

A Meta-analysis about Organizational Innovative Responses to Performance Feedback

Abstract

The investigation into how companies respond to performance feedback through innovation represents a significant area of management research. However, existing studies often yield inconsistent results. This study seeks to address these inconsistencies by conducting a systematic review of the relationship between firm performance feedback and innovation through meta-analysis. Our findings suggest that firm innovation efforts increase both when performance falls below aspirations and when it exceeds aspirations. These relationships are further nuanced by different facets of innovations pursued, with varying impacts observed based on aspects such as R&D investment, innovation degree, and innovation quality. Moreover, by considering performance feedback measures into performance indicators, aspirations, and dimensions of feedback, we uncover subtleties in how performance feedback influences firm innovation.

Keywords

Performance feedback, behavioral theory of the firm, innovation, meta-analysis, R&D investment

1 Introduction

Innovation has persistently stood as a focal point in both management research and practice, recognized as fundamental to a firm's competitive advantage and long-term success (Porter, 1999). Existing literature supports innovation's positive impact on organizational performance (Khosravi, Newton & Rezvani, 2019). A vital strand of research grounded in the behavioral theory of the firm (BTOF) has inversely explored how firms' performance affects innovation (Cyert & March, 1963). Utilizing performance feedback theory within BTOF, scholars have investigated the negative relationship between performance feedback and various organizational innovation strategies, including but not limited to R&D investment (Greve, 2003a; Chen, 2008), exploitation and exploration (Greve, 2007; Lu & Wong, 2019), innovative search (Zhang, Gu & Yang, 2024). However, alternative theoretical frameworks such as the threat rigidity theory offer contradictory perspectives (Staw, Sandelands & Dutton, 1981). Thus, empirical research on the relationship between performance feedback and organizational innovation is marked by controversy and inconsistency (e.g., Chen, 2008; Greve, 2003a; He et al., 2021; Jirásek, 2019; Xu et al., 2019; Yu et al., 2019; Zhong et al., 2021). Additionally, there remains a notable gap in the literature systematically delineating innovation strategies within the context of performance feedback. This gap leads to ambiguity in categorizing innovation in response to performance feedback (Kotiloglu, Chen & Lechler, 2021; Xue, Chen & Wu, 2023).

Our understanding of the relationship between performance feedback and innovation is complicated by inconclusive findings, primarily stemming from two primary concerns: conflicting theoretical perspectives and diverse measurements. Firstly, there is no consensus on how firms react to performance feedback through innovation, as each study employs a specific theoretical lens. This diversity provides us with an opportunity to assess the aggregation and average effect size of focal relationships. Secondly, the variability in measurements for both innovation and performance feedback obscures our understanding. The extant literature explores a range of firms' innovation strategies in response to performance feedback, such as R&D investment (Chen, 2008; Greve, 2003a), exploration and exploitation (Greve, 2007), and scope and depth of innovation (Yu et al., 2019; Zhang et al., 2024). Additionally, operationalizations of performance feedback constructs vary across studies, encompassing performance indicators (financial, innovative, environmental) (e.g., Chen, 2008; Greve, 2003a; Zhong et al. 2021; Zhao & Qu, 2023), aspiration measurement (historical aspiration, social aspiration, combining or switching these two aspirations) (e.g., Chen, 2008; Greve, 2003a; Lu & Wong, 2019; Yu et al., 2019), and dimensions of performance feedback (intensity, duration, scope) (e.g., Chen, Zhong & Lan, 2023; Greve, 2003a, Yu et al., 2019). To reconcile controversial empirical findings, it's crucial to acknowledge that firms might adapt their innovation strategies depending on the types of innovation and the metrics used for performance feedback. Therefore, we adopt a meta-analytical approach to quantitatively evaluate whether these factors indeed shape organizational innovation in responses to performance feedback.

Building upon empirical evidence from a meta-analysis of 63 studies, this study aims to assess the impact of performance feedback on organizational innovations. Our study contributes to the understanding of the performance feedback-innovation nexus in several ways. Firstly, it systematically reviews the reverse effect of performance on innovation, synthesizing inconsistent empirical findings from diverse theoretical perspectives to present aggregated effects of the relationship between performance feedback and innovation. Secondly, we expand the scope of innovation metrics, extending beyond traditional R&D measures to include the degree and quality of innovation. Similarly, we consider distinct measures for performance, aspirations and dimensions respectively in the operationalization of performance feedback, facilitating a more comprehensive analysis of performance feedback-innovation relationships. Thirdly, by testing moderation effects of innovation categories and performance feedback measures, we identify factors that affect the direction or strength of the relationship, providing valuable insights into the dynamics of organizational performance and innovation.

2 Theoretical background and hypotheses

2.1 Research Question 1: Performance feedback and organizational innovations

The concept of performance feedback posits that organizations evaluate their performance by comparing actual performance against aspirations. Aspiration refers to

the target or standard that an organization aims to reach or exceed in terms of performance, often serving as a motivating factor to drive effort and commitment towards improvement and excellence (Kotiloglu et al., 2021; Greve, 2003b). In the context of the BTOF, performance aspirations may not always align perfectly with rational economic objectives and are influenced by past performance (historical aspiration) and performance of comparable peers (social aspiration) (Cyert & March, 1963). This perspective emphasizes the importance of understanding the diverse motivations, cognitive biases, and social dynamics that shape organizational behavior and performance.

