Methodological and Conceptual Issues in Studying Effort-Reward Fit

Jonas W.B. Lang[1, 2], Sander Van Hoek[1], J. Malte Runge[1]

[1]Department of Human Ressource Management and Organizational Psychology, Ghent University, Belgium

[2]Business School, University of Exeter, UK

Author Preprint

Article was accepted for publication on 08-September-2020

To appear in:

Lang, J. W. B, Van Hoek, S., Runge, J. M. (in press Methodological and Conceptual Issues in Studying Effort-Reward Fit? In Searle, B. J. (Ed). Are Challenge Hindering Us? The Limitations of Models That Categorise Work Stressors. [Special issue]. *Journal of Managerial Psychology,* doi:10.1108/JMP-11-2019-0659

Abstract

Purpose. Research on effort-reward "imbalance" has gained popularity in the occupational health literature, and authors typically use effort-reward ratios to study this phenomenon. This article provides a methodological and theoretical critique of this literature, and suggestions on how future research can better study joint effects of efforts and reward.

Design/methodology/approach. The authors conducted a simulation study, analyzed panel data, and surveyed the literature on the theoretical and methodological basis of the "imbalance" concept.

Findings. The simulation study indicates that under many conditions the effort-reward ratio captures main effects of effort and reward and that effects also depend on the scaling of the variables. The panel data showed that when main effects and the interactions of effort and reward are entered simultaneously in a regression predicting mental and physical health, the significant effect of the effort-reward ratios disappears. The literature review reveals that psychological theories include more elaborate theoretical ideas on joint effects of effort and reward.

Research implications. The results suggest that moderated multiple regression analyses are better suited to detect a misfit between effort and reward than effort-reward ratios. The authors also suggest to use the term effort-reward fit in future research.

Originality/value. Methodologically and conceptually the authors showed that the effort-reward ratio is not an appropriate approach because it confuses main effects with interaction effects. Furthermore, the concept of effort-reward imbalance is better substituted by a broader conceptualization of effort-reward fit that can be integrated with the existing literature on person-environment fit. Recommendations for future research are provided.

Keywords: Ratio variables, person-environment fit, occupational health, burnout

Methodological and Conceptual Issues in Studying Effort-Reward Fit

Occupational health and stress researchers have long been interested in understanding the reasons why employees experience reduced well-being (or ill-being), stress, or burnout. A popular concept explaining detrimental health effects is effort-reward imbalance (Siegrist, 1996; Van Vegchel et al., 2005). The idea is that employees show stress-related symptoms when the ratio between the effort they invest and the perceived reward they receive in a work context is high. Research on effort-reward imbalance as a stressor category suggests that it predicts a range of physical and psychological health outcomes (Kinman, 2019; e.g., Van Vegchel et al., 2005). Effort-reward imbalance is one of a number of models that categorise multiple job characteristics into one of two groups, and as with many such models, people are now questioning whether conventional research applications of effort-reward imbalance lead to misleading conclusions.

Effort-reward imbalance is typically operationalized as the ratio between a questionnaire measuring subjective perceptions of effort for the organization, and a questionnaire asking respondents for the degree to which they feel rewarded by their organization (Siegrist *et al.*, 2004). The rationale behind using effort-reward imbalance as a stressor category is the idea that an "imbalance" between effort and rewards causes stress-related health problems in organizational members like students or employees. The effort-reward imbalance idea is typically tested using the efford-reward ratio (ERR) as predictor and without entering effort and reward simultaneously in regression analyses (Pelissier et al., 2015; Peter et al., 1998).

In this article, we advance research on effort and rewards as a form of stressor by critically examining methodological approaches and developing a set of recommendations for future research in this area. We identify three main issues with combining stressors and buffers into a single joint effort-reward imbalance category and associated data analytical strategies.

First, researchers have frequently argued that it can be problematic to include ratios as a single predictor in regression analysis because it confounds interaction and main effects (Certo et al., 2020; Kronmal, 1993; Lang et al., 2010). Second, as we show below, when reward is used as a divisor in a ratio it is not a linear function of reward. These two issues related to the measurement of effort-reward imbalance as a stressor category suggest that the ERR is not an operationalization of the theoretical concept of imbalance. A third issue is that the effort-reward imbalance theory does not necessarily offer advantages over psychological theories with similar predictions on misfit or imbalance of effort and rewards and is not well integrated with these theories. The contribution of our article is that we demonstrate these issues and explain to researchers how they can potentially addressed in future research. We suggest—based on methodological arguments (Kronmal, 1993; Lang et al., 2010) and previous studies on effort-reward imbalance (Lang et al., 2010; Van Vegchel et al., 2005) —that full moderated multiple regression (MMR) analysis (Aiken and West, 1991) with effort-reward interactions and effort and reward as separate predictors is an appropriate measurement of a misfit or imbalance idea. First, we show how MMR addresses the problems associated with ERR mentioned above and explain its value for developing interaction theories. We then use simulations to compare both approaches—ERR and MMR—in their capability to successfully detect a misfit between effort and reward when it is present and detect no misfit when it is not present. Finally, we use an empirical dataset to demonstrate that these choices also occur in typical real data.

Theories of Occupational Well-being

The occupational well-being literature has many different theories for modeling the effects of stress. Most theories include different types of stressor categories, an approach that is intuitively appealing but also comes with several disadvantages. One of the most influential

models of occupational stress is the Demands-Control model (Karasek, 1979). Karasek (1979) argued that high job demands cause strains but job control can buffer the impact of job demands on strains. Workers who experience high levels of job demands with low levels of job control would experience the most strain. Job demands is a relatively broad category including different types of stressors and researchers have argued that different stressors may be differently related to health outcomes (Clarke, 2012; Podsakoff et al., 2007).

A more recently developed occupational stress model is the job demands-ressources model that addresses some of the limitations of the Demands-Control model (Bakker and Demerouti, 2007). The job demands-ressources model explains strain as a response to an imbalance between work related demands and ressources that are available to cope with the job demands. The model is relatively broad in that it includes several types of demands and ressources and focusses not only on stress as outcome but also on employee well-being. It can be interpreted as flexible framework that integrates other occupational stress theories.

