suited to answer, and it will be left to the decisions of other researchers.

I. Unnecessary vs. Necessary Suffering

The first argument that Kotzmann and Pendergrast give is that although animal welfare seems to be increasing through more vegan diets and animal advocacy, animal cruelty has also been rising, which suggests that animal

welfare laws are not enough to protect animals. This correlation may exist because animal welfare protection does not prevent all forms of suffering of animals. Using animal welfare, we try to remove the "unnecessary" suffering put on animals, because that's what welfare stands for. However, when we talk about removing only unnecessary suffering, that also assumes that suffering and pain for the animals is acceptable, as long as it is necessary. If, for example, animals were to continue to be used as food or for experiments because humans find it beneficial, that suffering may be seen as beneficial from a human standpoint. Additionally, welfare laws are built under the assumption that humans may continue to utilize animals for their own cause, as long as there is a beneficial reason. Not every human will agree that all suffering animals undergo is unnecessary, and for this reason, animal welfare laws aren't very effective because they stand to simply remove the unnecessary suffering of animals.

Legal rights on the other hand wouldn't face this issue, because they would provide animals the identity of individuals whose interests and rights need to be defended. Instead of animals' lives being representative of human interests (like welfare laws do), legal rights would consider the animals' interests. A piece of evidence from the U.S. Constitution, which proves the animals will be provided enhanced protection with legal rights, states that anyone who is a holder of rights is entitled to a fair hearing of the law, and equal protection under the law. With these entitlements, animals would be much more likely to be provided a voice in our society. Unlike welfare laws, which focus on managing what minimum treatment animals should be granted, legal rights would help society recognize this equality that they are promised under the Constitution. Legal rights would, in short, deem animals relevant enough in society to stop being mistreated, just as humans with rights are relevant enough to not be mistreated by other humans. Therefore, legal rights would be more sufficient in removing all human related suffering of animals because they provide animals with the necessary components to help society consider them individuals with the right to not be mistreated.

II. Easier Advocacy with Rights

The second argument that Kotzmann and Pendergrast gives is that with the addition of legal rights, animal advocacy becomes much easier to argue for. A main objective of the implementation of rights is to protect marginalized groups. Kotzmann and Pendergrast argue that "the attribution of rights to people belonging to marginalized and persecuted groups enables more effective advocacy on their behalf" (Kotzmann & Pendergrast, 2019, p. 185). To elaborate, arguing for the liberty of a group that is uncared for in society is difficult, as there will not be many other advocates to hear your claims. One can advocate for a group as much as he wants, but without that legal right to identify that group as rights-holders, it becomes much more difficult to successfully protect their interests. Under welfare laws, the interests of animals are overruled because human interests are prioritized. As previously mentioned, welfare laws are created with the purpose to remove the unnecessary suffering of animals, and the suffering is considered either necessary or unnecessary depending on whether it is beneficial to the human race. For this reason, welfare laws are not efficient enough to protect the interests of animals because their interests are overridden by human interests.

However, in granting the animals legal rights, their interest would be recognized, which would help people consider the animals' interests as well in any cases concerning animals. Consequently, their interests wouldn't be as easily overridden by human interests. This is because legal rights give the animals a stronger position when pitted against conflicting interests between humans. Humans would be unable to kill animals for their own benefit because it would be equivalent to killing an individual with rights, which is both morally and

legally wrong. An individual's life is valued when people value that individual's interests as well, so if we were to give animals rights (which would also make society value their interests), then we will value their life. Humans will instead start to recognize animals more as souls that deserve to live just as much as we humans do. Prior to the current racial status of African Americans, they were extremely detested in the United States, so killing one wouldn't be considered horrible, at least not in the same way as people would see it now. This lack of empathy for murder of an African American was due to the fact that African Americans didn't have legal rights, and were seen as no more than property. In the same way, because animals don't have legal rights at the moment, their mistreatment isn't an issue that the world is trying their hardest to address. In giving animals legal rights, we would accomplish something that welfare laws couldn't, which is shifting the priority of interests from humans over animals, to humans and animals as equals. Therefore, legal rights are necessary to protect animals because they force us to recognize the interests of animals and make it so such interests cannot easily be overridden by human interests.

Additionally, giving animals legal rights would allow for a stronger foundation when having to challenge opposing interests, and therefore lets advocates defend the animals using the rights. Kotzmann and Pendergrast also mention that "the attribution of legal rights also legitimizes the claims made by rights-holders and their advocates" (Kotzmann & Pendergrast, 2019, p. 185). Similar to the previous quote, this one explains how legal rights give greater authority to the interests of the ones who hold them because their claims are recognized under legal law. An example that Kotzmann and Pendergrast give for this situation is that although welfare laws tell people that animals shall not be killed, it assumes the idea that humans are the ones in control, and fails to give the animals that right to live that advocates strive to gain for them. Legal rights on the other hand, might say something along the lines of, "the animals have a right to live, and therefore will not be killed." This not only implies that the animals shall not be killed, but also provides a reason that they should not be killed: it acknowledges that they have the right to live. Therefore, legal rights provide a clear justification for protecting animals, rather than simply hinting at treating them well, making legal rights much more sufficient than welfare laws in protecting animals.

One may argue in objection that providing animals the right to not be killed, there may also be an mitigation of human technological advancements. This is due to the fact that we utilize animals mainly for food and experiments, which in the past few years has provided significant findings to advance in technological evolution. Additionally, ceasing to kill animals for this purpose may affect factors such as economy, diets, and overpopulation of certain animals due to the apex predator not being able to kill them. This evidence supports that we shouldn't give animals rights, because that would have detrimental effects to human progress. Animals shouldn't be treated the same as humans, because they simply serve as assets in the grand development of human technology, so in giving them rights, we would be unable to utilize them for that purpose because of what they would hold (rights to live).

However, even with all these consequences, it does not necessarily mean that technological advancements will be guaranteed to decline if we give animals rights. Scientific research isn't limited to the usage of animals, and is even developing alternatives, examples being, computer models, cell cultures, and tissue studies. These alternatives allow animals to not be harmed, while also allowing humans to experiment. Furthermore, this objection fails to recognize the fact that we humans interfere with each other's politics and growth all the time (wars, debates, genocide), yet we still manage to provide humans with rights. If the idea that anyone who interferes with other humans shouldn't be granted rights were true, then people would start to be stripped of

their rights, simply due to minor inconveniences, whether it be something small, or large. Yet we do not, simply because we automatically see each other as humans with rights. If we were to see animals in the same way, giving them rights wouldn't feel so absurd. Although the objection is a plausible consequence to the distribution of animal rights, it ultimately fails to consider humans also being a problem in mitigating advancement. To sum up, legal rights would be a more efficient implementation to protect animal rights, because they provide a stronger basis to advocate for the interests of animals.

III. The Three Principles of Rights

Thirdly, Kotzmann and Pendergrast argue that legal rights are based on principles that can provide stronger protection against mistreatment prevention than animal welfare laws can. Specifically, human rights are based on three principles: dignity, accountability, and participation, and if animals were to be given rights, they would be provided with these three principles. For one, dignity is the foundation of human rights which means that they should be the foundation of animal rights as well. Giving animals these rights in the first place already recognizes that they have inherent worth (interests, right to live), and would therefore boost their overall position in our world. Secondly, there is the factor of accountability, which means that governments are responsible to enforce the principles of legal rights and to reprimand those that violate them. Legal rights are known as something called negative rights, which requires the government to stop others from doing something if it interferes with someone's rights. Welfare on the other hand, is known as a positive right, which requires the government to provide something to the victim instead of stopping the persecutor. To further explain this idea, the factor of participation becomes relevant. Participation allows the holder of the right to participate, or become involved with the decisions concerning those rights, meaning that any interests the animals have would be obligated to become defendable.

However, someone may argue in objection that although participation may allow animals to defend their own interests, there is the problem that they cannot participate in what they cannot understand. The objection may address that to defend one's rights, it is essential that they possess a clear understanding of what their rights protect them from. The reason why someone is able to get a hearing from the court in the first place is because they possess that right to a fair hearing and trial. The purpose of that permission is so that the defendant has a chance to defend themselves, stating that they either did or did not do something against the law. Therefore, since animals can't speak or understand our language, they can't speak for themselves in court, meaning they don't deserve rights.

