Pressure, Reference Point, and Risk-taking Behavior: Evidence from Bench Press Competition[*]

Masaya Nishihata[a] Suguru Otani[b]

Abstract

This study explores the impact of pressure and reference points on risk-taking behavior and success outcomes in competitive settings. Using a unique panel dataset from official bench press competitions, we decompose the effects of pressure from rivals on lifters' risk-taking decisions and realized outcomes. Our findings reveal that pressure from lower- and higher-ranked rivals drives more aggressive weight attempts, particularly in earlier stages, with the likelihood of success increasing as pressure intensifies. In third and final attempts, pressure from higher-ranked competitors leads to more conservative choices. Counterfactual analysis shows that in the absence of pressure, lifters adopt more conservative strategies in second attempts and take greater risks in third attempts, though with reduced success probabilities. These results underscore the importance of strategic focus on personal goals and the potential benefits of disregarding external pressures in the later stages of competition.

Keywords: reference point, pressure, risk, benchpress
JEL classification: D90, Z22, L23

[*] This paper has no conflicts of interest to disclose. This work was supported by JST ERATO Grant Number JPMJER2301, Japan.
[a] Graduate School of Economics, Keio University, nishihata-masaya@keio.jp
[b] Market Design Center, University of Tokyo, suguru.otani@e.u-tokyo.ac.jp

1. Introduction

Understanding the behavioral effects of reference points, particularly in the context of pressure and risk-taking, is a critical area of research. The core concept is that an individual's assessment of an outcome is influenced not only by the outcome itself but also by how it compares to a reference point (Tversky and Kahneman 1992). Unlike controlled experimental settings as in Schwerter (2024), where risk-taking can be modeled as a simple binary lottery, field data often presents complexities that make such decompositions difficult. In this paper, we utilize a unique sequential competition setting and extensive panel dataset from official bench press competitions, offering a rare opportunity to explore the interplay between pressure and risk-taking behavior. This dataset enables us to observe weight attempts, lifting outcomes, rankings, and the exogenous pressure exerted by rivals over time.

The primary contribution of this study is the decomposition of the effects of pressure arising from reference points into distinct elements: the choice of weight attempt (analogous to a lottery choice) and the actual probability of success (analogous to a lottery gain). We also explore alternative competition designs that manipulate the availability of pressure-related information. Through this investigation, we seek to answer an analogous question in real-world competitive settings: What would be the impact on risk-taking behavior and the distribution of expected outcomes if the pressure exerted by rivals were removed?

2. Data and Background

We use the data from OpenPowerlifting which is a community service project to create a permanent and open archive of the world's powerlifting data.[c] In this paper, we focus on the bench press competition which is the most popular division and less complex than Squat-Bench-Deadlift (SBD) composite competition.

Each lifter's goal is to lift the maximum weight possible to improve their rank. Competitors are divided into categories based on weight class, age class, equipment class, and gender to ensure fair competition. Competitors declare their opening weight (first attempt) before the competition starts. The declared weights determine the initial lifting order. Lifters are arranged in ascending order based on their declared opening attempts. That is, the lifter with the lightest weight goes first, followed by the next lightest, and so on. Each lifter has three attempts. Each attempt is judged based on control, stability, and completion of lifting. A lift is considered successful if the lifter adheres to all the rules and completes the lift as per the judge's commands from the viewpoints of two of three referees. After completing an attempt, the lifter must declare the weight for their next attempt within a specific time frame (usually 1 minute after their attempt). Once a weight is declared, it generally cannot be decreased, only increased. The order of lifters is adjusted after

[c] https://gitlab.com/openpowerlifting.

each round of attempts based on the declared weights for the next attempt, again proceeding from lightest to heaviest. Each lifter's highest successful attempt is recorded as their final score.