Organizations choose strategies aiming at enhancing or sustaining performance to meet aspiration levels. Empirical research underscores the pivotal role of innovation strategies in responding to performance below or above aspiration, as innovation has been shown to enhance organizational performance and serve as a key driver of long-term success (Greve, 2003a, 2007; Chen, 2008; Jirásek, 2016; Khosravi et al., 2019). According to performance feedback theory within BTOF, firms tend towards innovation when performance falls below aspiration and demonstrate a reduced inclination towards innovation as performance surpasses aspiration (e.g., Chen, 2008; Chen & Miller, 2007; Greve, 2003a). However, the literature presents contradictory empirical findings on this relationship. Some scholars find no significant relationship between underperformance and innovation (Xu et al., 2019). Others propose a curvilinear relationship between performance shortfall and innovation (Jirásek, 2016; Yu et al., 2019). Similarly, there are inconsistencies in studies examining organizational innovation as performance exceeds aspiration. Some research suggests a positive relationship between performance above aspirations and innovation (Xu et al., 2019), rather than a negative one as proposed within the BTOF (Chen, 2008; Cyert & March, 1963). To reconcile these inconsistencies, meta-analysis offers a robust methodological approach to quantitatively evaluate the average effect size for the relationship between performance feedback and organizational innovations.

Existing meta-analytic reviews of performance feedback and innovation also lacks comprehensiveness for many studies primarily focus on R&D related innovation inputs, overlooking other dimensions of innovation (Kotiloglu et al., 2021; Xue et al., 2023). This study extends beyond mere R&D to encompass a wider array of innovation strategies, such as exploration and exploitation, business innovation, and patents. We synthesize these into three categories of innovation: R&D investments, degree of innovation, and quality of innovation. Specifically, R&D investment includes R&D intensity and expenditure, change in R&D and R&D internationalization. Degree of innovation includes exploration, exploitation and business/product/process innovation. Quality of innovation involves the effectiveness of innovation outcomes, including patent citations and applications. Thus, our study provides a more refined categorization of innovation strategies to performance feedback through a meta-analysis review.

The first research question examines the overall impact of performance feedback on firms' innovation.

Research Question 1: How does performance feedback affect firms' innovation?

Scholars argue that it is necessary to investigate innovation responses to performance above aspiration and to below aspiration separately (Keil, Posen & Workiewicz, 2023). The need for differentiation is supported by different theoretical perspectives. Specifically, when performance falls below aspiration, performance feedback theory conflicts with that of threat rigidity theory. When performance exceeds aspiration, performance feedback theory contradicts those of the slack search mechanism.

Performance below aspiration

According to performance feedback theory within BTOF, negative performance feedback triggers problemistic search, prompting firms to adopt risky strategies and make changes to meet aspirations (Greve, 1998). Empirical studies support the assertion that organizations are more likely to deploy innovation when their performance falls below aspiration. For instance, Chen (2008), He et al. (2021), and Cabral et al. (2023) argue that firms increase their R&D search as performance falls further below aspiration levels. Similarly, Saraf et al. (2022) suggest that the probability of innovation increases as performance falls below aspirations. Conversely, the threat rigidity theory posits that organizations exhibit rigidity and prefer conservative and cost-effective strategies due to information restriction, control constriction, and resource conservation caused by poor performance (Chen & Miller, 2007; Liu et al., 2013; Staw et al., 1981). For instance, Chen and Miller (2007) propose that R&D search intensity decreases as firms approach bankruptcy, a reflection of the threat rigidity effect. Given the high costs and risks associated with innovation, firms are likely to reduce innovation efforts when performance falls below aspiration.

Further exploration introduces the attention model, which combines performance feedback theory and threat rigidity theory. This model, proposed by March and Shapira (1992) and later expanded by Hu et al. (2011), suggests that firms shift their focus between aspirations and survival threats depending on the degree of performance decline. When performance slightly falls below aspiration levels, firms prioritize aspirations and may increase innovation. However, as performance falls further below aspiration levels, firms' focus shifts towards survival, potentially curtailing innovation endeavors. Therefore, some scholars advocate for an inverted U-shaped relationship between performance shortfall and innovation (Jirásek, 2019; Yu et al., 2019).

Overall, empirical evidence regarding the direction of the relationship between performance shortfall and innovations remains inconsistent. This ambiguity underscores the necessity of further investigation, leading us to propose the following research question:

Research Question 1a: How does performance below aspiration level affect firms' innovation?

Performance above aspiration

According to performance feedback theory, firms are satisfied when their performance exceeds aspiration, leading to a reduced motivation to change their current strategic actions (Cyert & March, 1963). And firms are likely to avoid risky strategies in order to maintain current performance levels. For example, Greve (1998, 2003a) proposes

that the probability of innovation declines as performance beyond aspiration level. Similarly, Chen (2008) and Ye et al. (2021) find a decrease in R&D intensity with positive performance feedback. However, BTOF also posits that firms engage in slack search when they possess ample slack (Cyert & March, 1963). When performance is above aspiration, firms can generate or accumulate slack (Levinthal & March, 1981; Xu et al., 2019), thereby enabling them to pursue risky actions. For instance, Chen and Miller (2007) suggest that firms increase R&D search when their performance exceeds aspirations. Xu et al. (2019) propose that high-performing firms are more motivated to engage in product development and increase R&D to sustain their competitive advantage especially in environments of high legal development and industry competition. Additionally, if decision makers are confident in their capabilities, they are more inclined to implement radical strategies to achieve higher performance (Xu et al., 2019). Therefore, firms may undertake more innovation activities when performance is above aspiration.

Overall, empirical findings regarding how performance above aspiration level influences firm innovation are contradictory. Therefore, we propose the following question:

Research Question 1b: How does performance above aspiration level affect firms' innovation?

2.2 Research Question 2: Measurement method as a moderator

To delve deeper into the reasons behind the inconsistent relationships between performance feedback and organizational innovation, it is crucial to examine the role of measurement heterogeneity, which substantially contributes to the inconclusive nature of empirical findings (Xue et al., 2023). We posit that the operationalization of both dependent (innovation) and independent variables (performance feedback) moderates the impact of performance feedback on firms' innovation strategies.