However, it isn't the defendant themselves that speak for their rights, instead a lawyer who speaks in place for them. The defendant has rights, so they should be able to speak for their own rights, but they require a lawyer to do so, which leads me to believe that this objection is built on the basis that animals don't deserve rights because they cannot speak at all, not because they cannot defend themselves. Additionally, while it is true that animals certainly cannot speak for themselves, it is also true that they can be provided another human to speak for them. For example, it is undeniable that a human infant is unable to speak for itself, but we do not deprive that infant of its rights because we still recognize its worth, even if it can't speak for itself. Instead, we allow the infant to have someone to speak in place for it. In the same aspect, an animal who cannot speak for its own rights can be provided with someone who can. All in all, because this inherent worth would provide a sense of identity to animals and that accountability and participation can help represent their interests, legal rights would be able to give animals rights equal to those of humans.

IV. The Critiques

In this section, I will discuss some additional critiques of animal rights advocacy and provide counterarguments for them. For one, many critics of animal rights argue that giving animals rights is absurd because humans are a significantly different species compared to other animals, due to our ability to make rational decisions, debate, and exercise autonomy (make your own choices). However, certain humans are also denied the ability to make decisions for themselves, some examples being the disabled, infants, and those with language barriers, yet this doesn't mean that we refuse to give them rights. Therefore, if animals can't be rights-holders for the reason that they don't have the same capacities as humans with vocality, then humans without these capabilities should also not be considered rights-holders. The idea that animals lack the capabilities we possess is a weak claim. Although animals may not own our traits, we, in the same way, lack their traits. Animals are not lacking compared to humans, simply unique. Knowing this, Kotzmann and Pendergrast also argue that "humans should be careful not to underestimate the competencies of animals," and that where they falter in ability, humans will assist them (Kotzmann & Pendergrast, 2019, p. 192). For example, while a dog cannot debate, their sense of smell is phenomenal. This skill has been used by humans in my scenarios, such as tracking injured individuals, security detection, and in wars. Many accomplishments in our history have been from the direct result of animals using their traits, traits that humans don't have.

A second argument that critics make is that under the government, animals are considered property, and property cannot possess rights. To counter this, groups that were once under slavery or oppression were also treated as property, something to be controlled or put to use against their will. However, these groups were eventually given these rights to be recognized from then on as their own individual person. In the same way, animals may be treated as property without rights at the moment, but it wouldn't be entirely impossible for them to gain their rights in the future. Therefore, we shouldn't accept the argument that animals don't deserve rights just because they are considered property today. To sum up, although providing rights for animals seems near impossible and absurd to some, they should consider that groups previously considered undeserving of rights are now rights-holders.

Conclusion

In conclusion, the fight for animal rights is one that requires much knowledge on moral and legal issues. Those who believe that animals are solely meant to be of use to humans, will be against advocates of animal rights, while those that view animals as their own individuals will respect the animals' personal interests. However, it goes without saying that legal rights are much more sufficient than welfare laws are because they actually recognize that the animals have rights to live, and that they have inherent worth. The first section explained how welfare laws only stand to prevent unnecessary suffering of animals. The second section describes that legal rights would provide a stronger basis for animal rights advocacy. The third section states the three principles that rights are based off of, and the final section countered possible arguments that one may provide for being against animal rights.

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Public Policy & Social Justice

The Philosophical Analysis of Incarceration and Its Alternatives

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Abstract

This paper examines the moral justification of incarceration and alternatives to incarceration through a restorative justice framework associated with Antony Duff. It considers programs that provide treatment, social support, employment opportunities, and community supervision, drawing on institutional materials, published scholarship, and an interview. The analysis asks whether these alternatives can satisfy the purposes of punishment while supporting rehabilitation, community safety, and the repair of relationships between offenders and victims. It distinguishes evidence of reduced reoffending from direct evidence of repentance, recognizing that the former does not by itself establish moral transformation. Because direct evidence concerning repentance is limited, the paper develops an abductive argument about how stabilization and rehabilitative support may create conditions for change. It also considers objections to alternative forms of punishment. The paper argues that these approaches can offer a more morally justified response than incarceration within its chosen framework, while acknowledging the need for stronger evidence concerning the mechanisms connecting rehabilitation, repentance, and restorative outcomes.

Keywords: incarceration; restorative justice; rehabilitation; public policy; repentance

Introduction

The courts in New York primarily rely on incarceration as the default form of punishment for crime, sentencing 317 per 100,000 people to jails, prisons, detention centers, and other facilities, based on statistics provided by the Prison Policy Initiative (New York profile 1). The *United Nations Office on Drugs and Crime* states that imprisonment exists to protect society from crime and reduce recidivism, as well as to allow offenders to reintegrate into society as law-abiding citizens (Jourdan-Ethvignot, 2019, p. 1). However, with incarceration come alternatives. The Pathways to Public Safety Division in the Manhattan District Attorney's Office primarily provides care by addressing the root causes of the crime and helping individuals stabilize in their communities (Manhattan District Attorney's Office, 2022, pp. 3, 7). In addition, they prioritize maintaining family relationships, property ownership, and employment ties to support easier reintegration into society, according to the NYC Mayor's Office of Criminal Justice. Some of the programs that they provide include providing services that prioritize decision-making, social skills, community integration, and reducing substance use. In addition, they also provide intensive individual and group counseling, as well as paid internships and employment opportunities (New York City Mayor's Office of Criminal Justice, n.d.). However, with this come the complications involving the morality behind these methods of punishment. The main point of this paper is to establish that the alternatives to incarceration exist as a more morally justifiable form of punishment compared to incarceration. This is done by analyzing both methods of punishment through the restorative justice framework proposed by Antony (R.A.) Duff.

What are Alternatives to Incarceration?

Before comparing the morality behind incarceration and its alternatives, it is important to first highlight what the alternatives to incarceration truly are. Alternatives to Incarceration, or ATIs, are forms of punishment directly stated in New York Executive Law Section 13-A, and it strives to keep thousands out of jail while improving outcomes in society, according to the Mayor's Office of Criminal Justice. Some of the programs that are provided by the Office include group therapy sessions, employment opportunities, and paid internships. According to a personal interview conducted with Zoe Shea and other pieces of evidence from the Mayor's Office of Criminal Justice, these programs aim to remove the root cause of the crime (Shea and NYC-MOCJ).

It is through such programs that the programs strive to rehabilitate the offender, and when considering what type of program is suitable for the offender, ATIs analyze the offender's background and the roots that led to the crime. Afterwards, it is decided what the appropriate measures would be, which can include individualized or communal therapy sessions and services that promote healthy decision-making. One primary example is the Nathaniel Community Success Program, which provides therapeutic case management that prioritizes behavioral changes as well as social support services and employment opportunities. Established by CASES (Center for Alternative Sentencing and Employment Services), this program strives to improve the lives of anyone 16 or older with mental health issues by providing therapy, mental health treatments, and housing support (Nathaniel Community Success Program). The main goal of CASES is to provide care to people who have been harmed by the public, helping them to stay out of jail while also providing recovery outside of incarceration (CASES, 2013).The results of these objectives have been noticeable, as demonstrated by the noticeable difference in recidivism rates between ATIs and incarceration. According to the Legal Action Center, the recidivism rates of the alternatives (which include the Nathaniel Community Success Program) stand at less than 20%, whereas incarceration is at roughly 42%. The ultimate goal of CASES is to heal people rather than imprison them, and these statistics demonstrate that such alternatives do have societal impacts.

Are ATIs a form of punishment?

ATIs are a direct form of punishment not just because they're listed in New York Executive Law 13-A, but also because they satisfy the philosophical definition of punishment. In philosophical terms, the definition of punishment requires five main categories: unpleasant consequences, a violation of the legal system, an offender who is facing the charges, applied through a legal authority, and administered through a human action (Thomsen 24). The alternatives satisfy this definition as the punishment is applied to the offender through the State Court and administered by judges. The "unpleasant consequences" can be demonstrated through the multiple diverse punishments that are imposed, including probation (living under the supervision of a probation officer), house arrest, and mandated financial fees. This is exemplified by the way ATI treats offenders. Rather than cutting off immediate relationships with families and employees during incarceration, ATIs allow these offenders to maintain their connection to their loved ones, which is directly stated in their mission plans and summary under the MOCJ website. Therefore, ATIs exist as a form of punishment that strives to change individuals rather than incarcerate them.