A theory focusing on differentiating types of stressors is the challenge-hindrance approach (Cavanaugh et al., 2000; LePine et al., 2005). Stressors are categorized according to their potential to support an employee's goals (challenge stressors) or to obstruct goal attainment (hindrance stressors). Although both types of stressors can cause stress, the stress associated with challenge stressors is positively associated with job satisfaction and negatively with the intention to leave (Podsakoff et al., 2007). In contrast, stress resulting from hindrance is negatively associated with job satisfaction. The challenge-hindrance approach has been criticized because most of the research on it uses a priori categorizations of stressors as challenges and hindrances, The model thus does not account for the possibility that individuals appraise the same stressors differently (Searle and Auton, 2014).

The Effort-Reward Approach

The focus of this study is on the effort-reward imbalance theory that can be seen as a special case of the the job demands-ressources model in that effort is a specific type of job demand and reward a specific type of resource. The core of this theory centers around detrimental effects of an imbalance between effort and reward. The effort-reward imbalance (ERI) model identifies distinct features of health-adverse psychosocial working conditions, with a focus on the work contract and subjective perceptions of the work environment. The model distinguishes between intrinsic and extrinsic components (Van Vegchel et al., 2005). The extrinsic components refer to an imbalance between efforts and rewards. It is built on the assumption that effort at work is spent as part of a contract based on the norm of social reciprocity where rewards are provided in terms of money, esteem, and career opportunities including job security (Siegrist, 1996). Imbalances refer to situations where the reciprocity between effort and reward is not met which may cause stress-related health problems in organizational members. The core of the theory, thus, combines effort and reward into a stressor imbalance category.

The intrinsic component refers to individual differences in overcommitment, including the need for control and a desire for approval (Siegrist, 1996, 2002; Van Vegchel et al., 2005). Overcommitment is a specific pattern of coping with demanding situations characterized by excessive engagement and desire of being in control (Siegrist and Li, 2016). Researchers have suggested that effects of effort-reward imbalance are moderated by overcommitment (Kinman, 2019). Highly overcommitted individuals may show an increased risk of poor health, especially when effort-reward imbalance is high. Evidence for the explanatory power of overcomitment and the interactive effects with effort reward imbalance are somwhat inconsistent (Kinman, 2019;

Siegrist and Li, 2016; Van Vegchel et al., 2005). Most studies on ERI, however, focus on the misfit between effort-reward imbalance. Thus, in this study, we focus on the misfit between effort and reward and not on overcommitment.

A major contribution of the model was the insight that rewards may be important for the relationship between job demands and stress. Previous research has typically focused on job control (Karasek, 1979). After a period of increasing interest in effort-reward imbalance research, there is now a steady stream of research. A search in Web of Science for the term "effort-reward imbalance" revealed more than 100 papers each year over the last six years.

The effort-reward imbalance theory shows some similarity to the challenges-hindrance approach because both models include a broad category describing detrimental effects on health (effort and hindrance) and a broad category with positive effects on health (rewards and challenges). Both approaches, however, differ in what the broad categories encompass.

An important difference is that the categories with a positive relationship to health outcomes differ in what they encompass. Rewards refer to a type of compensation employees receive for their work, and challenges are aspects of the job itself that may be stressful (but have a positive effect on health). The challenges-hindrances approach, thus, differentiates stressors based on their relationship with the outcomes. In effort-reward imbalance theory, efforts are typically seen as stressors having negative relationships with health. Thus, one could argue that the challenges-hindrance approach uses a more fine grained differentiation between stressors. However, researchers pointed out that an important limitation of the challenge-hindrance model is that the differentiation between stressors is actually too coarsed (Staufenbiel and König, 2010; Wood and Michaelides, 2016) and that categorizing different stressors based on their relationship with outcomes may cover up important differences in the underlying mechanisms. As effort-

reward imbalance may be seen as even broader category, this criticism on challenges-hindrance research naturally also applies to it.

Researchers have frequently only investigated effort-reward imbalance—which is the core aspect of the theory—and not separate effects of effort and reward. Investigating effort-reward imbalance and not separate effects of effort and reward can cover underlying mechanisms—for instance the main effects of effort and reward—and makes it difficult to disentangle different processes. From a theoretical standpoint it seems useful to first focus on separate effects of effort (which may increase stress) and rewards (which may reduce stress) and only when these effects are taken into account, focus on the mechanical interplay of effort and reward (giving more effort than receiving rewards creates cognitive imbalance and stress). The idea of imbalance is closely related to the rationale behind using the effort-reward ratio. ERR values close to zero would indicate a favorable condition (relative low effort and relative high reward), whereas values beyond 1.0 would indicate an imbalance of investing much effort that is not met by rewards received or expected. In this study, we show that measuring effort reward imbalance using ERR is likely to accentuate the imbalance effect and diminish the role of effort and reward as main predictors of stress. Furthermore, there are methodological issues associated with using ratios as predictors that may have important consequences for how well misfits can be captured by ERRs.

Systematic Literature Review

To investigate how widespread investigating effort-reward imbalance with ERR and without main effects of effort and reward is in the current literature, we conducted an analysis of the effort-reward imbalance literature in 2019. We searched in Web of Science for “effort-reward imbalance” in the topic search for papers published in 2019, which resulted in 133 papers. We

removed 20 papers that were not empirical, 37 that mentioned but did not measure effort-reward imbalance, 11 that were not in English, and five papers that we could not get access to. We thus included 60 papers in our analyses. As shown in Table 1, 78.3% of these papers used the ERR in models without including the main effects for effort and reward, 20.0% used the ERR with the main effects, and only one paper (1.7%) used the main effects and an interaction term. Thus, a substantial amount of research on effort-reward imbalance relies on the ERR as a single predictor.

Regression Analyses with Ratio Variables

The effort-reward imbalance model suggests that employees who put more effort into their work than they receive back from their organizational environment should experience a decrease in psychological or physiological health. To test this idea, it is important that effort-reward imbalance is operationalized and conceptualized such that statistical methods successfully identify imbalances. However, statisticians have argued that ratio coefficients—typically used as the operationalization of effort-reward imbalance—can lead to problems in statistical analyses (Pearson, 1896; Neyman, 1952; Firebaugh and Gibbs, 1985; Kronmal, 1993; Dunlap *et al.*, 1997). Pearson (1896) used the term "spurious correlation" to describe correlations between ratios that exist even if all the component variables of the ratios are uncorrelated. Neyman (1952) provided a famous hypothetical example with data on the relationship between newborn babies and storks. In Neyman's example, both the number of storks and the number of babies are divided by the number of women. When a regression with storks/women as the predictor of babies/women is run, the *b* weight for storks/women is highly significant and the correlation is $r = 0.63$. However, when the number of babies is predicted using the number of storks and the number of women as a control variable the regression weight for storks is exactly

0.