2.2.1 The categories of innovations as a moderator

Existing studies have identified diverse innovation strategies in responses to performance feedback, such as R&D investment (Chen, 2008; Greve, 2003a), exploitative and exploratory innovation (Greve, 2007; Lu & Wong, 2019), innovation search behavior (Yu et al., 2019). The influences of these different categories of innovation demonstrate significant variability. For instance, Chen (2008) and O'Brien and David (2014) suggest that firms are more likely to increase R&D when performance falls below aspiration; Greve (2007) propose that underperforming firms tend to increase exploitation but decrease exploration as performance falls below aspiration; Yu et al. (2019) describe a curvilinear relationship between performance shortfall and innovation search. In situations when performance exceeds aspiration, Xu et al. (2019) identify a positive relationship between performance and R&D, indicating that firms may increase R&D as performance exceeds aspiration, while Greve (2007) posit that outperforming firms might decrease both exploitation and exploration.

In light of these observations, we categorize specific innovations discussed in literature concerning performance feedback into three broad categories ranging from

investment (R&D investment) to outcomes (including degree of innovation and quality of innovation). R&D investment includes all measurements related to R&D, such as R&D intensity (Chen, 2008; Choi, Rhee & Kim, 2019), R&D expenditure (Alessandri & Pattit, 2014; Rhee, Ocasio & Kim, 2019), change in R&D (Rudy & Johnson, 2016) and R&D internationalization (Chen Zhong & Lan, 2023; Zhong, Chen & Ren, 2022). Degree of innovation refers to the extent or level of innovation embodied in specific products, processes, or business, such as exploration and exploitation (Greve, 2007; Lu & Wong, 2019), and business/product/process innovation (Manzaneque et al., 2020; Saraf, Dasgupta & Blettner, 2022). Quality of innovation means effectiveness of innovation outcomes, with one aspect being measured through patent applications (Peng et al., 2022) and patent citations (Zhong et al., 2021).

Therefore, we anticipate that different categories of innovation will demonstrate variations in the relationship between performance feedback and firms' innovation. Thus, we propose the following hypotheses:

H1: The categories of firms' innovations (R&D investment, degree of innovation, quality of innovation) moderate the relationship between performance feedback and organizational innovation.

2.2.2 The measurement of performance feedback as a moderator

Several studies indicate that the way aspiration and performance are measured can influence strategic actions (Kotiloglu et al., 2021; Xue et al., 2023). Expanding the dimensions of performance feedback, such as duration and scope, has become the focus of recent literature, potentially offering valuable insights into the nexus between performance feedback and innovation. Next, we will analyze the moderating role of performance feedback measurements, including performance indicators, aspiration measurements, dimension of performance feedback.

Performance: numerous studies assess performance feedback using financial performance, such as ROA (Greve, 2003a), ROE (Audia & Greve, 2006), since profitability is often considered the primary objective for firms. As society evolves, objectives extending beyond profitability, such as innovation and social responsibility, have become increasingly important. This shift has prompted researchers to integrate these broader performance indicators into performance feedback analyses. Xue et al. (2023) propose that different types of performance (accounting-based, marketing-based and other) yield varying effects on firms' strategic actions. We summarize all the performance metrics related to performance feedback-innovation research and categorize them into financial, innovative and environmental performance. Financial performance includes the financial index, such as ROA (Greve, 2003a), ROS (Rudy & Johnson, 2016), profit (Saemundsson, Candi & Sigurjonsson, 2022). Innovative performance means the outcomes of innovation efforts, such as patent citations (Zhong et al., 2021), the number of patents (Zhong, Song & Chen, 2022). Environmental performance refers to firms' use of energy and other resources (Shou et al., 2020), and the information about environmental and sustainable development (Xue et al., 2022; Zhao & Qu, 2023). We explore how feedback from different performance indicators influences firms' innovation actions.

H2a: The measurement of performance (i.e., financial, innovative and environmental) moderates the relationship between performance feedback and firms' innovation.

Aspiration: Cyert and March (1963) suggest that firms set aspirations based on historical and social aspirations. Historical aspirations involve benchmarking current performance against past performance, while social aspirations focus on comparisons with peer groups. Initially, aspiration was computed by combining these two metrics in a weighted manner (Greve, 2003a). However, subsequent research has highlighted that historical aspiration and social aspiration may convey distinct information. Historical aspiration, rooted in a firm's own past performance, reflects its capabilities and resources, while social aspiration, although important, involves comparisons with peer performance, which presents challenges due to the difficulty of accurately gathering peer-related information (Kim, Finkelstein & Halebian, 2015). Consequently, firms may opt for different actions depending on whether they compare their performance against historical or social benchmarks. Some scholars have advocated for treating these two aspirations separately (Chen, 2008; Chen & Miller, 2007; Ye et al., 2021), while others have proposed a switching model where firms may shift between historical and social aspirations based on their actual performance (Alessandri & Pattit, 2014; Lu & Fang, 2013). Thus, the way aspiration is measured may influence the outcomes of studies on performance feedback.

H2b: The measurement of aspiration (i.e., historical, social, weighted combination and switching aspirations) moderates the relationship between performance feedback and firms' innovation.