The Philosophical Outlook

This paper primarily utilizes Antony Duff's restorative justice framework. This framework's core idea is that a punishment is considered morally just if it (i) fosters a repair in the relationship between the offender and victim while, at the same time, (ii) promotes safety in the community, both of them being requirements to make a punishment morally justifiable (Duff & Hoskins, 2021). More specifically, the punishment that is imposed on the offender should create a genuine sense of repentance, and such repentance should drive the offender to fix the wrongdoing that they committed against the victim. Professor of Philosophy at Flagler College Justin A. Capes defines repentance as the act of acknowledging one's wrongdoings, feeling genuine remorse, rejecting the wrongdoing because it is immoral, and resolving not to repeat that same behavior in the future (Capes, 2025, p. 2). Specifically, repentance should foster not simply an internal change but a change in the relationship between the offender and the victim for the better, and the only way to achieve this would be through communication. Communication is necessary because it is what explicitly provides the offender with the opportunity to actually interact with the victim, which is plausibly necessary for a reconciliation of the relationship. In practice, Victim-Offender Dialogues (VODs) are what allow offenders to interact with the victim, thereby fulfilling the necessary conditions of communication. VODs are meetings that are requested by the victims rather than the offender, and these allow victim(s) and offender(s) to have a 1-on-1 interaction (New York State Department of Corrections and Community Supervision, 2026). While these meetings do provide an opportunity for discussions, these meetings do not directly foster behavioral changes in the offender. Without a changed mindset, these meetings are simply ineffective since there would be no sense of repentance that the restorative framework demands.

What helps foster the change in mindset are the programs provided in Alternatives to Incarceration. Pre-existing data reveals that the recidivism rates for patients who are sent to these programs are lower. As mentioned prior from the Legal Action Center, recidivism rates are less than 20%, which is more than half less compared to incarceration's 42% recidivism rate in New York. However, while there is data that suggests that ATIs correlate with positive behavioral outcomes in offenders (as seen in the recidivism statistic), the same statistic does not demonstrate that these behavioral changes are the leading qualities that would lead to a reconciliation in the relationship between the offender and victim. This topic remains nuanced in society, and we should acknowledge that there is an insufficient amount of evidence to directly prove that ATIs increase repentance. More extensive quantitative research on this topic may be required to effectively address the role of ATIs in the repentance of patients.

Therefore, due to the lack of direct data, this paper utilizes abductive reasoning to reasonably conclude that ATIs foster a sense of repentance. While evidence mentioned prior to this paragraph regarding the recidivism rates did show that ATIs demonstrate behavioral changes, no direct study measured whether ATIs foster repentance. Therefore, this paper relies on utilizing abductive reasoning to reasonably conclude that ATIs help foster a sense of repentance. Under abductive reasoning, this paper comes up with two separate hypotheses. The first hypothesis is that ATIs indirectly reduce reoffending by providing stabilization programs, such as housing, employment, and treatment, without directly influencing moral change. The second is that it directly strives to increase a sense of repentance through therapy or education. These two hypotheses can explain how ATIs improve repentance in individuals, and at first, they may seem to contrast, as one takes an indirect approach while the other takes a direct path to increasing repentance. However, these two conjectures do not contradict each other, but instead help form a coherent reasoning. Stabilization provided by the indirect

approach helps foster the condition for repentance, since a person who may struggle with mental health issues or financial problems is poorly positioned to actually reflect on their behavior. To combat this, programs like the Center for Employment Opportunities (CEO) work to provide the patients with financial assistance. For example, a CEO provides financial assistance including job training, transitional employment, and placement services. The CEO proves the first hypothesis regarding the indirect approach (Center for Employment Opportunities, n.d.). By providing financial support, ATIs essentially remove the barrier that prevents patients from effectively reflecting on their behavior. The second hypothesis, which promotes repentance through a more direct approach, is proven by programs like Moral Reconation Therapy, for example. This program requires participants to actually face and abandon their rationalizations before receiving such therapy, which is what repentance actually requires (Rutter, 2024, Section 1). This program takes a more direct approach since it strives to increase the sense of accountability, an important part of repentance, in individuals. This program can be provided both in incarceration and its alternatives, yet that is precisely the evidence that proves that these hypotheses work together. While MRT takes the direct approach but is given with both incarceration and its alternatives, CEO is provided to those in the alternatives to incarceration program and those who are later released from incarceration. These programs are proof that the hypotheses that were claimed earlier work together. While one takes a more direct approach, its applicability in both incarceration and alternatives downplay the argument, which is why the CEO provided exclusively to those in the alternatives or the pardoned work to prove that ATIs foster repentance. Simply put, these hypotheses explain how providing stabilization creates the conditions for accountability, and this drives lasting change when combined with the programs from ATI. This paper's use of abductive reasoning provides a reasonable conclusion, not proof. Thus, the claim that is made in this section is modest: ATIs foster the conditions for repentance in ways that incarceration fails to. This section of the paper requires more research, which can be done by comparing outcomes in individuals taking responsibility from incarcerated individuals and those from the alternatives.

Counterarguments

One counterargument that goes against the alternatives is that the benefits that these substitutions provide are not unique to these alternatives at all. If restoration is what justice requires, one may argue that prisons could simply incorporate more restorative programming such as victim mediation, therapy, and reentry planning, without abandoning the idea of incarceration as the underlying mode of punishment. This counterargument is recognizable, as it is valid to argue that prisons can fix their current structure to focus more on rehabilitation. In fact, restorative elements have in fact been introduced into many prisons; one example is the Impact of Crime / Victim Awareness Classes, which build a sense of rehabilitation and empathy by exposing participants to the stories of victims and the impact of crime. This ultimately results in the argument of "Why can't Rikers and other prisons in New York do this too?" While this argument is valid, it also underestimates that physical confinement itself is the obstacle that prevents restoration. Well-resourced prisons restrict the offender's ability to engage with their community, maintain employment, and repair relationships with victims. Simply layering restorative programming on a structure that has lasted for decades requires a change in structure, system, and modeling. Alternatives, by contrast, do not need to overcome confinement to achieve restoration, as they are designed around continuous community presence.

Simply put, a prison that attempts to increase its ability to provide restoration is a diminished version of what alternatives already accomplish without the barrier. This is not to say that incarceration should never be used;

cases involving serious risks in society may still require some form of confinement, and the argument for alternatives is limited to cases in which confinement is not necessary to protect public safety.

Conclusion

This paper argues that, under Antony Duff's restorative justice framework, the Alternatives to Incarceration (ATIs) in the Manhattan District Attorney's Office are a more morally justified form of punishment compared to incarceration. Duff's framework requires two conditions: the form of punishment repairs the relationship between the offender and victim through genuine repentance, and that it promotes safety in the community. Current evidence proves that ATIs meet the second condition, as shown by the recidivism rates under 20% in programs like the Nathaniel Community Success program. These also plausibly satisfy the first condition as well. By addressing the root issue of the crime, stabilizing offenders through housing, employment, and treatment, and pairing such stability with programs like the Moral Reconation Therapy, ATIs help foster the conditions where repentance can occur, whereas incarceration fails to do so. The strongest counterargument to this is that prisons could adopt the restorative framework on their own. While this is a valid argument, confinement that is provided in incarceration that is not provided in the alternatives is what helps with restoration, and therefore applying a similar method simply becomes a diminished version of the alternatives. This paper does acknowledge the lack of evidence; there is no direct study that measures whether ATIs foster repentance, and thus the paper relies on the process of abductive reasoning. Therefore, what follows is a call for further research regarding whether ATIs directly increase or influence the sense of repentance at all, in patients. This is not to argue that incarceration should be completely removed, since it isn't only a traditional method of punishment but also since it still serves a purpose. However, until evidence like this is collected, the case for the alternatives stand on the best available reasoning: the alternatives to incarceration are a more morally just form of punishment.

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Philosophy & Ethics

The Ethics of Instrumented Mouthguards in the NFL: A Structural Ethical Dilemma

Woobin Park

Abstract

This paper examines whether instrumented mouthguards designed to protect National Football League players nevertheless create unresolved ethical problems. It analyzes privacy and autonomy, unequal access to safety technology, and coercion, using the league's collective bargaining agreement and philosophical accounts of consent and agency. The discussion distinguishes ownership of sensor data from meaningful control over its access and use. It argues that safety benefits do not automatically justify unrestricted institutional access or compulsory monitoring. Proposed responses include limiting identifiable data access, improving transparency, and recognizing an individual right to refuse monitoring. The analysis then examines the limits of those responses. A genuine right to refuse permits uneven participation, whereas guaranteed universal coverage may require compelling players who would otherwise decline. Medical use of the data can remain disadvantageous to players seeking to stay on the field even after privacy protections improve. The paper identifies this conflict between individual control and equal protection as a structural ethical dilemma rather than claiming that a single reform resolves every concern.

