Sources of frustration in the Beer Distribution Game

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Typical behaviors and decisions arising from the beer distribution game (BDG) are well documented and understood. One such observation that has been frequently reported by the game facilitators is that players frequently get frustrated. Sterman (1992) says that many players report feelings of frustration and helplessness, blame their teammates for their problems, and the sometimes even heated arguments break out. Croson and Donohue (2005) found in informal post-game discussions with student participants that some downstream members felt frustrated by not being able to counteract what they saw as poor decisions made by their suppliers. The suppliers, in a similar manner, experienced frustration towards downstream members because of the seemingly capricious ordering decisions they received and could not influence. Similar observations have been reported by many BDG facilitators over the years but this frustration as such is usually not discussed further. There is a lack of studies attempting to understand at what points in the game people get frustrated and what are sources of their frustration. This paper presents some insights into these questions based on an online BDG experimental study.

Individuals in the BDG, similar to individuals in organizations, make decisions that have both economic and socio-emotional consequences, with the obvious restriction of BDG being a virtual environment and not a real-world one. As Colquitt (2001) explains, the importance of those consequences causes individuals to judge the decision making process they experience and to ask themselves whether or not it was fair. We use players' evaluations of fairness of different aspects of the BDG as a measurement of their frustration with the game. The four aspects we will be looking into are based on four different types of fairness established in the literature: (1) distributive fairness, (2) procedural fairness, (3) interpersonal fairness, and (4) informational fairness (Colquitt, 2001). Additionally, we analyze their in-game level of frustration by measuring their satisfaction at different points in the game. Finally, we want to find out whether their own performance in any way affects their evaluations during or after the game.

This study uses structural equation modeling to evaluate hypothesized relationships between the profit and the frustration measures. The relationships we are testing are between players' performance (measured as their final profit) and the reported intermediate levels of satisfaction, as well as their evaluation of fairness of different aspects of BDG measured with the four-factor fairness model. We use standard controls such as gender, nationality, education level and previous experience with the BDG. Additionally, we divided our subjects into two groups based on the profit information available to them during the game.

In order to conduct our study, we developed a computer-based flight simulator of the BDG in which players take over a single position in the supply chain, while other positions are replaced by computer algorithm. We used the Forio Epicenter® interface that consists of multiple pages through which a player progresses over approximately 30-45 minutes. The game lasts for the standard 36 weeks and, at the beginning of each week, players are provided with either complete profit information or incomplete profit information in graph and table form. Additionally, players receive information about inventory and backlog in graph and table form, information about the incoming order from the downstream stage, and the information about the number of cases arriving next week from the upstream stage.

The game itself is driven by the demand pattern used in the standard version of the game. Final customer demand is constant at four cases until week five, after which it jumps up to eight cases for the rest of the

game. Upon completing the game, the players are redirected to the questionnaire screens. The first screen contains basic demographics controls, followed by one screen with questions for each of the four categories of the fairness model. The fairness questions are based on the measures compiled and suggested by Colquitt (2001).

We conducted the experiment at two different occasions, in April and September of 2020. Participants were recruited among bachelor and master business students from two German universities. In total, 60 participants finished the game and completely answered the questionnaire. We had no missing values in our data, but observed two unengaged responses (answering all questions in the final questionnaire with the value of 3), which caused us to eliminate two responses, resulting in 58 valid cases. There were no outliers in any of observed demographics controls. Overall, our measurement model exhibits good fit, which can be seen in Table 1 (indices and thresholds based on Kline, 2016).

Table 1. Model fit scores

Measure	Scores	Rating
Chi-square	1.373	Good (<3)
RMSEA	0.081	Moderate (<0.1)
CFI	0.904	Good (>0.9)
SRMR	0.0834	Good (<0.09)

Based on these results, the first simple analysis we conducted was the comparison of means of the in-game satisfaction and the four fairness factors. We can observe that players start moderately satisfied (the mean reported satisfaction at week 0 is 2.6 with standard deviation of 0.917). During the game, their satisfaction tends to go down (86.2% of the players report a mean level of satisfaction below 2.67). Low levels of in-game satisfaction, however, do not translate into low scores on all four fairness factors. Distributive aspects are evaluated as the most unfair, procedural scores are moderate, while interpersonal and informational fairness are evaluated as fair to large extent.