Dimension of Performance Feedback: The literature on performance feedback has extensively examined how the intensity of feedback influences firms' strategic actions, where intensity is defined as the gap between performance and aspiration (Yu et al., 2019). Recent research has broadened this inquiry to include the effects of duration and scope. Scholars have recognized the temporal dimension of performance feedback, specifically considering the notion of duration, which refers the length of a period a firm has been underperforming (Goyal & Goyal, 2022; Yu et al., 2019). This duration of underperformance can affect how feedback is interpreted and subsequently shape firms' innovation behavior (Yu et al., 2019; Liu et al., 2024). Furthermore, some researchers have proposed that firms concurrently establish multiple aspirations across various key performance to systematically assess their performance (Chen et al., 2023). Consequently, they have investigated the impact of the scope of performance feedback, which addresses situations where firms simultaneously fail or succeed in meeting multiple aspirations. For example, Chen et al. (2023) suggest that negative performance feedback across a broad scope prompts firms to increase R&D investment. Therefore, we aim to examine whether firms' innovation varies based on different dimensions of performance feedback, including intensity, duration, and scope. We propose the following hypotheses:

H2c: The dimension of performance feedback (i.e., intensity, duration, scope) moderates the relationship between performance feedback and firms' innovation.**3 Methods**

We conducted a meta-analysis to answer our research questions. We chose meta-analytic method because it can not only utilize all accessible data to systematically assess the mean effect of performance feedback on innovation, but also can compare effect sizes among various organizational innovation strategies and performance feedback settings (Kotiloglu et al., 2021).

3.1 Search strategy

We used a series of search strategies to identify studies for our meta-analysis. First, we searched all possible studies that contained performance feedback and organizational innovations. We used the following keywords: (“behavioral theory of the firm” OR “performance feedback” OR “aspiration” OR “attainment discrepancy” OR “problemistic search” OR “slack search”) And (“innovat*” OR “innovation investment” OR “research and development” OR “R&D”) to search studies in the Web of Science and EBSCO databases. Second, we conducted backward citation search by complying the references of literature reviews of performance feedback, including Posen et al. (2018) and Kotiloglu et al. (2021). Third, we employed forward citation search to include studies that cited Greve (2003a), which is the pioneer study in the research about performance feedback and innovation investment, and both related to innovation that include “innovat*” OR “innovation investment” OR “research and development” OR “R&D”. Lastly, to further enrich our dataset, we conducted a manual search of key journals in management, strategy and innovation are rated ABS 3 and above, ensuring comprehensive coverage of high-impact research.

3.2 Sample

We removed the duplicate records ($n = 296$) and one retracted paper from search as the initial sample. Then we conducted a systematic screening process to identify the most relevant studies for our meta-analysis (Figure 3.1). First, utilizing ASReview, an open source machine learning-aided pipeline that applies active learning to efficiently filter the most relevant records (Van De Schoot et al., 2021), we identified 84 studies pertinent to our subject. Second, we remained the records sought for retrieval. Third, we further assessed for eligibility for studies: 1) selected studies with performance feedback as the independent or control variable or moderator, and organizational innovations as the dependent variable; 2) selected longitudinal firm-year observations for empirical; 3) remained studies that report Pearson's correlation coefficients r , t-test statistics t or effect sizes d (both t and d can be transformed to r) of performance feedback and organizational innovations¹; 4) excluded studies with measurement is not

¹ If the article did not publish the correlation coefficient, we tried to email the author to get the value. We added the correlation coefficient of one paper.

common (less than two papers), for example, performance feedback is a binary variable (Huang, He & Yang, 2021), or is in percentage terms (Kotlar et al., 2014). And we also removed only one article on social aspiration because the number of articles was too small for meta-analysis. We added 7 papers by manual search from management, strategy and innovation journal with ABS 3 and above.

This rigorous multi-step screening and selection process ultimately yielded a final sample of 63 studies with 174 effect sizes and a total of 1,541,479 firm-year observations.

Insert Figure 3.1 about here

3.3 Coding

For meta-analysis, each study was meticulously coded based on performance feedback (performance, aspiration, dimension of performance feedback) and organizational innovation (R&D investment, degree of innovation, quality of innovation). If a study explored multiple relationships, for example separately examined the impact of performance above or below historical aspiration, and above or below social aspiration, we coded each relationship separately.

3.3.1 Performance feedback

We initially coded performance feedback without separating performance above and below aspiration, and then differentiated performance below aspiration, performance above aspiration and non-split below and above aspiration. Performance below aspiration means current performance minus aspiration level if performance is below aspiration and 0 otherwise. For studies that reported absolute values, we reversed the sign of their correlations. Performance above aspiration refers to performance minus aspiration level of performance is above aspiration and 0 otherwise. Non-split below and above aspiration equals performance minus aspiration whether performance is below or above aspiration.

To test the measurement as moderator, we coded performance, aspiration, dimension of performance feedback separately.

Performance: we include the financial performance (such as ROA, ROS), innovative performance (patent) and environmental performance (outcomes of environmental activities).

Aspiration: performance feedback literature suggests that firms' performance aspirations are operationalized as historical aspiration (their own past performance), and social aspiration (performance of peer groups) (Tyler & Caner, 2016) or a weighted combination of both (Vissa, Greve & Chen, 2010), or a switching model (Lu & Wong, 2019). Due to all operationalizations belong to the subcategory of Cyert and March's (1963) views, we included them in our meta-analysis.

Dimension of performance feedback: we coded dimensions of performance feedback as following: Intensity of performance feedback means the discrepancy between performance and aspiration (e.g., Greve, 2003a). Duration of performance

feedback is the length of continuous period of negative performance feedback or positive performance feedback (e.g., Yu et al., 2019). Scope of performance feedback means the count of negative or positive performance feedback based on different performance (Chen et al., 2023).