Keywords: sports ethics; instrumented mouthguards; autonomy; data privacy; coercion

Introduction

Wearable technology has become a significant part of the sports industry, with professionals and amateurs using them as a daily routine. Athletes utilize these devices in training and in competition, generating data about their bodies that coaches, medical staff, and organizations use to make decisions. In the National Football League (NFL), wearable technology is now embedded throughout the sport, with sensors placed in shoulder pads, helmets, and even mouthguards during both practices and games (National Football League, 2023).

The ethical difficulty lies not in whether this technology works, but how to properly balance its benefits and risks. The organization collecting the data gains information it can use for multiple purposes, while the player generating the data bears the consequences that follow from how it is used. A player can be required to wear the device without being asked for his permission, and clubs that do not use the technology may protect their players less well than those that do. This technology therefore raises three distinct problems: a privacy and autonomy problem, a fairness problem about unequal access of the kind usually discussed under the heading of technology doping, and a coercion problem.

This paper narrows its focus to instrumented mouthguards, which monitor the force and location of head impacts in real time. They are an interesting case for each of the three problems because, unlike most wearable technology, they exist for player safety rather than performance enhancement, which allows me to test whether a protective purpose is sufficient to resolve these concerns or whether they persist even when the technology is

designed to benefit the player.

My argument proceeds in three stages for each problem. First, I state what the problem is and why it arises. Second, I examine the solution the NFL has already adopted, found mainly in Article 51, Section 14 of the Collective Bargaining Agreement between the league and the NFL Players Association. Third, where that solution leaves something unresolved, I offer my own. The first two problems have answers; the third does not, and showing why is the contribution of this paper. My analysis commits me to two values that cannot both be satisfied: individual control, meaning that a player decides what is done to his own body and what information is taken from it, and equal protection, meaning that safety benefits should reach every player who can receive them. Protecting individual control requires permitting refusal, which leaves protection uneven; guaranteeing equal protection requires compelling participation, which overrides individual control. This conflict is a structural ethical dilemma, and it is the result of my analysis rather than an assumption I began with.

The Technology

The NFL's mouthguard sensor program launched in 2019 as part of the league's Engineering Roadmap (National Football League, 2021). Sensors embedded in the mouthguards collect head kinematic data including impact speed, direction, and severity. The mouthguards are custom-fitted to each player using intraoral scanning technology supplied by a league equipment partner, and they are worn in both practices and games. The league states that it analyzes the data across the preseason and regular season, and that it has used the results to evaluate changes to the kickoff play and to the preseason ramp-up period (National Football League, 2023).

One feature of the program matters for the arguments that follow. Nothing in it removes a player from a game when his sensor registers a dangerous impact. This distinguishes the NFL's program from World Rugby's, where smart mouthguard alerts trigger an in-game head injury assessment (Gibson & Nelson, 2025). In the NFL, the device only records.

The accuracy of this technology is also not settled. Research on instrumented mouthguards has raised questions about whether the devices misestimate head accelerations and whether readings taken without video verification produce false positives (Gibson & Nelson, 2025).

Smart mouthguards collect data that is sensitive by continuously monitoring the head-impact exposure of an athlete. This matters more than ordinary fitness data because a documented history of head impacts has implications well beyond the current season. It can factor into contract value or how an athlete is regarded by teams and medical staff for the rest of their career. For instance, if a certain athlete's data indicates a sign of being "injury-prone" or "concussion-prone", a coach or medical staff may be influenced to have a biased opinion such as an athlete having a short career lifespan. This can influence a coach to regard an athlete less valuable.

Who controls this data has historically been unclear. The power imbalance between athlete and institution can also undermine consent. An athlete may agree to wear the device, but if declining carries a serious professional cost, his agreement no longer shows what he actually wanted.

Privacy/Autonomy

The athlete is both the source of information and the subject that produces data collected by instrumented mouthguards. Teams, leagues, organizations, and researchers may all have an interest in accessing it or using it. This leads to an important ethical question: who should control information generated by an athlete's own body? The question is particularly relevant to ethicality because the interests of these groups are not necessarily the same. An athlete may want their data to be used to improve their safety, while a team may have an interest in using the same information to evaluate the athlete's future value. Researchers may want to access athletes' data to study head injuries, whereas a technology company may need access to process the data. There are three factors of the question of who should control information generated by an athlete's own body: who should own the data, who should have access to the data, and what actions can be taken with the data.

Data Ownership

First, I will discuss the factor of ownership of biometric data in the NFL. The NFL has attempted to address this issue through the Collective Bargaining Agreement, which guarantees that players retain individual ownership of personal biometric and sensor data (National Football League & National Football League Players Association, 2020, Article 51, § 14(h)). The agreement also establishes rules governing the use of sensor technologies and provides for a Joint Sensors Committee consisting of representatives from the NFL and NFL Players Association to review and approve sensors used by players (National Football League & National Football League Players Association, 2020, Article 51, § 14(c), (f)).

However, ownership does not necessarily provide complete control over information. An athlete can own their data while still having limited control over how that data is used. For example, an athlete can retain ownership of their head-impact data while allowing a team to access it for the purpose of monitoring exposure to potentially harmful impacts. That access may be justified as a means of protecting the athlete's health but it could also be used for unrelated purposes behind the back of the athlete such as evaluating the athlete's long term value to the organization. Consequently, simply determining who owns the data does not resolve the question of who should be permitted to access the data or what actions can be taken with it. Now, I will discuss the remaining questions of who has access and what actions can be taken with the biometric data.

Data Access

Here, I will discuss the concerns regarding access. Access is a separate question from ownership because access determines who can be in a position to act on information, regardless of the owner. Several parties have a plausible claim to data produced by instrumented mouthguards.

Medical staff have the strongest claim to the access of data. If the purpose of collecting the data is to protect players from undetected head injuries, the people making medical judgments require it to make decisions. Similarly, scientific and medical researchers can argue that the data is needed for the future players that will benefit the whole industry. For instance, medical researchers can use the head impact data to create a safer helmet design, design preventative measures, or determine what actions/scenarios cause severe head impact that can damage the brain. Coaching staff may demand data for decisions on how practices are structured and how contact is distributed.

The agreement does not distinguish among these claims. Section 14(h) grants access to "members of the Club staff" as a category, without limiting it to medical personnel or restricting the purposes for which access may

be exercised (National Football League & National Football League Players Association, 2020, Article 51, § 14(h)). The league's own description of the program states that club staff use the data and insights in their work with players (National Football League, 2023).

The league also states that data collected across the mouthguard program is anonymized and analyzed by independent experts at Biocore and the Children's Hospital of Philadelphia (National Football League, 2022). That statement describes how the league conducts its research, not what clubs may see. The two are separate channels. Researchers receive data stripped of names in order to study impacts across many players and produce findings about rules and equipment. Clubs receive something different: Section 14(h) gives club staff access to data generated by approved sensors, and the league says club staff use that data in their work with individual players (National Football League, 2023). A club cannot manage one player's practice contact using data that does not identify him. The anonymized research channel therefore does not limit the club channel, and only the agreement creates rights a player could enforce.

This creates the central difficulty. Once a coach can see a player's cumulative impact data for the legitimate purpose of managing practice contact, the coach can also form judgments about the player's durability on the field and future value. The agreement grants access for one purpose but does not restrict what the accessing party may then do with what they have seen. Even if the data was accessed for a "good" purpose, a coach can start forming biased opinions based on this information that might threaten the athlete's reputation and have bad consequences for the player. The agreement's response to this problem is not to restrict access but to restrict use. The next section responds to this issue.

Data Use

Finally, I will discuss the question of what actions can be taken with biometric data. The agreement takes a clear position on the most obvious risk. Section 14(i) prohibits sensor data from being referenced or cited by any club, player, or player's representative in contract negotiations (National Football League & National Football League Players Association, 2020, Article 51, § 14(b), (i), (k)). This is a use-based restriction rather than an access-based one. It does not prevent a club from seeing data; instead, it prevents the club from invoking it in a specific context where the player's interests and the organization's are directly opposed.

Contract negotiations are distinctive in this respect. For most of the season, a club and a player want broadly the same things: that he stays healthy, plays well, and the team wins. A negotiation removes that overlap. The player seeks the largest guarantee he can obtain, and the club seeks to commit as little as possible, so any argument that lowers his value is worth making. The following example shows what this makes possible. Consider a linebacker entering his fifth season, seeking a long-term extension. Three years of accumulated head-impact data would let the club argue that his exposure is unusually high for his position, that players with comparable exposure decline earlier, and that a shorter deal with less guaranteed money is therefore appropriate. The example shows why Section 14(i) targets this setting: data gathered to protect the player becomes an argument for paying him less.