An article by Kronmal (1993) provides a detailed account of the statistical problems that occur when one uses ratios in regression analyses. Kronmal suggests that a ratio as a dependent variable is only appropriate when also all elements of the regression equation on the predictor side are divided by the same denominator variable. For instance, in Neyman's example, the effect of storks/women on babies/women becomes 0 when 1/women is added as an additional predictor.

Research on effort-reward imbalance typically uses a ratio (ERR) as an independent variable. In this scenario, it is important to realize that the ratio is effectively an interaction effect between X (effort) and 1/Z (1/reward). Kronmal (1993) shows that the use of a ratio in this context is only appropriate when its constituents are also added as main effects. For instance, when the regression equation is $Y = b_0 + b_1(X) + b_2(1/Z) + b_3(X/Z)$ the use of a ratio is statistically appropriate as X/Z is equivalent to the product of X and 1/Z and thus the ratio is simply an interaction between X and 1/Z. The use of a ratio in this equation would also make theoretical sense when a researcher could justify that 1/Z is more in line with his or her theory than using Z directly. As we discuss below, this may not always be the case. In contrast, using a ratio as an independent variable is not statistically correct when $b_1(X)$, $b_2(1/Z)$ or both $b_1(X)$ and $b_2(1/Z)$ are not included in the analysis. This logic is analog to testing interaction effects in MMR analyses where the literature shows that all main effects that make up the interaction term(s) need to be included in the regression equation. When the main effects are omitted, the interaction term does not test the interaction effect but instead a conglomerate of the interaction effect and the omitted main effects. Researchers may then erroneously conclude that the ratio is important when there is actually no interaction in the data and the ratio is only a significant

predictor because it also includes the main effects.

ERR as a Test of Effort-Reward Misfit or "Imbalance"

Most research investigating the notion of effort-reward imbalance use ERR as a predictor but do not include effort and 1/reward as control variables of main effects and instead use the basic model $Y = b_0 + b_1(\text{effort/reward})$. This approach has two problems.

First, the effect for effort/reward does not only capture an effort-reward misfit but also the omitted main effects for effort and 1/reward. The ERR regression coefficient, therefore, cannot be interpreted as a test of misfit or imbalance because it may result from substantial main effects of either effort, 1/reward or both that exist in the data.

Second, the use of 1/reward instead of reward as a predictor may affect the results because 1/reward is not a linear function of reward. 1/reward has higher values when reward is close to 0 (e.g., 1/0.2 = 5) and then has lower values when reward is beyond 1 (e.g., 1/50 = 0.02). The scale of the predictor variables effort and reward on a particular scale or sample accordingly changes the results.

To understand the implications of these two problems for research using the ERR approach, it is useful to plot how data that is in line with the typical ERR model looks like. Figure 1 describes the relations between effort, reward, and, ill-being on the basis of a regression model with the ERR as the only predictor, $Y = b_0 + b_1(\text{effort/reward})$. In Figure 1, b_0 is 50 and b_1 is 1.5 and both reward and effort are systematically varied. In Figure 1A, the scales for effort and reward are close to the *M*s and *SD*s for effort and reward in a recent paper on effort-reward imbalance (Williams *et al.*, 2018).

As indicated by Figure 1A, persons with high effort have relatively higher levels of ill-being. A person with low reward also has relatively higher levels of ill-being. The magnitutde of

these effects somewhat differs across the scale continuum like in an interaction effect. This pattern of results emerges because the single ERR effect in the typically used $Y = b_0 + b_1$(effort/reward) model is a fixed combination of main effects for effort, 1/reward, and the interaction effort × 1/reward.

This situation has major implication in actual empirical research because a significant ERR effect in a regression analysis without effort and 1/reward may indicate a substantial effort effect, a substantial 1/reward effect, a substantial effort × 1/reward interaction, or a combination of these three effects. A researcher who interprets a significant ERR effect as evidence of effort-reward imbalance/misfit may accordingly conclude that the theory is supported when there is no actual evidence for it in the data.

Figures 1B and 1C illustrate what happens when the scales for effort and reward change. When the effort and reward scales have higher absolute values, the main effects of effort and reward are more important in the ERR effect. In contrast, when the effort and reward scales have smaller absolute values, the relative effect of the interaction becomes larger (Figure 1C). A simple transformation of a predictor scale can accordingly change the results when a researcher uses the ERR approach. For instance, a researcher who scores his Likert scale from 1 to 5 and then takes the average of the Likert scale will find different effects than a researcher who simply aggregates his Likert responses. This observation is important because psychologists commonly avoid assumptions on the absolute values of their measurement scales and use methods like correlation coefficients, multiple regression, or MMR with centered variables that are not sensitive to changes in the scaling of the predictor variables.

Simulation Study

The discussion up to this point shows that the use of the $Y = b_0 + b_1$(effort/reward) model

is methodologically problematic (a) because it omits the main effects and (b) because the use of 1/reward in the effort x 1/reward interaction is difficult to justify and leads to a situation in which the scaling of the predictor variables affects the results. However, an important question from a practical research perspective is whether these methodological issues do matter in typical research settings. To provide additional insights, we conducted a small simulation. Our goal was to quantify and understand the degree to which the ERR model under-detects or over-detects patterns of effort-reward misfit or imbalance.

The core idea behind simulation studies is the idea that a statistical method is a detection tool that should correctly detect when an effect is present in the model (or mechanism) that generated the data (statistical power). When the mechanism is present, the p-value should be significant. However, a viable statistical method should also detect when an effect is not present in the sense that the p-value should then not be significant (low false-positive rate).

Figure 2 shows four different scenarios that were included in the simulation study. The first scenario includes main effects but no interaction and thus no evidence of misfit/imbalance (Figure 1A). The other three scenarios include main effects and a positive interaction effect (Figure 1B), main effects and a negative interaction effect (Figure 1C), and a positive interaction effect but no main effects (Figure 1D) and thus all include substantial misfit/imbalance.