3.3.2 Organizational innovation

We adopt a bottom-up approach to summarize all the literature on performance feedback and innovation involved in our review. After a comprehensive review, we synthesize firms' innovation into three primary categories: R&D investment, degree of innovation and quality of innovation. R&D investment includes R&D intensity (Chen, 2008; Choi et al., 2019), R&D expenditure (Alessandri & Pattit, 2014; Rhee et al., 2019), change in R&D (Rudy & Johnson, 2016) and R&D internationalization (Chen et al., 2023; Zhong et al., 2022). Degree of innovation encompasses exploration and exploitation (Greve, 2007; Lu & Wong, 2019), the degree of business innovation (Saraf et al., 2022), product or process innovation (Manzaneque et al., 2020). Quality of innovation involves the number of patents (Peng et al., 2022) and the way of patent citations (Zhong et al., 2021).

3.4 Meta-analytic techniques

We conduct the meta-analytic procedure to assess effect sizes, which was calculated by the sample size and Pearson correlation coefficient. First, we transformed the sample correlation r into Fisher's z , which has a normal distribution and its variance is independent of the correlation, to correct the potential skewness distribution of effect size (Hedges & Olkin, 1985). Then we used Fisher's z to calculate effect sizes. The equation is as following:

$$r = \frac{\sum n_i r_i}{\sum n_i}$$

Where r is the average effect size, n_i is the sample size and r_i is the Pearson correlation coefficient. If a study operationalized one dependent variable in different ways, the correlations in this study were averaged to obtain a single result. For example, Jirásek (2016) measured the dependent variable—R&D change—through two variables: R&D investment change and R&D intensity change. For each performance feedback variable (performance above/below historical aspiration, performance above/below social aspiration), we averaged the correlation coefficients of these two dependent variables in each performance feedback. There are 7 studies that averaging was done in our sample.

We obtained the mean effect size in STATA 18 as the following procedures: First, we used the *meta set* command to declare the effect sizes and standard errors from each study as *es* and *se*. Secondly, we conducted *meta summarize, random* to calculate the mean effect size between performance feedback and organizational innovations for all studies. Third, we examined the heterogeneity by I^2 and τ^2 (τ^2). I^2 is the percentage of the between- study variability, and if it is greater than 75%, there is large heterogeneity (Higgins et al., 2003). τ^2 is the value of the between-study variance. And we tested the homogeneity by Q , which refers to “a within-group homogeneity statistic

that has an approximate Chi-square distribution with $k-1$ degrees of freedom” (Neville et al., 2019, p. 2553). If Q is statistically significant, it suggests the need to test moderators. We further did a series of subgroup analyses to compare the effect sizes for different measurement of organizational innovations and performance feedback. We calculated the mean effect sizes for different subgroups by organizational innovation, performance, aspiration, dimension of performance feedback in performance above and below aspiration separately.

4 Results

4.1 Main effects of performance feedback and organizational innovations

Table 4.1 displays the random-effects results regarding the relationship between performance feedback and organizational innovations. Research question 1 assumed the relationship between performance feedback and organizational innovations, especially performance below and above aspiration respectively. The mean observed effect size for a total set of 174 independent samples that contains 1,541,479 observations is statistically negative ($r=-0.014$), and the 95% CI does not include 0 ($[-0.028, -0.001]$). The negative effect size indicates that the more performance falls below aspiration, the higher possibility of innovation. We analyzed the effects of performance below and above aspiration separately. When performance is below aspiration, the mean effect size of performance feedback and organizational innovation is significantly negative ($r=-0.043$), aligning with the arguments of performance feedback theory within BTOF (Cyert & March, 1963). But when performance is above aspiration, the mean effect size is positive ($r=0.018$). This finding is not consistent with the assumptions of performance feedback that firms may not change when performance exceeds aspiration, but may be explained by the slack search mechanism. In addition, the heterogeneity statistics in whole sample ($Q=26805.17$, $p=0.000$) and subgroups ($P<A$: $Q=16164.35$, $p=0.000$; $P>A$: $Q=3958.21$, $p=0.000$) indicate significant unexplained variations across the studies, suggesting that further investigation into potential moderators is warranted.

Insert Table 4.1 about here

4.2 Moderation effects of categories of innovations

Given the diversity of innovation strategies in the research on performance feedback, we propose that measurement of innovations is a key moderator of the main effect and explore whether different categories of innovations can account for variance in the relationship between performance feedback and organizational innovation. Due to the differences in effects when performance is below and above aspiration, we respectively conducted meta-analysis for each condition. Table 4.2 shows that the mean effect sizes for R&D investment ($r=-0.061$, 95% CI $[-0.089, -0.033]$) and that of degree of

innovation ($r=-0.004$, 95% CI $[-0.039, 0.031]$) and quality of innovation ($r=-0.001$, 95% CI $[-0.036, 0.034]$) are similar in direction but differ in size when performance below aspiration. The test of group differences is significant ($Q_b=9.42$, $p=0.009$), suggesting that there are variations in effect size among different categories of innovation when performance below aspiration. When performance above aspiration, the mean effect sizes for R&D investment ($r=0.018$, 95% CI $[-0.003, 0.039]$), that of degree of innovation ($r=0.036$, 95% CI $[0.018, 0.055]$) and that of quality of innovation ($r=0.003$, 95% CI $[-0.013, 0.019]$) are also similar in direction but differ in size. And the test of group differences in different categories of innovations is significant ($Q_b=6.86$, $p=0.032$), suggesting there are variations among the operationalizations of innovations when performance above aspiration.

4.3 Moderation effects of measurement of performance feedback

We propose that the operationalization of performance feedback, including performance indicators, measurement of aspiration, and dimension of performance feedback, could account for between-study variation in the main relationship as hypothesized in hypotheses 2.