The agreement also provides a way to enforce these rules. Under Section 14(g), the players' association, the league, a club, or an individual player may bring forward a complaint about a violation. Representatives designated by the parties then look into it, and they may interview the people involved and request documents. Where the parties cannot resolve the matter between them, it goes to an impartial arbitrator. Penalties rise with repetition, and a second violation within the same league year carries a fine of at least $250,000. This

complaint process is directed at the approval and use of sensors in NFL practices (National Football League & National Football League Players Association, 2020, Article 51, § 14(g)).

Restricting use is more practical than restricting access because a rule can only govern conduct that can be observed. A rule against citing sensor data in a contract negotiation, as Section 14(i) establishes, governs something a person does out loud in front of others. A rule restricting access would have to govern what a coach does with information already in his head, and penalizing him for a private judgment about a player's durability could not be enforced. Despite these existing policies, use-based restrictions face two limitations, one logical and one procedural.

The logical limitation is that a rule can prohibit citing sensor data in a contract negotiation, but it cannot prevent that data from informing an organization's private valuation of a player, which then shapes the offer made without ever being cited. The prohibition addresses the explicit use while leaving the implicit one intact, and the implicit use may be the more consequential of the two.

The procedural limitation is that the enforcement mechanism is deliberately opaque. Section 14(g)(iii) provides that investigation reports shall remain confidential, that neither party is required to share its report with the other, and that these reports shall not be publicly disseminated (National Football League & National Football League Players Association, 2020, Article 51, § 14(g)). No public record therefore exists from which a player, or anyone outside the process, could determine whether these rules are working. A player cannot find out whether other players have filed similar complaints, whether violations have been substantiated elsewhere in the league, or whether any club has ever been disciplined under this section.

These three protections fail to establish a working system where a player is protected. A player owns data he cannot keep anyone from seeing, club staff can see it without limits on why, and when a rule is broken the outcome stays private. Each protection exists, but none reaches the point where a player could tell whether he is actually protected.

Conclusions on Privacy/Autonomy

Each of the three factors receives a different answer from the agreement, and each answer leaves part of the original concern unaddressed.

Section 14(h) establishes that players own their sensor data. The same provision grants club staff access to it. A player therefore holds ownership of information but cannot prevent others from seeing it.

That access is granted to "members of the Club staff" as a single category, without distinguishing medical staff from coaching staff. Once a coach sees a player's cumulative head-impact exposure, he can form judgments about that player's durability, and no provision of the agreement addresses this.

Section 14(i) restricts use rather than access, targeting the contract negotiation context discussed above, and Section 14(g) backs the rule with enforcement. Because Section 14(g)(iii) keeps investigation results confidential, a player has no way to learn whether the rule protecting him has ever been invoked.

Taken together, the agreement settles which parties may approve sensors and how complaints about sensor rules are resolved, but says comparatively little about what may be done with the data once it exists. Two changes would close much of the gap, and both build on mechanisms the agreement already contains.

First, access should be tiered by identifiability. Individually identifiable head-impact data should only be available for licensed medical personnel, while aggregated data can remain available to coaching and performance staff. Section 14(h) already distinguishes these, granting club staff access to sensor data while giving the league and players' association access to aggregated data (National Football League & National Football League Players Association, 2020, Article 51, § 14(h)). Therefore, rather than creating an entirely new system, a stronger privacy framework can be extended toward athlete protection. What would stay the same is that clubs continue to receive head-impact information and continue to use it in structuring practices and managing contact. What would change is that coaching and performance staff would receive that information at the team level rather than attached to named players. The distinction the agreement already makes between the two kinds of access would simply be applied within the club as well as between the club and the league.

Second, enforcement should be reported publicly. The parties should jointly publish an annual report of sensor-related complaints filed, complaints substantiated, and discipline imposed, naming the clubs found in violation while keeping player identities confidential. This would help in three ways. It would tell players whether the rules work, since a player deciding whether to file a complaint currently has no way of knowing whether complaints ever succeed. It would let the players' association identify repeat offenders, who are presently indistinguishable from one-time offenders because each investigation is known only to the parties involved. And it would give clubs a reason beyond the fine to comply, since a violation would become part of the public record and ruin their reputation.

Technology Doping

Technology doping refers to the use of technology to provide an athlete with an unfair competitive advantage. Unlike conventional doping, which involves substances or methods that enhance physical capabilities, technology doping concerns equipment that confers an advantage the athlete has not earned through training or ability. The ethical concern is not simply that technology can improve performance, but that unequal access to increasingly advanced technology could cause competition to depend on financial resources rather than physical ability. This is a documented limitation of wearable technology generally: high-quality devices are expensive enough to limit accessibility for teams with constrained budgets (Migliaccio et al., 2024).

I argue, however, that this concern does not amount to doping in the case of instrumented mouthguards in the NFL, though it points to a related problem. Stating why clarifies what technology doping actually consists in. I take the argument in three steps: what kind of advantage is at stake, whether access to it is unequal, and what should be done about it.

First, what kind of advantage is at stake? Unlike equipment designed to increase speed, strength, or endurance, instrumented mouthguards measure head impact. Wearing one does not make a player faster or stronger, and a player wearing one gains no advantage during the play in which the data is collected. Any advantage the technology confers is informational: better data enables better decisions about training and recovery, and those decisions may over time produce a healthier, more available player. But the improvement is still produced by the player's own training and the staff's judgment. The mouthguard only informs choices that were already being made, less well, without it. On this understanding, an informational advantage belongs in the same category as better coaching or better medical staff.

Nevertheless, instrumented mouthguards may still contribute to an unequal competitive advantage depending on how the data is used. It is possible for a team to obtain more information about the athlete's physical condition, allowing to devise superior training, recovery, and medical decisions. An athlete may also benefit from increased awareness of even minor injuries and the career longevity that results from this.

Second, is access unequal across the NFL? Access to this technology is in fact unequal within the NFL, though not for the reason the cost-based argument states. When the league announced its collegiate partnership in 2021, it described the sensors as used by players at ten clubs (National Football League, 2021). The following year, it described identical data collection as underway at four clubs (National Football League, 2022). No club figure has been published since, and the program has never been described as league-wide. Cost is unlikely to be the barrier, since every NFL club could afford the equipment. The cost-inequality version of the objection is therefore weak at the NFL level, while the access asymmetry it was meant to identify is real.

Third, what action can be taken to address the concern of unequal access? I argue that the appropriate response to unequal access to safety technology is distribution rather than restriction. Although banning and expanding both result in equality, they do not preserve the same benefits. A governing body may still ban performance-enhancing equipment because it changes the conditions under which athletic ability is measured, as occurred with high-tech swimsuits (ABC News, 2010). Safety is different because its value does not depend on how safe one team is relative to another. If better head-impact monitoring helps one player avoid a concussion, other players do not become less safe as a result. Giving the same technology to every team would therefore make everyone safer, while banning it would simply remove that benefit from everyone. Because the problem is unequal access to a valuable safety benefit, the appropriate response is to expand access rather than eliminate the technology.

The conclusion is therefore conditional. Where an advantage substitutes for athletic capacity, it should be banned, because the competition is then measuring the equipment rather than the athlete. Where the advantage benefits everyone, it should be distributed. Instrumented mouthguards fall into the second category, which means the league should extend the program to all clubs.

Coercion

The use of instrumented mouthguards raises the question of whether athletes can meaningfully choose to participate in biometric monitoring. I argue that the current arrangement is coercive, that the league's justification for it is strong but incomplete, and that the remedy is an individual right to refuse.

Defining Coercion

Before even questioning whether the NFL coerces its players, I must define coercion. A widely accepted philosophical definition treats coercion as a kind of threat: one party proposes to put another in a significantly worse position than he is in, or than he ought to be in, unless he complies (Wertheimer, 1987, as cited in Eyal, 2025, § 5.1). Two features of this definition matter. Coercion does not eliminate agency: a coerced person still chooses, but among options arranged by someone else, so the fact that players wear the devices does not show that they consented. And a threat must be distinguished from an offer, since a threat makes someone worse off if he refuses while an offer makes him better off if he accepts. The test is what happens to the person who declines.

That test is difficult to apply here, because the agreement never states what happens to a player who declines, so the threat definition requires an inference the text does not supply. A better account is available. Scott Anderson argues that what makes an action coercive is not the issuing of a threat but one party's ability to enforce decisions about what another person will or will not do, based on a power difference between them (Anderson, 2011, § 3.1). Threats are one way of exercising such power, but an institution that can simply impose its decision has no need to threaten at all. On this account the question is not what was threatened but who decides, and that question the agreement answers directly.