The simulation study generated 10,000 datasets with a sample size of 300 for each of the four scenarios. In the next step, we fitted (a) a MMR analysis, $Y = b_0 + b_1(\text{effort}) + b_2(\text{reward}) + b_3(\text{effort*reward})$, (b) the typical ERR model, $Y = b_0 + b_1(\text{effort/reward})$, and (c) a modified ERR model that also included both main effects, $Y = b_0 + b_1(\text{effort}) + b_2(1/\text{reward}) + b_3(\text{effort/reward})$.

The exact starting parameters for generating the simulated datasets and the results of the

simulations are shown in Table 2 and were based on typical effort-reward research (e.g. Siegrist *et al.*, 2009). As indicated by Table 2, MMR rarely detects an effect when no effect is present (5 percent), and also typically detected the presence of an effect in the scenarios in the simulation study (more than 70 percent). In contrast, the ERR analysis systematically mis-flags data with main effects as indicating effort-reward misfit. The ERR model also fails to detect effort-reward misfit when no main effects are present in the model. The simulation also shows that these results are largely caused by the missing main effects. When the main effects effort and 1/reward are added to the model the results improve dramatically. The power is still lower than with the standard MMR model in some specific scenarios but overall the results are quite close. Readers interested in the simulations study can download the R script for the simulation study like the other material of this paper online (https://osf.io/7m5gz/?view_only=5ae18119fbf6410ca3251c6cc52db6b7).

Overall, the simulation results show that the ERR model detects misfit in data without any misfit and vice versa fails to detect misfit when it clearly exists. These results suggest that significant ERR effects cannot be interpreted as evidence for an actual effort-reward misfit. An appropriate test for a misfit or imbalance idea is full MMR analysis.

Empirical Study

Earlier studies have linked effort-reward imbalance to both mental health outcomes like depressive symptoms (Rugulies et al., 2017; Siegrist, 2008). Researchers have also linked the ERR to physical symptoms like fatigue, the common cold, back pain, or gastro-intestinal symptoms (de Jonge et al., 2000; Peter et al., 1998). The goal of our empirical study was to investigate the degree to which the link between effort-reward imbalance and health is influenced by how effort-reward imbalance is conceptualized in an actual empirical dataset. We

therefore compared the standard method—ERR as a single predictor—with MMR using effort, reward, and the interaction of effort and reward as predictors.

Participants

Respondents were part of the Dutch population that participated in the Longitudinal Internet Study for the Social Sciences (LISS) panel study panel administered by CentERdata (Tilburg University, The Netherlands). We used a specific study of the LISS, in which effort and reward was measured in 2013 and linked the sample to the health questionnaire that was collected in the same time span. From the total sample of 5,478 respondents, we excluded 2,141 respondents that did not work, and 3 respondents for which we had no complete information on effort and reward. The final sample comprised 2,138 respondents (1,083 were female) with a mean age of 45.94 (*SD* = 11.09; range from 18 to 65).

Measures

Effort (Cronbach's α = .63) and reward (α = .77) were measured with five and ten items from the Dutch version of the Effort Reward Imbalance Questionnaire (Siegrist et al., 2004), respectively. Respondents answered on a scale from (1) *strongly disagree* to (4) *strongly agree.* We built sum scores for effort and reward, and then calculated the ERR as effort/reward (Siegrist et al., 2004). To correct for the difference in the number of items between effort and reward, we multiplied effort/reward by the ratio of the number of items, 5/10.

Mental health (α = .84) was measured using the five-item Mental Health Inventory (Cuijpers, Smits, Donker, ten Have, & de Graaf, 2009). Participants were asked to indicate how often during the past month they experienced emotions such as "I felt very depressed and gloomy" on a scale ranging from (1) *never* to (6) *continuously*.

Physical health was measured using a checklist covering eight physical symptoms such as

pain in back and joints, heart complaints, short breath, coughing, stomach issues, headache, fatigue, and sleeping problems. Respondents indicated whether or not they regularly suffered from these symptoms ($\alpha = .66$).

Analysis

We first analyzed the link between effort-reward imbalance and physical and mental health using the commonly applied approach with ERR as single predictor in a regression in Model 1. We then analyzed the same link using MMR, and included effort and reward as a main effects, as well as an interaction term for effort and reward.

Results and Discussion

As shown in Table 3, when the ERR was used as a single predictor (Model 1), it was strongly positively and significantly related to both mental ($t = 8.96$) and physical health ($t = 7.20$). However, when effort, reward and the interaction between effort and reward were entered simultaneously (Model 2), effort-reward misfit—conceptualized as an interaction term—was not a significant predictor of mental ($p = 0.724$) and physical health ($p = 0.782$). These results demonstrate that using the ERR as single predictor may lead to false positives and support for the effort-reward imbalance hypothesis when there is no statistical support of this idea.

We further found that reward was a significant predictor of health, indicating that higher ratings of reward are associated with less health issues. Main effects of reward experiences on health have received less research attention than effort-reward imbalance, although a few researchers have been interested in this topic (Geschwind et al., 2010). Studying the buffering qualities of rewards may be an interesting and promising research approach in itself.

The Theoretical Concept of Effort-Reward "Imbalance" and Potential Alternatives

There are also several theoretical challenges with research on effort-reward imbalance.

One challenge that transfers from the methodological discussion to the theoretical discussion are issues around the operationalization of the construct. Theoretical work on effort-reward imbalance is closely linked to the operationalization of the construct through the ERR. Researchers have suggested that the use of the ERR is theoretically more in line with theory on effort-reward imbalance and therefore discards the MMR results in light of the significant ERR effects (Williams et al., 2018). This argument is line with the majority of earlier articles on effort-reward imbalance (Siegrist, 1996; Siegrist et al., 2004) even though other authors have considered interaction effects (Van Vegchel et al., 2005) and also used them in their research (Lang et al., 2010). As the simulation results in the previous section and our empirical study have shown, using the ERR without the main effects for effort and 1/reward is not an acceptable operationalization of misfit or imbalance. The typical regression model with ERR as the predictor is basically an incomplete MMR model that uses 1/reward instead of reward as a linear predictor. Our findings clarify that MMR is better suited to analyze imbalance or misfit than ERR because it adequately tests misfit and has inherent advantages over ERR both for theory and practice.

A second challenge of research on effort-reward imbalance is that the original theory on effort-reward imbalance only provides a reference to sociological theorizing to explain the specific situation of high effort and low reward on why effort and reward should interact. Siegrist (1996) wrote:

> "According to sociological theories of self and identity (Mead, 1934; Schutz, 1962-1964) such threats [high cost low gain] are likely to occur if the continuity of crucial social roles is interrupted or lost. Under these circumstances, control over basic interpersonal rewards is restricted, and as a consequence, self-esteem and emotional well-being are impared. (p.