We examine whether different performance indicators can account for between study variation in the relationship between performance feedback and organizational innovation (Hypothesis 2a). Table 4.2 shows that the mean effect sizes of measures of financial performance ($r=-0.045$, 95% CI $[-0.068, -0.023]$) and environmental performance ($r=-0.030$, 95% CI $[-0.044, -0.016]$) are negative and differ from that of innovative performance ($r=0.025$, 95% CI $[0.011, 0.040]$). Moreover, the test of group differences is significant ($Q_b = 40.90$, $p = 0.000$). These findings support Hypothesis 2a, indicating that there are variations in the relationship between performance feedback and innovation across different performance indicators when performance below aspiration. Due to the absence of innovative and environmental performance data in studies with performance above aspiration, we do not explore the heterogeneity of performance indicators of positive performance feedback.

Regarding the measurement of aspiration, we investigate if the effect size varies based on how aspirations are measured. Table 4.2 shows that the mean effect sizes for performance below historical aspiration ($r= -0.055$, 95% CI $[-0.094, -0.016]$), performance below social aspiration ($r= -0.035$, 95% CI $[-0.069, -0.001]$), and performance below combined aspiration ($r= -0.049$, 95% CI $[-0.096, -0.002]$) are all negative and similar in direction. And the test of group differences is not significant ($Q_b = 2.57$, $p = 0.463$). The results are similar when performance above aspiration. The effect sizes of performance above historical aspiration ($r= 0.027$, 95% CI $[-0.013, 0.067]$), performance above social aspiration ($r= 0.022$, 95% CI $[-0.002, 0.047]$), performance above combined aspiration ($r= 0.009$, 95% CI $[-0.015, 0.032]$) are positive and similar in direction, and the effect sizes of performance above switching aspiration is very small ($r=0.000$, 95% CI $[-0.028, 0.028]$). And the test of group differences is not significant ($Q_b = 1.95$, $p = 0.583$). So, there is little variation among operationalizations of aspiration, whether performance below aspiration or above aspiration. This finding does not support Hypothesis 2b.

Finally, we evaluate if the dimensions of performance feedback could account for between study variation in the relationship between performance feedback and organizational innovation (Hypothesis 2c). Only the data for performance below aspiration was sufficient for analysis. Table 4.2 shows that the effect sizes of intensity of negative performance feedback ($r = -0.049$, 95% CI $[-0.074, -0.025]$), and duration of performance shortfall ($r = -0.008$, 95% CI $[-0.044, 0.027]$) are negative and differ from the scope of performance shortfall ($r = 0.005$, 95% CI $[-0.103, 0.112]$) in direction. But the test of group differences is not significant ($Q_b = 4.02$, $p = 0.134$), indicating little variation in the relationship between performance shortfall and innovation across the dimensions of performance feedback.

Insert Table 4.2 and Table 4.3 about here

4.4 Post hoc analyses

To address potential publication bias, which arises from the higher likelihood of statistically significant studies being published, we carried out several tests. The Egger test shows no evidence of publication bias ($z = -0.34$, $p = 0.73$), whereas the Begg test indicates significant publication bias ($z = -3.98$, $p = 0.00$). To assess and adjust for this bias, we used a “trim-and fill” method, which estimates the amount of studies potentially omitted from the analysis and recalculates an adjusted effect size. After imputing 35 studies, we obtain an updated estimate of the mean effect size of -0.042 with a 95% CI $[-0.056, -0.028]$, which is similar with our finding. We further applied the “trim-and fill” separately when performance below and above aspiration. The mean effect size after imputing 16 studies ($r = -0.073$, 95% CI $[-0.096, -0.050]$) is similar with our findings in direction when performance below aspiration ($r = -0.043$, 95% CI $[-0.065, -0.021]$). And there are no imputed studies when performance above aspiration. All results of publication bias tests suggest that our findings are robust.

5 Discussion

By integrating 63 studies, our meta-analytic review provides a comprehensive understanding of the relationship between performance feedback and innovation. It also sheds light on reconciling various controversies in current research by considering the variations in innovation categories and performance feedback measurements.

5.1 Theoretical contributions

This meta-analytic literature review contributes to the literature in several ways. First, it provides a systematical and comprehensive review of the reversing impact of performance on innovation by investigating how performance feedback affects firms' innovation behaviors, considering both negative and positive performance feedback separately. Existing studies often focused narrowly on specific innovation strategies like R&D investment (Greve, 2003a; Chen, 2008), exploration and exploitation (Greve,

2007), leading to inconsistent findings across different perspectives, including performance feedback theory and slack search proposition in BTOF, as well as threat-rigidity theory (Xue et al., 2023). Through integrating findings from 63 empirical studies, our study provides a comprehensive literature review of firms' innovation categories in responses on performance feedback. We find that performance below aspiration negatively impacts innovation, whereas performance above aspiration yields a positive effect. This differentiation helps reconcile debates regarding firms' responses to performance above or below aspiration.

Second, we provide a comprehensive overview of different categories of innovation by summarizing existing studies on firms' innovation strategies in responses to performance feedback. Previous literature reviews have largely focused on R&D, resulting in an ambiguous categorization of innovation responses (Kotiloglu et al., 2021; Xue et al., 2023). Our study spans the full spectrum of innovation, from investment to degree and quality of innovation, examining how different categories of innovation respond to performance feedback. We find that performance below aspiration may generally increase all firms' innovation strategies, with a strong effect on R&D investment. When performance is above aspiration, firms exhibit divergent responses across different actions that they may increase R&D investment and degree of innovation but decrease in terms of quality of innovation.

Third, we achieve a granular understanding of performance feedback by considering three measurements, including performance indicators, aspiration, dimensions of performance feedback. This review gives valuable evidence on how measurement strategies of performance feedback affect organizational innovation. We find that the relationship between performance shortfall and innovations is contingent upon performance indicators and dimensions of performance feedback, highlighting areas for future research. Specifically, financial and environmental performance shortfalls negatively affect organizational innovations but innovative performance shortfall has positive effect. The intensity and duration of performance shortfalls have negative relationships with organizational innovations, while scope of performance shortfall positively impacts innovations.