Absence of Individual Right to Refuse

Four features of Section 14 together show that the agreement gives individual players no right to refuse sensor monitoring.

- First, Section 14(b) provides that the NFL may require all players to wear equipment containing sensors during games (National Football League & National Football League Players Association, 2020, Article 51, § 14(b), (i), (k)). The permission belongs to the league, and nothing in the provision makes its exercise depend on players agreeing.
- Second, Section 14(f) allows clubs to mandate any sensor approved by the Joint Sensors Committee for practice (National Football League & National Football League Players Association, 2020, Article 51, § 14(c), (f)). The sole condition is device approval by the Joint Sensors Committee, not consent of a player.
- Third, Section 14 does require consent in specific instances, but names entities other than the player. For instance, the players' association must consent before sensors are placed on helmets or used outside games and practices (National Football League & National Football League Players Association, 2020, Article 51, § 14(b), (i), (k)). The omission of player consent can be interpreted as deliberate rather than accidental. A contract that specifies whose consent is needed in two separate clauses, and names the union both times, suggests that the drafters made an intentional decision.
- Fourth, the individual player does appear elsewhere in the section. Section 14(h) makes him the owner of his data, and he may bring a complaint about violations (National Football League & National Football League Players Association, 2020, Article 51, § 14(h)). He appears as an owner and as a complainant, but never as someone whose agreement is required before monitoring begins.

Ultimately, whenever the agreement required consent, it named entities other than the individual player. A player therefore enters the league under a term already in force: the requirement was bargained in 2020, applies to every player alike, and was never put to him as a question.

Measured against the definition above, this meets the definition of coercion, provided that refusal would in fact cost a player his place. Under Sections 14(b) and 14(f), the league and its clubs decide whether a player wears an instrumented mouthguard, and the player's own view has no bearing on the result. A player can refuse only by declining to comply, which puts his position in the league at risk. An athlete who loses his place for refusing monitoring is plainly worse off than one who agrees to wear the device. The agreement does not state what happens to a player who declines, so this last step is an inference. It is a safe one, because clubs control playing time and roster decisions at their own discretion and are not required to explain them.

The league has a reply. Its policy is not coercive, because no explicit threat is made: no official singles out a player or threatens to cut him for refusing to wear a mouthguard. Wearing it is simply a condition of employment, like complying with practice schedules or equipment standards. On this view the NFL is setting

the terms of the job rather than threatening players into compliance. I argue below that this reply fails (see Explicit and Implicit Threats), but first I ask whether the coercion might be justified anyway.

Justifying Coercion

Establishing that players cannot refuse monitoring does not, by itself, prove that anything wrong has happened. Coercion is not automatically impermissible, and the preceding subsections establish only that the league must answer for it. Evaluating this case therefore requires criteria, and the philosophical literature raises two separate questions: whether coercion is wrong in itself, and what makes it wrong when it is.

On the first question, I adopt the most commonly held position, which holds that coercion is presumptively wrongful (Anderson, 2011, § 3.1). On this view, the fact that an action is coercive counts against it, but does not decide the matter on its own. Whoever coerces must have a strong enough reason, and if they do, the action can still be acceptable. This position matters for how the argument proceeds: the league does not have to show that requiring sensors is a positive good, only that it has adequate reason, but the burden sits with the league rather than with the player who objects.

The league's justification would run as follows. Head injuries in football are severe, cumulative, and often undetected when they occur, and sensor data collected across many players is what makes it possible to identify which situations produce the most dangerous impacts. The league has used this data for exactly that, including modifications to the kickoff play and the preseason ramp-up period (National Football League, 2023). Research of this kind requires broad participation, since a dataset drawn only from volunteers may be too small or unrepresentative to support reliable conclusions. It is worth being precise about who this benefits. The device does not protect the player wearing it at the moment, since nothing in the program removes him from a game when his sensor registers a dangerous impact. His data contributes to a larger set that eventually improves rules and equipment, so the benefit goes to players generally and arrives later.

The arrangement was also collectively bargained: players did not agree to it individually, but the players' association did, and it secured protections in return, which is the kind of trade unions ordinarily make. This gives the league a legitimate argument that the requirement was negotiated on behalf of the players. I grant the general point and deny that it settles this case. Collective consent is the right instrument for terms that affect players as a group, such as practice length, roster limits, and pay scales. In those cases every player is affected in the same way, gains for some can be weighed against losses for others, and no individual has a claim to be exempted. Decisions about a person's body, and about information taken from it, are usually treated differently, which is why an employer cannot bargain on an employee's behalf over submitting to a medical procedure. The agreement appears to recognize the distinction itself. Section 14(h) makes the individual player the owner of his sensor data rather than vesting ownership in the union (National Football League & National Football League Players Association, 2020, Article 51, § 14(h)). The drafters treated the data as individually his when they assigned ownership, and as collectively bargainable when they assigned control over whether it is collected, and the agreement never explains why the same information should be individual property for one purpose and a collective asset for the other.

Even if the justification above succeeds, there are further reasons to think the current implementation is objectionable.

Why Persuasion Would Have Been Enough

Ambrose Lee argues that coercion is wrong when it is used to make people do what they already have a good reason to do (Lee, 2014, as cited in Anderson, 2011, § 3.1). A person capable of recognizing a good reason deserves the chance to act on it. Forcing them instead treats them as something to be moved rather than someone to be convinced, and where they would have agreed anyway, the force accomplishes nothing that explaining would not have accomplished on its own.

This creates a problem for the league's defense. Its argument for requiring sensors is that head injuries are severe and the data is needed to reduce them. But if that is true, players may reasonably want their impacts measured, since the injuries in question are their own. Head-impact data can benefit a player in several ways. It can reveal exposure that he cannot feel or count himself. A collision profile built over a career could help whoever provides his medical care, including after he stops playing (Gibson & Nelson, 2025). And the data informs rule changes and equipment design that protect players generally, such as the changes to the kickoff and the preseason ramp-up (National Football League, 2023). The league could have explained the program and asked the players. The stronger its safety argument, the more likely persuasion would have worked, and the harder it becomes to explain why compulsion was necessary at all. Some players may not share these reasons. But the league cannot justify compelling everyone by pointing to the few who would refuse. For the players who do have good reason to wear the device, compelling them is still disrespectful, since the force accomplishes nothing that explaining would not. At most, the league would owe an explanation of why letting the unpersuaded decline would defeat the research, and that is the league's burden to show.

Explicit and Implicit Threats

The league’s first reply was that no one threatens anyone. This does not settle the matter. On the power-based account adopted above, a threat is what a party resorts to when the other side could still refuse. Here the agreement already gives the league the decision, so it never needs to threaten.

The power imbalance also creates an implicit threat where no explicit one is needed. Even if the league does not directly or explicitly threaten a player to wear instrumented mouthguards, the power imbalance between the league and the player can create a rationally legitimate fear in the player that they would be worse off if they don't consent (Lee, 2014, as cited in Anderson, 2011, § 3.1). Coaches have authority over important aspects of an athlete's career, including playing time, training opportunities, and continued position on a team. A player who declines therefore risks losing playing time or his roster spot, and may feel compelled to participate whatever his own view of the matter. Refusal is available in principle and unrealistic in practice.

The league’s second reply was that wearing the device is an ordinary condition of employment, like attending practice. The comparison fails because of what the device records. A practice schedule governs a player’s conduct at work. Head-impact data records the condition of his body, including facts he could not report himself, since no one can feel his own accumulated exposure. That record follows him out of the building, into contract negotiations, club assessments of his durability, and his medical care after he retires. Requiring it takes something he had a claim to withhold, so declining is not a request for special treatment.

A Right to Refuse

The problem identified so far is that the decision about a player's own body belongs to someone else. The direct remedy is to return it to the player. I propose that the agreement be amended so that an individual player

may decline instrumented mouthguard monitoring without losing playing time, roster position, or contract value.

Three features of the proposal are worth stating. It is a right to refuse being measured, not a right to refuse protective equipment, so a club could still require an ordinary mouthguard, which protects the wearer without creating a record about him. It would need the same enforcement machinery that already backs Section 14(i), since a right a player cannot enforce is the kind of protection that exists only on paper. And it is a small change in form, because the agreement already contains a clause of this shape: Section 14(b) requires the players' association's consent before sensors are placed on helmets. My proposal uses the same device and names the player instead of the union.

The obvious objection is that participation would fall. The league's justification rested on broad participation, and if players can opt out, the resulting dataset may become too small, or drawn from too narrow a range of positions, to support the rule and equipment changes that make the program worth defending. On this view the right to refuse would be purchased by giving up the benefit that justified monitoring in the first place.