30)”

There are also several psychological theories that include the notion that a discrepancy or interaction between effort and reward can lead to ill-being or stress and that provide more detail on the mechanisms that are responsible effort-reward misfit or discrepancy effects.

One example is Aronson’s (1969) discussion of rewards in the context of cognitive dissonance theory. He suggested that for individuals who feel dissonance between their own beliefs and their behavior, the dissonance can be reduced when they receive a good justification in the form of a reward so that dissonance and rewards get weighted against each other. For instance, an employee may hold the belief "I do not like my job" but he also works very hard. A high reward in the form of high status or good compensation may make up for the perception of this discrepancy. A compelling element of this theory is that it can readily explain why some employees may not develop reduced well-being or stress.

A second example of a theory that includes a comparison between effort and reward is equity theory (Adams, 1963; Colquitt et al., 2005). Equity theory asserts that people feel equity or fairness when their input and outcomes are in the same ratio as the input and outcomes of others. Equity theory is particularly popular in research on distributive justice and pay satisfaction.

Finally, a third example of a theory that includes comparisons or discrepancies between effort and reward is distributive justice theory (Colquitt et al., 2005; Deutsch, 1985; Leventhal, 1976). Distributive justice theories assert that people apply justice norms to relationships and feel distributive injustice when these justice rules are violated. This type of injustice leads to distress.

All three mentioned theories provide a relatively clear description of why an effort-reward discrepancy should lead to reduced well-being: Cognitive dissonance between behavior

and rewards in dissonance theory and unfairness in equity and distributive justice theory. One the one hand, the existence of these theories somewhat questions the focus on effort-reward imbalance. On the other hand, they also put the concept on a somewhat broader foundation by linking it to extant research in social and organizational psychology. Future research may benefit from explicitly studying this link to complement the existing sociological focus of effort reward imbalance theory with psychological theories of underlying mechanisms.

Discussion

In this article, we provided a critical discussion of the existing literature on effort-reward imbalance. Methodologically and conceptually, we showed that effort-reward imbalance as a stressor category, measured with the ERR is not an appropriate conceptualization of imbalance. Our simulation study and our empirical study demonstrated how using the ERR entices researchers to interpret main effects of effort and reward as evidence for imbalance effects. We further demonstrate that the use of MMR will solve this issue and we accordingly suggest that all future research should use MMR. In addition to our methodological critique of the effort-reward imbalance literature, we also discussed the theoretical status of the conceptualization.

An Agenda for Future Research on Effort-Reward Dissonance

The discussion and the simulations in this note have several direct implications for the interpretation of existing and the design of future research. The first implication is that the ERR is not an appropriate operationalization for misfit or imbalance. On the basis of the reported simulation results, it is likely that many existing studies in the literature may falsely report evidence for a misfit between effort and reward. Likewise, there may also be studies that actually provide evidence for an interaction effect. However, the latter situation may occur less frequent because the ERR is typically primarily determined by the main effects.

A second implication of this note is that existing data should be reanalyzed using more appropriate methods so that researchers can check whether existing studies actually provide evidence for the idea that a misfit between effort and reward leads to reduced well-being. One solid strategy for future research is to use MMR. Another potentially fruitful approach that extends MMR is to use polynomial regression analyses (Edwards, 2007). Polynomial regression is frequently used in the literature on person-environment fit and is a more flexible method than MMR. Specifically, polynomial regression adds curvilinear terms and thus can account for more complex types of fit and misfit. A question that could be studied using polynomial regression is whether an increase in misfit is exponentially related to an increase in ill-being. Some researchers have found non-linear relations between stressors and health (Janssen, 2001; Tadić et al., 2015). Some researchers even identified moderators who influenced the non-linear relationship between a stressor and its outcome (Long et al., 2015). With polynomial regression possible boundary conditions for the impact of misfts on health could be identified. Identifying moderators and boundary conditions will help in better understanding the underlying mechanisms for the relationship of misfits between effort and reward with health.

A third implication is that the use of the term “imbalance” is likely problematic for future research because the term is closely linked to the use of the ERR and the notion that the scaling of the predictor variables that enter the ERR ratio matter. A better alternative may be to substitute the term with either the term effort-reward dissonance on the basis of one of the first theories that suggested that a misfit between effort and reward could lead to distress, or alternatively, to use the more general and more descriptive term effort-reward fit. In further developing research on efforts and rewards as an important stressor framework, using effort-reward fit as the new term for the concept may be the easiest approach and we therefore suggest

that future researchers use this term.

Finally, as we noted in our introduction, classifying different stressors and ressources into a single category is frequently suggested by many different occupational stress theories. As we have broadly discussed, effort-reward imbalance can be seen as an occupational stress theory combining effort and rewards into one ratio category. However, effort and reward—as conceptualized in effort-reward imbalance measures—also contain different types of stressors themselves. For instance, effort includes time pressure and working overtime, high work responsibility, and physical demands. Rewards include esteem, promotion, and security (Siegrist *et al.*, 2004). Classifying different stressors and ressources into a single category has, however, not always been the preferred approach and researchers have previously built theories based on single and distinct stressors. Research focusing on separate and distinct stressors has found that—although they may all lead to an increase in stress and strain—different stressors were seen as having different qualities, mechanisms, and effects (Warr, 1987). We accordingly also suggest that future research may investigates whether fit for different efforts and rewards show similar or diverging mechanisms. For instance, it may be interesting to understand whether a misfit of high work responsibility and promotion has a more detrimental effect on health than a misfit of high work responsibility and security.

References

Adams, J.S. (1963), "Towards an understanding of inequity", *The Journal of Abnormal and Social Psychology*, Vol. 67 No. 5, pp. 422–436.

Aiken, L.S. and West, S.G. (1991), *Multiple Regression: Testing and Interpreting Interactions.*, Sage, Newbury Park, London.

Aronson, E. (1969), "The theory of cognitivie dissonance: A current perspective", *Advances in Experimental Social Psychology*, Vol. 4, pp. 1–34.

Bakker, A.B. and Demerouti, E. (2007), "The Job Demands-Resources model: State of the art", *Journal of Managerial Psychology*, Vol. 22 No. 3, pp. 309–328.