5.2 Practical implications

This study offers important practical implications for firms' innovation strategies. First, our findings reveal that various innovation strategies respond differently to performance feedback both in directions and magnitudes. Managers should carefully consider and select categories of innovation that align with their own capabilities and resources rather than uniformly increasing or decreasing all innovation strategies. Second, our study guides managers should adopt a comprehensive view of performance feedback, considering both financial and non-financial performance indicators. This not only provides a more holistic understanding of organizational situation but also takes into account the diverse requirements of stakeholders. Additionally, while the intensity of performance feedback undoubtedly influences organizational innovation, managers should also consider the temporal effect of underperformance and the scope of performance feedback derived from various indicators. This nuanced approach enables

managers to better interpret of discrepancy between performance and aspiration overtime, thereby informing more effective strategic decision-making.

5.3 Limitations and directions of future research

This meta-analytical literature review is subject to several limitations. Firstly, this study predominantly focuses on firms' categories of innovation in responses to performance feedback including R&D investment, as well as degree and quality of innovation. However, it is important to recognize that there exists a wide array of innovation strategies beyond those included in the study of performance feedback. Future research endeavors should consider a boarder spectrum of innovation strategies, such as dynamic innovation, innovation balance, etc. Secondly, our meta-analysis only examines the moderating roles of measurement strategies to test the boundary conditions of the relationship between performance below or above aspiration and innovation. Nonetheless, it is essential to acknowledge that there exist additional relevant factors at the individual-, organizational- and environmental- level that may alter firms' response to negative or positive performance feedback (Audia & Greve, 2021). We encourage future research to explore more interesting moderators from different level. Thirdly, due to the limitations of meta-analysis, our study only examines the linear relationship between performance feedback and innovation. Some studies have been explored the curvilinear relationship (Yu et al., 2019; Liu et al., 2024), giving important opportunity to advance the stream of studies in performance feedback.

6 Conclusion

The study of performance feedback and innovation has always been a vital field of management research, characterized by contradictory and inconsistent findings. There remains a lack of reviews on performance feedback and innovation responses. Therefore, we conduct a meta-analysis including 63 studies to systematically reviews the relationship between performance feedback and firms' innovation. Moreover, we also examine whether the measurement strategies of innovations (R&D investment, degree of innovation, quality of innovation) and performance feedback (three performance indicators, four measures of aspiration, three dimension of performance feedback) cause heterogeneity in the relationship between performance below or above aspiration and firms' innovation strategies. Our study not only makes theoretical contributions to the study of performance feedback and innovation but also has practical implications for firms' innovation strategy.