My answer is Lee's argument run forward. The objection assumes that players offered a real choice would mostly decline. But if the league's safety case is as strong as it claims, then most players have good reason to accept, and the league's task is to make that reason visible: to show them what the data has already changed, what their own readings would reveal about exposure they cannot feel, and exactly who inside the club would see a reading with their name attached to it. A program explained on those terms should attract most of the players it needs. If it does not, the league faces the choice described in The Dilemma below: accept uneven participation, or return to compulsion.

What a right to refuse cannot fix

One kind of player is not reached by any amount of explanation. A player on a one-year contract, or one competing for a roster spot, may have reason to keep playing through an injury rather than generate a record that could be used to sit him down or lower his value. For him, information about his own exposure is a liability rather than a benefit. Explanation cannot reach him. Persuasion works by showing a person a benefit. He can see the benefit. The problem is that the data can be used to take him off the field, which is the outcome he is trying to avoid.

There is an escape route worth examining, because it is the strongest response available to my own argument. Much of this player's reason to refuse comes from how the data might be used against him, and the privacy reforms proposed earlier are designed to remove exactly that. If named readings never left medical staff and enforcement were published, his fear of being valued lower or passed over would be substantially reduced, and the opt-out problem might shrink to very little.

It would shrink, but it would not close. The decision that most threatens this player is being held out of play, and that decision belongs to the medical staff who retain access under my own proposal. The reforms remove the coach from the picture; they do not remove the possibility that the data results in his being sat down, which is the outcome he is trying to avoid. Removing that would mean denying medical staff the data, defeating the safety purpose that justifies collecting it. The reforms therefore narrow the dilemma without dissolving it.

The Dilemma

The two values named in the introduction are now both on the table, and they conflict. Individual control requires that a player may refuse monitoring, which permits uneven coverage. Equal protection, the value defended when I argued for distributing safety technology rather than withholding it, favors universal coverage, which requires compelling those who would decline. Neither can be dropped without abandoning a conclusion already defended: individual control grounds the objection to coercion, and equal protection grounds the case for extending the program to every club.

Two levels of this claim should be distinguished. At the level of principle, the conflict is certain: a genuine right to refuse necessarily permits different participation decisions, so no system can guarantee both unrestricted refusal and universal participation. At the level of practice, its severity is unknown. I do not know how many players would decline, or whether refusals would cluster in particular positions. It is plausible that insecure contracts and heavy contact often go together, in which case the players most exposed to risk would have the strongest reason to refuse and the dilemma would fall hardest on those the program exists to protect, but I offer that as a risk worth investigating rather than an established pattern.

Three features of the case produce the conflict, which is why I call it structural rather than a difficult policy choice. The benefit is collective and delayed while the cost is individual and immediate: the device records rather than intervenes, so what a player gives up is information about his own body now, and what he receives is a share in changes that arrive later and accrue to players in general. Consent is hardest to obtain where the person asked bears the cost and a class receives the benefit. Second, the research requires breadth, so refusals that are not randomly distributed damage the data precisely where it matters most. Third, the decision to refuse belongs to the person whose interests may diverge most from the program's purpose. None of these follows from how Section 14 happens to be drafted; they follow from what the technology is and whom it serves.

Conclusion

This paper asked whether instrumented mouthguards, a technology built to protect players rather than to improve their performance, still raise ethical problems in the NFL. They do, and two of the three admit answers. On privacy and autonomy, the agreement gives players ownership without control, lets club staff see identifiable data without limiting what they may use it for, and keeps enforcement out of view; tiering access by identifiability and publishing enforcement figures would close most of that gap. On unequal access, the concern is real but it is not doping, since the technology does not substitute for athletic ability, and the appropriate response is to extend the program to every club rather than restrict it. On coercion, players hold no individual right to refuse, and the decision about what is done to a player's body belongs to his employer. The league's safety case justifies collecting head-impact data; it does not justify leaving the use of that data almost unlimited, and it does not discharge the burden of explaining why a less restrictive alternative would fail.

The third problem is where the paper's contribution lies. An individual right to refuse would remove the coercion, and the privacy reforms would reduce the reasons players have to exercise it. But some reason always remains, because the medical use of the data is both what justifies collecting it and what a player trying to stay on the field has most cause to avoid. If we prioritize making protection as equal as possible, some degree of coercion appears necessary; if we prioritize the player's freedom to decide what is done to his own body, we must accept that protection will be distributed unevenly. I do not take a position on which should be

preferred. The point is that the two cannot both be had, and that this follows from the analysis rather than from an assumption brought to it.

Addressing each ethical concern individually therefore does not by itself produce a satisfying solution to all of them at once: the privacy problem has an answer and the fairness problem has an answer, but the answer to coercion undoes part of the answer to fairness. That result indicates where effort should go — not into a better remedy for coercion considered alone, but into reducing the structural features that put the two values in conflict.

Three avenues for further research follow directly. The first is the hybrid arrangement examined above, pairing a right to refuse with purpose-limited access, which would test how far the privacy reforms shrink the opt-out problem. The second is how much participation research of this kind actually requires, and how badly non-random refusal distorts its conclusions; I have taken the league's claim that breadth is necessary largely on trust, and statistical work could settle it. The third is comparative: World Rugby's smart mouthguard alerts trigger an in-game head injury assessment, so there the device protects the player wearing it rather than only contributing to a dataset, (Gibson & Nelson, 2025) which removes the first structural feature. Whether such a program attracts voluntary participation would indicate whether the dilemma described here is intrinsic to biometric monitoring in contact sport or a product of how the NFL has implemented it.

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Psychology & Behavioral Sciences

Re-evaluating Adolescent Social Media Use and Emotional Adjustment in Lockdown

Eunbyeol An

Abstract

This paper critically examines the claim that increased social media use necessarily harmed adolescent mental health during COVID-19 lockdowns. It reviews a study of adolescents' digital communication with friends, describing its sample, measures, findings, and conclusions. Particular attention is given to differences between synchronous communication, such as video calls and social gaming, and asynchronous activities, such as posting on social media. The reviewed findings associate some forms of reciprocal communication with more favorable emotional adjustment. The analysis then considers whether those associations support the researchers' broader interpretations and practical recommendations. It identifies limitations involving causal direction, unmeasured confounding, sample composition, self-reported measures, and the exceptional conditions of lockdown. These limitations restrict the extent to which the findings can be generalized beyond the pandemic. The paper argues that adolescent technology use should be evaluated in relation to its form and context, while maintaining a clear distinction between observed associations and demonstrated psychological effects.

Keywords: adolescence; social media; digital communication; emotional adjustment; COVID-19

Introduction

The COVID-19 pandemic changed how adolescents spent their time. The onset of the pandemic and the accompanying stay-at-home orders drastically disrupted daily social routines, resulting in a dramatic surge in social media and digital device usage among youth. A meta-analysis of 46 studies covering about 29,000 children and adolescents found that daily screen time rose by roughly 52%, or 84 minutes a day, during the pandemic (Madigan et al., 2022). In the United States, 12 to 13 year-olds roughly doubled their non-school screen time, from 3.8 hours a day before the pandemic to 7.7 hours a day in May 2020 (Nagata et al., 2020)

Increased social media use is also positively associated with poorer mental health outcomes. A systematic review found that more time spent on social media is associated with depression, anxiety, and psychological distress in adolescents (Keles et al., 2020), and a meta-analysis found a small but statistically significant association between social media use and depressive symptoms (Ivie et al., 2020).

Together, these points form the intuitive hypothesis: because social media use among adolescents increased during the COVID-19 pandemic, and because increased social media use is positively associated with negative mental health effects, it would be reasonable to expect that adolescent mental health suffered during the pandemic because of social media use.

However, the study by Spiekerman et al. (2023) challenges this expectation: during the COVID-19 stay-at-home orders, increased use of certain forms of digital communication with friends was associated with more positive emotional adjustment among adolescents. In this paper, I will (1) describe the study, (2) describe the data results, (3) describe the researchers' claims and conclusions, and (4) critically examine those claims.

Study Overview

This study investigates how adolescents used different forms of digital communication to maintain connections during the COVID-19 stay-at-home orders and how these digital interactions were associated with their emotional wellbeing. The study evaluated three goals: " (1) identify which forms of digital communication adolescents most often used to connect with friends during shutdown orders; (2) test whether adolescents who did and did not use specific types of digital communication to connect with friends differed in terms of their emotional well-being (i.e., depressive symptoms, loneliness, and flourishing); and (3) examine the roles of gender and age differences in terms of the types of digital communication used to connect with friends and their associations with well-being." Because demographic variation (gender and age) falls outside the primary scope of this paper, those specific sub-analyses are excluded from this review.