Cavanaugh, M.A., Boswell, W.R., Roehling, M. V. and Boudreau, J.W. (2000), "An empirical examination of self-reported work stress among U.S. managers", *Journal of Applied Psychology*, Vol. 85 No. 1, pp. 65–74.

Certo, S.T., Busenbark, J.R., Kalm, M. and LePine, J.A. (2020), "Divided We Fall: How Ratios Undermine Research in Strategic Management", *Organizational Research Methods*, Vol. 23 No. 2, pp. 211–237.

Clarke, S. (2012), "The effect of challenge and hindrance stressors on safety behavior and safety outcomes: A meta-analysis", *Journal of Occupational Health Psychology*, Vol. 17 No. 4, pp. 387–397.

Colquitt, J.A., Greenberg, J. and Zapata-Phelan, C.P. (2005), "What is organizational justice? A historical overview", in Greenberg, J. and Colquitt, J.A. (Eds.), *Handbook of Organizational Justice*, Erlbaum, Mahwah, NJ, pp. 1–58.

Cuijpers, P., Smits, N., Donker, T., ten Have, M. and de Graaf, R. (2009), "Screening for mood and anxiety disorders with the five-item, the three-item, and the two-item Mental Health

Inventory", *Psychiatry Research*, Vol. 168 No. 3, pp. 250–255.

Deutsch, M. (1985), *Distributive Justice: A Social-Psychological Perspective*, Yale University Press, New Haven, CO.

Dunlap, W.P., Dietz, J. and Cortina, J.M. (1997), "The Spurious Correlation of Ratios that Have Common Variables: A Monte Carlo Examination of Pearson's Formula", *The Journal of General Psychology*, Vol. 124 No. 2, pp. 182–193.

Edwards, J.R. (2007), "The relationship between person-environment fit and outcomes: An integrative theoretical framework", in Ostroff, C. and Judge, T.A. (Eds.), *Perspectives on Organizational Fit*, Jossey-Bass, San Francisco, CA, pp. 361–372.

Firebaugh, G. and Gibbs, J.P. (1985), "User's guide to ratio variables", *American Sociological Review*, Vol. 50, pp. 713–722.

Geschwind, N., Peeters, F., Jacobs, N., Delespaul, P., Derom, C., Thiery, E., van Os, J., et al. (2010), "Meeting risk with resilience: high daily life reward experience preserves mental health", *Acta Psychiatrica Scandinavica*, Vol. 122 No. 2, pp. 129–138.

Janssen, O. (2001), "Fairness Perceptions as a Moderator in the Curvilinear Relationships Between Job Demands, and Job Performance and Job Satisfaction", *Academy of Management Journal*, Vol. 44 No. 5, pp. 1039–1050.

de Jonge, J., Bosma, H., Peter, R. and Siegrist, J. (2000), "Job strain, effort-reward imbalance and employee well-being: a large-scale cross-sectional study", *Social Science & Medicine*, Vol. 50 No. 9, pp. 1317–1327.

Karasek, R.A. (1979), "Job Demands, Job Decision Latitude, and Mental Strain: Implications for Job Redesign", *Administrative Science Quarterly*, Vol. 24 No. 2, pp. 285–308.

Kinman, G. (2019), "Effort-reward imbalance in academic employees: Examining different

reward systems", *International Journal of Stress Management*, Vol. 26 No. 2, pp. 184–192.

Kronmal, R.A. (1993), "Spurious correlation and the fallacy of the ratio standard revisited", *Journal of the Royal Statistical Society: Series A*, Vol. 156 No. 3, pp. 379–392.

Lang, J., Bliese, P.D., Adler, A.B. and Hölzl, R. (2010), "The role of effort-reward imbalance for reservists on a military deployment.", *Military Psychology*, Vol. 22 No. 4, pp. 524–542.

LePine, J.A., Podsakoff, N.P. and LePine, M.A. (2005), "A meta-analytic test of the challenge Stressor-hindrance stressor framework: An explanation for inconsistent relationships among Stressors and performance", *Academy of Management Journal*, Vol. 48 No. 5, pp. 764–775.

Leventhal, G.S. (1976), "The distribution of rewards and resources in groups and organizations", *Advances in Experimental Social Psychology*, Vol. 9, pp. 91–131.

Long, C., Li, Z. and Ning, Z. (2015), "Exploring the nonlinear relationship between challenge stressors and employee voice: The effects of leader–member exchange and organisation-based self-esteem", *Personality and Individual Differences*, Vol. 83, pp. 24–30.

Neyman, J. (1952), *Lectures and Conferences on Mathematical Statistics and Probability*, 2nd ed., Vol. 142, US Department of Agriculture, Washington, DC, available at:https://doi.org/10.1038/142274a0.

Pearson, K. (1897), "Mathematical contributions to the theory of evolution.—On a form of spurious correlation which may arise when indices are used in the measurement of organs", *Proceedings of the Royal Society of London*, Vol. 60 No. 359–367, pp. 489–498.

Pelissier, C., Fontana, L., Fort, E., Vohito, M., Sellier, B., Perrier, C., Glerant, V., et al. (2015), "Impaired mental well-being and psychosocial risk: a cross-sectional study in female nursing home direct staff", *BMJ Open*, Vol. 5 No. 3, pp. e007190–e007190.

Peter, R., Geißler, H. and Siegrist, J. (1998), "Associations of effort-reward imbalance at work

and reported symptoms in different groups of male and female public transport workers", *Stress Medicine*, Vol. 14 No. 3, pp. 175–182.

Podsakoff, N.P., Lepine, J.A. and Lepine, M.A. (2007), "Differential challenge stressor-hindrance stressor relationships with job attitudes, turnover intentions, turnover, and withdrawal behavior: A meta-analysis", *Journal of Applied Psychology*, Vol. 92 No. 2, pp. 438–454.

Rugulies, R., Aust, B. and Madsen, I.E.H. (2017), "Effort–reward imbalance at work and risk of depressive disorders. A systematic review and meta-analysis of prospective cohort studies", *Scandinavian Journal of Work, Environment & Health*, Vol. 43 No. 4, pp. 294–306.

Searle, B.J. and Auton, J.C. (2014), "The merits of measuring challenge and hindrance appraisals", *Anxiety, Stress and Coping*, Vol. 28 No. 2, pp. 121–143.

Siegrist, J. (1996), "Adverse health effects of high-effort/low-reward conditions.", *Journal of Occupational Health Psychology*, Vol. 1 No. 1, pp. 27–41.