3. Estimation

3.1. Choice of attempt weight

As the first empirical exercise, we employ a linear regression model to estimate the effect of pressure on the choice of attempt weight. We regress the outcome on the observed characteristics as follows:

$$\widetilde{W}_{it}^{k} = X_{it}\beta + Z_{it}^{k}\gamma + \varepsilon_{it}, \quad (1)$$

where $\widetilde{W}_{it}^{k}$ is the difference between lifter i's attempt weight compared to his current best in competition t at a k-th attempt, X_{it} is observed characteristics of lifter i and competition t including gender, body weight, number of competition experiences, a dummy variable for first participation, and fixed effects for competition t's equipment category, age class, division, weight class, and federation, Z_{it}^{k} is a pressure variable during attempt defined later, ε_{it} is assumed to be an i.i.d. normally distributed error, and β and γ are vectors of coefficient parameters of X_{it} and Z_{it}^{k}. Large $\widetilde{W}_{it}^{k}$ implies his choosing a more challenging attempt weight. Our primary interest lies in γ, that is, the sensitivity to pressure.

The pressure variables, Z_{it}^{k}, which are exogenous due to the sequential game setting, represent the difference between the lifter's current realized outcome and the attempted weight of the lower-ranked competitor at the next attempt, and the difference between the lifter's current realized outcome and the expected attempt weight of the higher-ranked competitor. These variables capture the potential for the lifter's rank to change by overtaking or being overtaken by the rivals.

3.2. Success probability

As the second empirical exercise, we use a linear probability model to estimate the probability of successfully lifting the attempt weight. We regress the outcome on the observed characteristics as follows:

$$Y_{it} = X_{it}\beta + \tilde{Z}_{it}^{k}\gamma + \widetilde{W}_{it}^{k}\delta + \eta_{it}, \quad (2)$$

where Y_{it} is whether the attempt is successful ($Y_{it} = 1$) or not ($Y_{it} = 0$), $\tilde{Z}_{it}^{k}$ is a pressure variable during lifting, η_{it} is an error, and δ represents the coefficient for the difference between lifter i's attempt weight and his current best. Note that $\widetilde{W}_{it}^{k}$, the choice of attempt weight, may be correlated with unobserved body conditions in η, potentially causing endogeneity issues. To address this, we employ a two-stage least squares (2SLS) regression, using Equation (1) as the first-stage regression, with the exogenous pressure variables during the attempt, $Z_{it}^{k}\gamma$, serving as instrumental variables (IV).

The pressure variable $\tilde{Z}_{it}^{k}$ during the lift is equal to one if the attempt involves overtaking a higher-ranked rival or being overtaken by a lower-ranked rival, and zero otherwise. These variables capture the potential for rank changes through overtaking or being overtaken.

4. Results

4.1. Choice of attempt weight

Our results show that pressure from rivals significantly affects the weights that lifters choose to attempt. During second attempts, pressure from both higher and lower-ranked rivals leads to more aggressive weight selection, as lifters push to outperform competitors. In third attempts, however, the impact of pressure from higher-ranked rivals leads to more conservative choices, likely due to lifters adjusting expectations as overtaking higher-ranked competitors becomes less feasible.

Table 1: Regression of the difference between the second and third attempt weight compared to the current best on pressure

	(1)	(2)
Dependent Variable	$W_{it}^{2} -$ (best)	$W_{it}^{3} -$ (best)
Pressure, lower rival, 2nd	0.481	
	(0.002)	
Pressure, higher rival, 2nd	0.483	
	(0.002)	
Pressure, lower rival, 3rd		0.869
		(0.009)
Pressure, higher rival, 3rd		-0.165
		(0.008)
Control	X	X
Num.Obs.	267062	267062
R2	0.968	0.468
R2 Adj.	0.967	0.466
RMSE	11.43	46.66

Notes: We control gender, body weight, equipment category, age-class, division, weight-class, federation, number of experience, and 1(first participation). The standard errors in the brackets are clustered at federation categories. W_{it}^{2} and W_{it}^{3} are lifter i's attempt weights in the second and third attempts in competition t. Pressure from lower rival at 2nd is (lower rival 2nd attempt) − (his 1st outcome). Pressure from lower rival at 3rd is (lower rival 3rd attempt) − (his 2nd outcome). Pressure from higher rival at 2nd is (higher rival 2nd attempt) − (his 1st outcome). Pressure from higher rival at 3rd is (higher rival 3rd attempt) − (his 2nd outcome).