The study was mainly conducted during the initial April 2020 lockdowns in the United States, where digital communication is widespread among youth with over 89% of adolescents residing in the United States owning a personal device (Rideout & Robb, 2018). The researchers evaluated a sample of 168 youth between the ages of 11 and 20 years old, comprising 51.40% female participants. The sample was predominantly White and non-Hispanic (58.10%), with the median household income falling in the USD 70,000-99,999 range and the majority of parents having highly educated backgrounds.

To measure communication patterns, the researchers utilized a single-item question from the "Adolescent Social Connection & Coping During COVID questionnaire" (Pfeifer et al., 2022) asking participants to select which non-in-person methods they used to connect with friends during the stay-at-home orders. The survey offered 6 response options: messaging/texting, video calls, voice-only calls, posting on social media, liking or responding to friends' posts, and playing online games together. Participants were allowed to select multiple options that were applicable. These communication methods were categorized into two distinct concepts: synchronous forms (real-time interactions such as video/voice calls, social gaming) and asynchronous forms (delayed interactions such as posting or responding on social media platforms), with text messaging noted as potentially falling into either category.

Adolescents' emotional adjustment was evaluated through three standardized psychological scales based on each distinct symptom: Center for Epidemiologic Studies Depression Scale (Radloff, 1977) for depressive symptoms; the UCLA Loneliness Scale Version 3 (Russell, 1996) for Loneliness; and the Flourishing Scale (Diener et al., 2011), which is an 8-item scale that measures the self-perceived success of the participants in areas such as relationships, self-esteem, purpose, and optimism.

Findings of the Reviewed Study

The most frequently used form of digital communication among adolescents was texting, with 87.5% of the participants reported using it (elsewhere, the authors refer to the percentage as 85.6%, but I decided to include the figure from Table 1 of the study). Over half of the participants (53.4%) reported using video calls, while 32.1% responding that they used voice-only calls and 36.3% reporting using social gaming. Asynchronous forms of communication showed 38.1% and 41.1% of participants engaging with posting on social media and responding to friend's posts, respectively. The mean age of each respondent stayed within the 15.72 to 16.75 range.

The researchers then recorded the relationship between the different forms of communication and emotional symptoms. Data suggested that participants that engaged with video calls showed significantly lower depressive symptoms, while other forms of communication showed insignificant results. In terms of loneliness, most significant reports were of video calls and social gaming being associated with lower levels of loneliness. Texting was largely associated with lower loneliness for participants with age of 14 and lower. The final criteria, flourishing, revealed that video calls and texting with friends had the most effect for positive emotional adjustment than other forms of communication. Texting had the most effect on adolescents who were 16 and younger. Other forms of communication, such as interacting on social media, showed no significant effect of flourishing.

Interpretation of the Reviewed Findings

Aligned with the researchers' original hypothesis, a notable relation between engagement with specific types of communication and emotional symptoms was discovered. Two of the three types of synchronous communication were significantly associated with positive emotional adjustment, and the researchers suggest that the reciprocal nature of synchronous communication fosters connection between friends for adolescents. Results regarding asynchronous forms of communication, posting and responding to friends using social media, also aligned with the researchers' hypothesis that these methods would show less significant effects in positive emotional adjustment than synchronous forms of communication.

Ultimately, the researchers conclude that connecting with friends through digital forms of communication during the pandemic is associated with a positive mental health state among adolescents. Based on their findings, the authors also claim that adolescents' use of technology is not inherently harmful; rather, its impact on psychological well-being depends heavily on the specific context and mode of interaction. Specifically, the researchers state that digital communication is significantly related to positive emotional adjustment – reduced loneliness, fewer depressive symptoms, and higher flourishing – when it involves synchronous, real-time engagement (such as texting, video calls, or social gaming) with friends.

In contrast to previous studies suggesting that adolescents' use of social media has negative impacts on their mental health, the present study found no meaningful association between them. The authors attribute this discrepancy to the possibility that benefits of consistent social engagement through social media amidst a lockdown environment, where in-person interaction was limited, outweigh the potential drawbacks of social media engagement.

Consequently, the researchers advocate for a shift in parental and practical guidance of adolescents' technology use: rather than a total or strict restriction on devices, parents should actively encourage digital practices that facilitate reciprocal, engaged peer connections. Finally, they call for future research to further investigate the specific mechanisms through which real-time digital interactions support adolescent emotional adjustment for more definitive conclusions.

Critical Evaluation

When evaluated against the study's central findings, the researchers' conclusions challenge the initial intuitive hypothesis that increased social media consumption during COVID-19 lockdowns necessarily led to worse adolescent mental health. Rather than confirming a uniform decline in well-being driven by digital

connectivity, the data reveals a nuanced distinction: synchronous, real-time interactions (such as video calls, texting, and social gaming) were associated with reduced loneliness, lower depressive symptoms, and higher flourishing, whereas asynchronous activities (posting and responding on social media) showed no significant negative impact. The major strength of this study lies in its theoretical reframing. By moving away from blunt, aggregate metrics like total "screen time," the authors distinguish forms of communication and their associations with emotional adjustment, although the study does not establish the mechanisms behind those associations. This shifts the broader academic debate from a binary framing of whether technology is inherently "good or bad" for youth toward understanding how specific communicative modes support psychological well-being. Practically, this offers a far more realistic foundation for parental guidance, advocating for behavioral direction toward reciprocal engagement rather than imposing blunt device bans.

However, significant conceptual and methodological limitations prevent these findings from serving as a definitive endorsement of digital communication. Primary among these is the direction of causality. The data only establishes correlation rather than strict causation. It remains equally plausible that well-adjusted, socially confident adolescents simply possess the psychological capacity to initiate real-time synchronous communication, while distressed, anxious, or depressed youth tend to withdraw into passive, asynchronous media consumption. This limitation is mentioned in the paper being discussed under ‘Limitations and Future Directions’.

Furthermore, the authors’ assertion that these findings extend “beyond the pandemic” raises skepticism. During stay-at-home orders, digital communication acted as a unique buffer against complete social isolation where in-person interaction was strictly prohibited. Under normal, post-pandemic conditions, high digital engagement may instead displace face-to-face peer interaction, a vital component of adolescent development (Twenge et al., 2019). This could potentially lead to negative mental health outcomes that were not observable during lockdown conditions.

The validity of the study’s claim is further constrained by unmeasured confounding variables, sample uniformity, and data collection limitations. The researchers did not record total screentime, and previous studies show significant association between screen time and mental health of adolescents, with more screentime relating to increase in negative symptoms (Ivie et al., 2020; Keles et al., 2020; Madigan et al., 2022). The control for broader pandemic-related stressors, such as family conflicts or sudden lifestyle disruptions, are also overlooked in the study. Additionally, the majority of the sample consisted of white, middle-class American adolescents who already possessed high device access and pervasive social media use. Consequently, the findings cannot be generalized to youth from lower socioeconomic backgrounds that lack access to digital communication, or populations living outside stay-at-home mandates. Methodologically, all measures of the study relied on self-reported data recall, which may contain over/underestimated numbers. The survey also failed to capture interaction quality or evaluate digital engagements with strangers, where online anonymity significantly increases exposure to negative or hostile content compared to interactions within familiar peer networks.

To resolve these ambiguities, future research must implement longitudinal designs that track the mental health data of the same subjects over extended periods to clearly disentangle cause-and-effect relationships. Researchers should re-evaluate these communicative models under post-pandemic conditions to determine whether synchronous digital tools continue to foster flourishing or begin to replace face-to-face contact. Future studies should also incorporate nuanced metrics regarding relationship quality, such as distinguishing

synchronous chats between close friends versus online strangers or unfamiliar acquaintances, and their effects on the results.

Conclusion

Ultimately, the study shows that it would be too hasty to conclude that social media use has negative effects on adolescents' mental health. A plausible explanation for such a conclusion is that synchronous digital communication was the closest option to in-person interaction, which was limited under the stay-at-home orders. While in-person communication makes a useful contribution to mental health (Stieger et al., 2023) , the study suggests that synchronous digital communication serves as a functional alternative to such practices although the absence of significant associations for asynchronous activities does not establish that those activities are ineffective or harmful.

The study suggests that social media usage may be positive when it functions in a similar way to practices established to have a positive effect on mental health (our example here would be in-person communication). This raises a question whether digital communication can wholly replace in-person socialization. However, more empirical data collected from various life contexts is needed to settle this question. Therefore, we should be cautious when approaching such conclusions.

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