Siegrist, J. (2002), "Effort-reward imbalance at work and health", in Perrewé, P.L. and Ganster, D.C. (Eds.), *Historical and Current Perspectives on Stress and Health*, Elsevier, Amsterdam: JAI, pp. 261–291.

Siegrist, J. (2008), "Chronic psychosocial stress at work and risk of depression: evidence from prospective studies", *European Archives of Psychiatry and Clinical Neuroscience*, Vol. 258 No. S5, pp. 115–119.

Siegrist, J. and Li, J. (2016), "Associations of Extrinsic and Intrinsic Components of Work Stress with Health: A Systematic Review of Evidence on the Effort-Reward Imbalance Model", *International Journal of Environmental Research and Public Health*, Vol. 13 No. 4, p. 432.

Siegrist, J., Starke, D., Chandola, T., Godin, I., Marmot, M., Niedhammer, I. and Peter, R.

(2004), "The measurement of effort-reward imbalance at work: European comparisons", *Social Science and Medicine*, Vol. 58 No. 8, pp. 1483–1499.

Siegrist, J., Wege, N., Pühlhofer, F. and Wahrendorf, M. (2009), "A short generic measure of work stress in the era of globalization: Effort-reward imbalance", *International Archives of Occupational and Environmental Health*, Vol. 82 No. 8, pp. 1005–1013.

Staufenbiel, T. and König, C.J. (2010), "A model for the effects of job insecurity on performance, turnover intention, and absenteeism", *Journal of Occupational and Organizational Psychology*, Vol. 83 No. 1, pp. 101–117.

Tadić, M., Bakker, A.B. and Oerlemans, W.G.M. (2015), "Challenge versus hindrance job demands and well-being: A diary study on the moderating role of job resources", *Journal of Occupational and Organizational Psychology*, Vol. 88 No. 4, pp. 702–725.

Van Vegchel, N., De Jonge, J., Bosma, H. and Schaufeli, W. (2005), "Reviewing the effort-reward imbalance model: Drawing up the balance of 45 empirical studies", *Social Science and Medicine*, Vol. 60 No. 5, pp. 1117–1131.

Warr, P. (1987), *Work, Uneployment, and Mental Health*, Oxford University Press, Oxford.

Williams, C.J., Dziurawiec, S. and Heritage, B. (2018), "More pain than gain: Effort-reward imbalance, burnout, and withdrawal intentions within a university student population", *Journal of Educational Psychology*, Vol. 110 No. 3, pp. 378–394.

Wood, S.J. and Michaelides, G. (2016), "Challenge and hindrance stressors and wellbeing-based work–nonwork interference: A diary study of portfolio workers", *Human Relations*, Vol. 69 No. 1, pp. 111–138.

Table 1

Analytical Approach in Articles on Effort-Reward Imbalance Published in 2019 in Web of Science

Analytical Approach	*N*	*%*
ERR tested without control for main effects, no main effects considered	47	78.3
ERR tested jointly with main effects	12	20.0
MMR with main effects	1	1.7

Table 2

Starting Parameters and Results of the Simulation Study

Parameter	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Starting parameters				
N		300		
M_{effort}		22		
SD_{effort}		5		
M_{reward}		35		
SD_{reward}		5		
$r_{effort, reward}$		-.20		
β_1(effort)	-.30	-.30	-.30	.00
β_2(reward)	.30	.30	.30	.00
β_3(effort × reward)	.00	-.15	.15	-.15
Proportion of significant effects in the simulated datasets (10,000 replications)				
Moderated multiple regression[a]	.05	.84	.84	.75
Typical effort-reward ratio model[b]	1.00	1.00	1.00	.07
Modified effort-reward ratio model[c]	.06	.72	.88	.73

[a]$Y = b_0 + b_1(\text{effort}) + b_2(\text{reward}) + b_3(\text{effort*reward})$

[b]$Y = b_0 + b_1(\text{effort/reward})$

[c]$Y = b_0 + b_1(\text{effort}) + b_2(1/\text{reward}) + b_3(\text{effort/reward})$

Table 3

Multiple Regression Analysis Linking Effort and Reward to Mental and Physical Health

	Mental health		Physical health	
Model, predictors	*b*	*t*(2,131)	*b*	*t*(2,125)
Model 1				
Intercept	2.202	129.58***	0.187	44.73***
Effort-reward ratio	0.152	8.96***	0.030	7.20***
Model 2				
Intercept	2.202	131.00***	0.187	45.01***
Effort	0.020	1.17	0.004	1.16
Reward	-0.20	-11.62***	-0.039	-9.26***
Effort × Reward	-0.005	-0.35	-0.001	-0.28

Note. $N =$ 2,138.