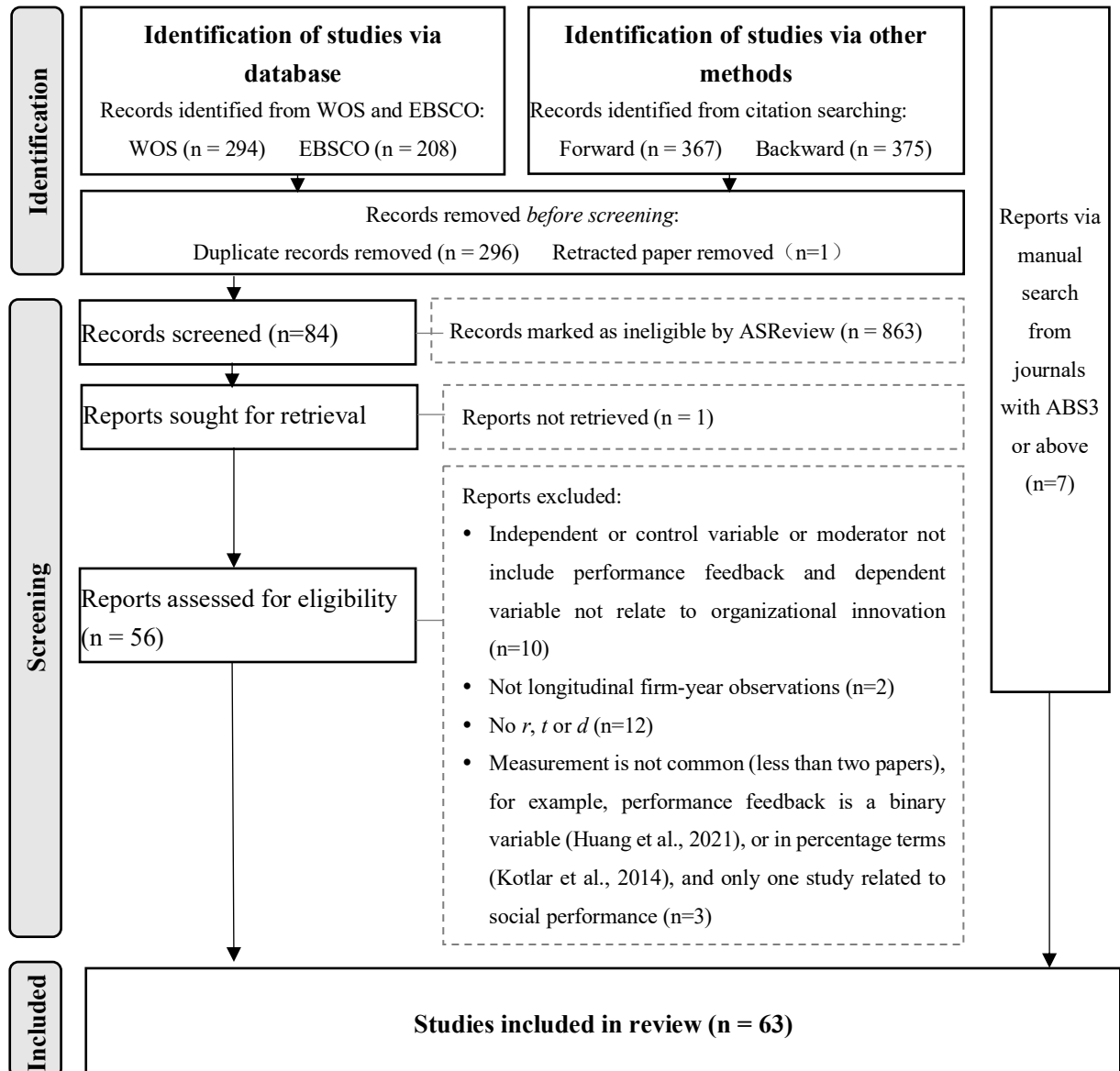


Figure 3.1 Flow diagram about selection of studies

Table 4.1 Meta-analytic correlations of performance feedback with organizational innovations

variables	K	N	r	95% CI		p _r	Heterogeneity				
				Lower	upper		Q	p _Q	tau ²	I ² (%)	H ²
Performance feedback	174	1541479	-0.014	-0.028	-0.001	0.04	26805.17	0.000	0.008	98.54	68.65
<i>Type of performance feedback</i>							<i>Q_b = chi2(1) = 19.61 Prob > Q_b = 0.000</i>				
Performance below aspiration	85	743026	-0.043	-0.065	-0.021	0.00	16164.35	0.000	0.010	98.83	85.83
Performance above aspiration	67	601221	0.018	0.002	0.035	0.03	3958.21	0.000	0.004	97.26	36.51
Not split below and above aspiration	22	197232	0.002	-0.021	0.024	0.89	574.91	0.000	0.002	95.34	21.45

Table 4.2 Meta-analytic of performance below aspiration with organizational innovations

variables	K	N	r	95% CI		p _r	Heterogeneity				
				Lower	upper		Q	p _Q	tau ²	I ² (%)	H ²
<i>Categories of innovations</i>							<i>Q_b = chi2(1) = 9.42; Prob > Q_b = 0.009</i>				
R&D investment	59	589155	-0.061	-0.089	-0.033	0.00	13773.47	0.000	0.012	99.10	111.58
Degree of innovation	14	77640	-0.004	-0.039	0.031	0.82	209.57	0.000	0.004	95.26	21.10
Quality of innovation	12	76231	-0.001	-0.036	0.034	0.95	79.46	0.000	0.003	94.82	19.29
<i>Type of performance</i>							<i>Q_b = chi2(1) = 40.90; Prob > Q_b = 0.000</i>				
financial	82	704149	-0.045	-0.068	-0.023	0.000	15706.16	0.000	0.010	98.84	86.40
innovative	2	19001	0.025	0.011	0.040	0.000	0.92	0.337	0.000	0.03	1.00
environmental	1	19876	-0.030	-0.044	-0.016	0.000	0	.	0.000	.	.
<i>Type of aspiration</i>							<i>Q_b = chi2(1) = 2.57; Prob > Q_b = 0.463</i>				
Historical aspiration	25	167494	-0.055	-0.094	-0.016	0.01	1916.50	0.000	0.009	98.20	55.67

Social aspiration	38	345250	-0.035	-0.069	-0.001	0.04	5856.45	0.000	0.011	98.95	95.65
Combined aspiration	20	225410	-0.049	-0.096	-0.002	0.04	7660.63	0.000	0.011	99.02	101.77
Switching aspiration	2	4872	0.000	-0.059	0.059	1.00	4.38	0.036	0.001	77.18	4.38
Dimension of performance feedback			$Q_b = \text{chi2}(1) = 4.02; \text{Prob} > Q_b = 0.134$								
Performance feedback intensity	73	641539	-0.049	-0.074	-0.025	0.00	15080.47	0.000	0.011	98.92	92.65
Performance feedback duration	10	73417	-0.008	-0.044	0.027	0.65	109.15	0.000	0.003	95.11	20.47
Performance feedback scope	2	28070	0.005	-0.103	0.112	0.93	63.57	0.000	0.006	98.43	63.57

Table 4.3 Meta-analytic of performance above aspiration with organizational innovations

variables	K	N	r	95% CI		p _r	Heterogeneity				
				Lower	upper		Q	p _Q	tau2	I ² (%)	H2
<i>Categories of innovations</i>				<i>Q_b = chi2(1) = 6.86; P > Q_b = 0.032</i>							
R&D investment	49	495522	0.018	-0.003	0.039	0.09	3874.12	0.00	0.005	97.96	49.06
Degree of innovation	11	51650	0.036	0.018	0.055	0.00	30.57	0.00	0.001	73.28	3.74
Quality of innovation	7	54049	0.003	-0.013	0.019	0.69	26.69	0.00	0.000	64.95	2.85
<i>Type of aspiration</i>				<i>Q_b=chi2(1)=1.95; Prob > Q_b = 0.583</i>							
Historical aspiration	20	146968	0.027	-0.013	0.067	0.19	1646.84	0.00	0.008	97.94	48.51
Social aspiration	25	216033	0.022	-0.002	0.047	0.08	684.61	0.00	0.003	96.51	28.64
Combined aspiration	20	233348	0.009	-0.015	0.032	0.46	679.31	0.00	0.002	95.89	24.32
Switching aspiration	2	4872	0.000	-0.028	0.028	1.00	0.00	1.00	0.000	0.06	1.00

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Note: References marked with an asterisk () indicate studies included in the meta-analysis.*

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