Our results would suggest that players in the BDG do not get frustrated with their facilitators and the information they were provided with. There was a significant difference in evaluation of informational fairness between male and female participants, with male participants evaluating provided information as less fair than female participants, but generally participants consider the provided information as fair. Instead, it would seem that, in addition to previous observations of players being frustrated by other players, they get frustrated because they invest a lot of effort into the game itself, but the effort itself is not translated well into their performance. Rules and procedures of the game do not appear to be a major source of frustration for most of the players, but for some they may also contribute to a smaller extent.

The results we presented need to be interpreted with some caution. Our sample size is quite small, meaning the results could change as we collect more data. One important limitation is that we only collected data for two positions in the BDG, the distributor and the manufacturer. It is possible that playing as the retailer or the wholesaler would change our findings. A notable limitation of our study is that information availability was varied between the two settings so that all manufacturers played with all profit information available to them, while the distributors played with limited profit information. Our earlier study suggests that this may have a significant impact on the responses and, thus, will need to be addresses as more data is collected in the future. The measures we used may also be inappropriate to study frustration. In an effort to avoid biasing the data and the responses, we did not ask directly for their level of frustration or the sources of frustration. Instead, we measured their satisfaction with the current situation and evaluation of fairness of different aspects of the game. We interpreted low scores on these measure as signs of frustration but more research is needed before our results are fully validated.

References

Adams, J. S. (1965). Inequity in social exchange. In L. Berkowitz (Ed.), *Advances in experimental social psychology: Vol. 2. Advances in experimental social psychology* (pp. 267–299). Academic Press.

Berger, V. (2005). *Frustration.* https://www.psychologistanywhereanytime.com/emotional_problems_psychologist/pyschologist_frustration.htm

Bies, R. J., & Moag, J. F. (1986). Interactional justice: Communication criteria of fairness. In R. J. Lewicki, B. H. Sheppard, & M. H. Bazerman (Eds.), *Research on negotiation in organizations* (pp. 43–55). Jai Press.

Colquitt, J. A. (2001). On the dimensionality of organizational justice: A construct validation of a measure. *Journal of Applied Psychology*, *86*(3), 386–400. https://doi.org/10.1037//0021-9010.86.3.386

Croson, R., & Donohue, K. (2005). Upstream versus downstream information and its impact on the bullwhip effect. *System Dynamics Review*, *21*(3), 249–260. https://doi.org/10.1002/sdr.320

Đula, I., & Größler, A. (2021). Inequity aversion in dynamically complex supply chains. *European Journal of Operational Research*, *291*(1), 309–322. https://doi.org/10.1016/j.ejor.2020.09.038

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). *Methodology in the social sciences*. The Guilford Press.

Leventhal, G. S. (1976). The distribution of rewards and resources in groups and organizations. In L. Berkowitz & E. Walster (Eds.), *Advances in experimental social psychology: Vol. 9. Advances in experimental social psychology* (pp. 91–131). Academic Press.

Leventhal, G. S. (1980). What should be done with equity theory? New approaches to the study of fairness in social relationships. In K. J. Gergen, M. S. Greenberg, & R. H. Willis (Eds.), *Social exchange: Advances in theory and research* (pp. 27–55). Plenum Press.

Shapiro, D. L., Buttner, E., & Barry, B. (1994). Explanations: What Factors Enhance Their Perceived Adequacy? *Organizational Behavior and Human Decision Processes*, *58*(3), 346–368. https://doi.org/10.1006/obhd.1994.1041

Sterman, J. D. (1989). Modeling Managerial Behavior: Misperceptions of Feedback in a Dynamic Decision Making Experiment. *Management Science*, *35*(3), 321–339. https://doi.org/10.1287/mnsc.35.3.321

Sterman, J. D. (1992). Teaching takes off: Flight simulators for management education. *OR/MS Today*, 40–44.

Thibaut, J. W., & Walker, L. (1975). *Procedural justice: A psychological analysis*. Erlbaum.