*$p < .05$ **$p < .01$ ***$p < .001$

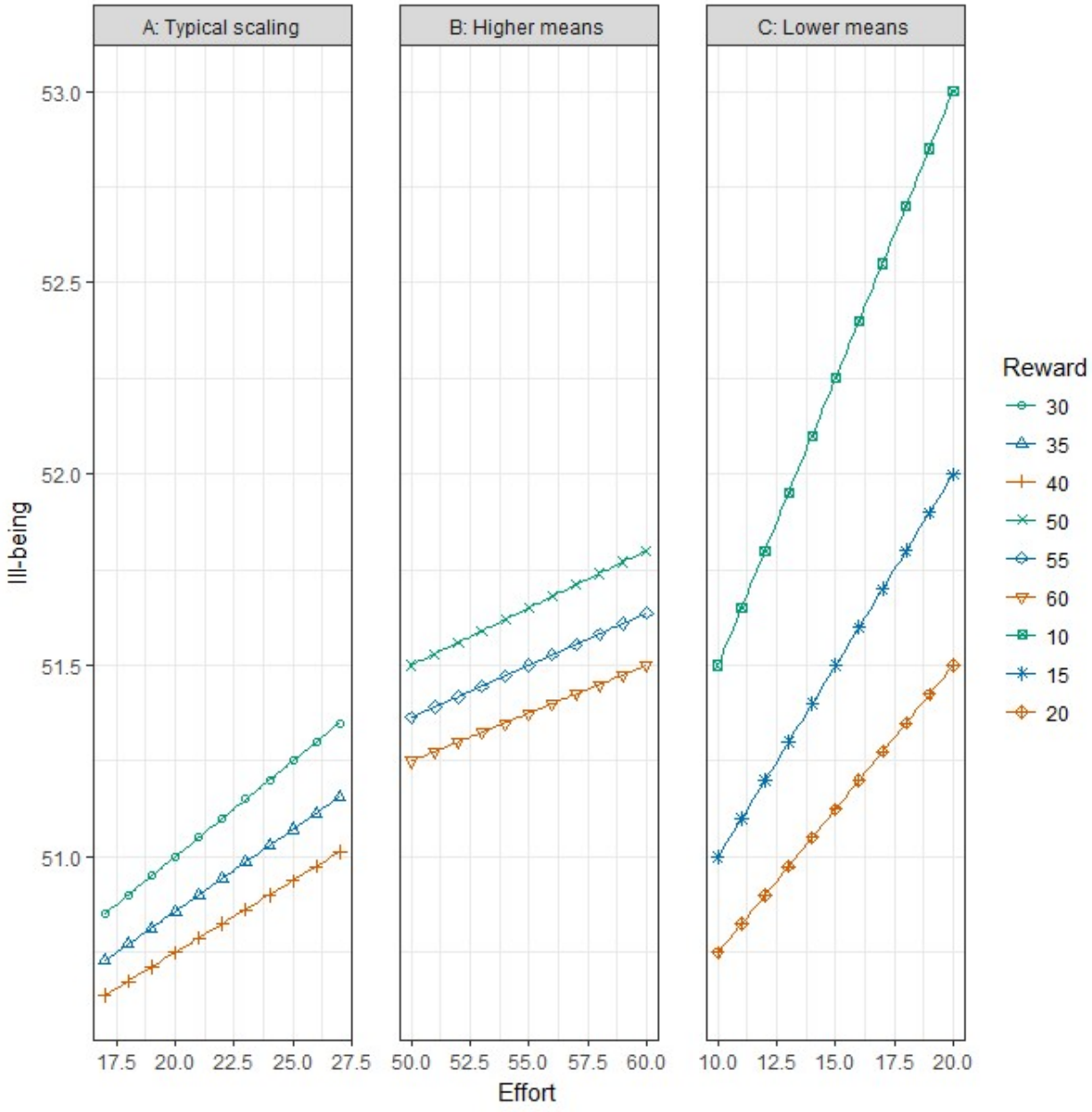

Figure 1. Predicted values from a regression model with an effort-reward ratio but no main effects for effort and 1/reward.

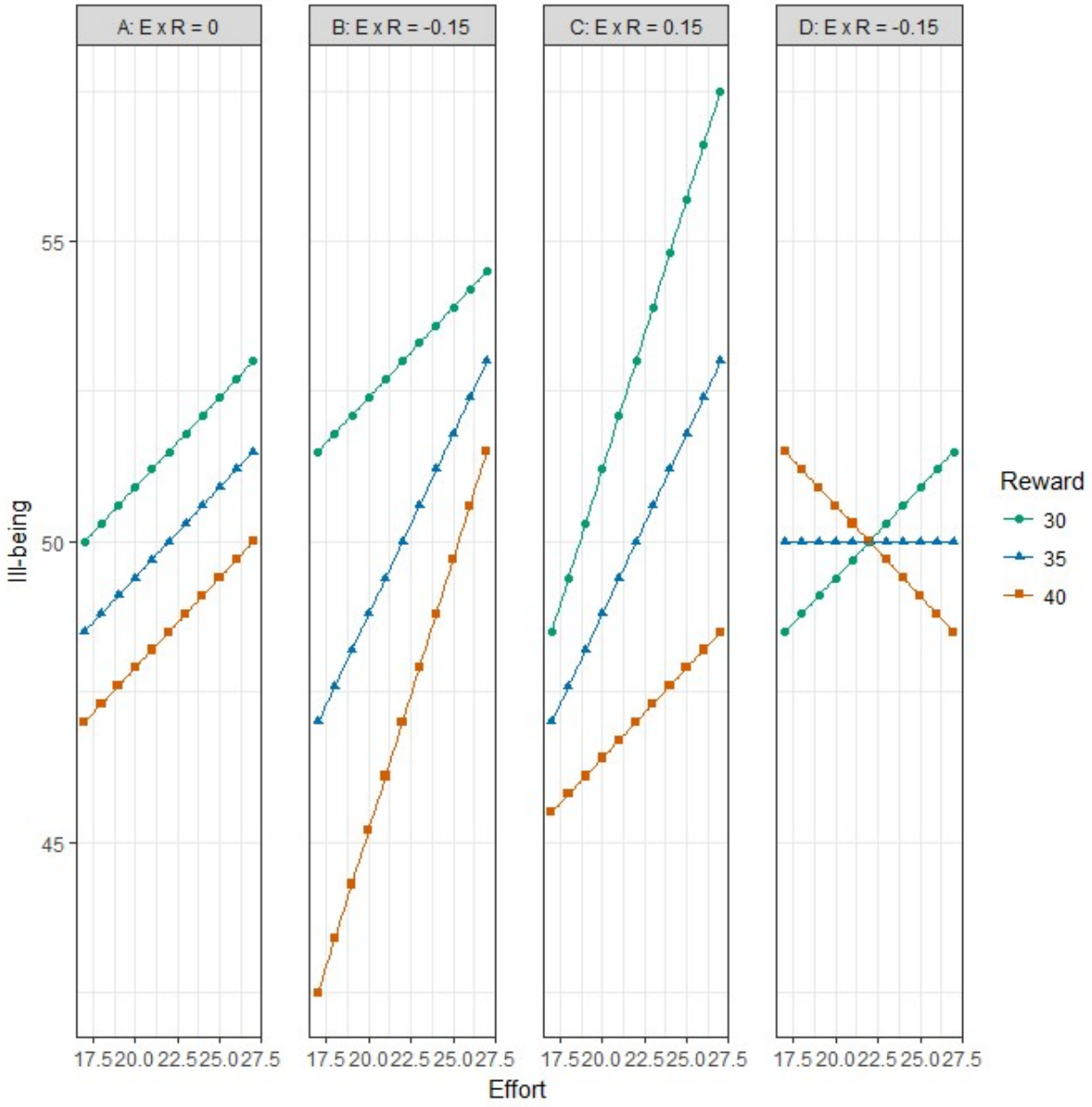

Figure 2. The figure shows predicted values for the starting parameters used in the simulation study.