4.2. Success probability

Regarding success probability, we find that lifters facing pressure in their second attempts are more likely to succeed, motivated by the fear of losing rank. In contrast, the effect of pressure on third attempts is weaker, with success probability slightly decreasing, possibly due to fatigue or reduced chances of rank improvement. This suggests that lifters adapt their strategies depending on the attempt stage and perceived benefits of taking risks.

Table 2: Regression of success probability of second and third attempts on pressure

	(1)	(2)	(3)	(4)
Dependent Variable	1(success 2nd)	1(success 3rd)	1(success 2nd)	1(success 3rd)
$W_{it}^2 -$ (best)	-0.001		-0.001	
	(0.000)		(0.000)	
$W_{it}^3 -$ (best)		0.000		0.000
		(0.000)		(0.000)
1(Turned around, 2nd)	0.086		0.086	
	(0.009)		(0.009)	
1(Turning around, 2nd)	0.038		0.038	
	(0.004)		(0.004)	
1(Turned around, 3rd)		0.009		0.008
		(0.006)		(0.006)
1(Turning around, 3rd)		0.049		0.049
		(0.003)		(0.003)
Control	X	X	X	X
IV			X	X
Num.Obs.	267062	267062	267062	267062
R2	0.052	0.021	0.052	0.021
R2 Adj.	0.048	0.017	0.048	0.017
RMSE	0.45	0.48	0.45	0.48

Notes: We control gender, body weight, equipment category, age-class, division, weight-class, federation, number of experience, and 1(first participation). The standard errors in the brackets are clustered at federation categories.

4.3. Counterfactual

In counterfactual simulations, we explore scenarios where pressure is removed. Without pressure, lifters tend to be more conservative in their second attempts, choosing weights closer to their personal bests. These patterns suggest that, in the absence of pressure, the expected outcome for

most lifters is lower than the benchmark, largely due to less challenging attempts. However, in the third attempt, lifters are more inclined to attempt weights near or slightly above their current best compared to the second attempt. This indicates that, under no pressure, the expected outcome may exceed the benchmark for a significant portion of lifters, mainly due to more challenging attempts, albeit with a slight decrease in success probability.

As practical advice for lifters seeking to maximize their expected achieved weight, each should consider adjusting their attempt plan based on the pressure experienced during the second attempt while maintaining commitment to the original plan in the third attempt, disregarding pressure from rivals. This strategy is crucial for final rankings. Similarly, in broader contexts such as maximizing expected gains from risky choices, individuals should commit to their original risky decisions, ignoring external pressures from competitors.

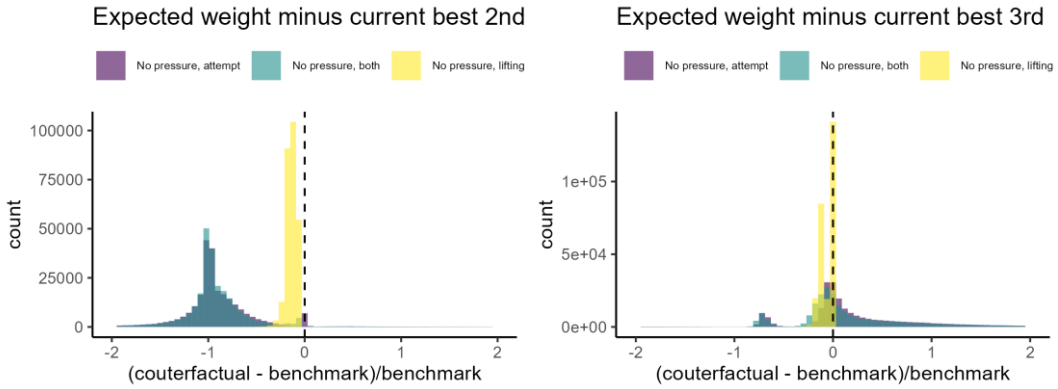

Figure 1: Counterfactual expected achieved weight minus current best weight

Notes: We use estimated coefficients in Table 1 and Columns (3) and (4) in Table 2.

Reference

Schwerter, F., 2024. Social reference points and risk taking. *Management Science*, 70(1), 616-632.

Tversky, A., and Kahneman, D., 1992. Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and uncertainty*, 5, 297-323.