Learning Organizational Ambidexterity:

A Joint-Variance Synthesis of Exploration-Exploitation Modes on Performance

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Abstract

Organizational ambidexterity (OA) figures prominently in a variety of organization science phenomena. Introduced as a two-stage model for innovation, theory specifies reciprocal reinforcement between the OA processes of exploration and exploitation. In this study, we argue that previous analyses of OA necessarily neglect this reciprocality in favor of conceptualizations that conform to common statistical techniques. Because reciprocality is theorized, yet absent in current models, existing results represent confounded or biased evidence of the OA's effect on firm performance. Subsequently, we propose joint-variance (JV) as an appropriate estimator of exploration-exploitation reciprocality. An updated systematic literature synthesis yielded K=50 studies (53 independent samples, N = 11,743) for further testing. The results reveal that the joint effect of exploration and exploitation explains more variance in organizational performance than either unique component. The value of this reciprocal relationship between exploration and exploitation is further supported by three complementary findings. First, JV reduced negative confounding from past operational inconsistencies of exploration-exploitation, explaining 45% of between-study variance. Second, JV quantified the positive confounding in current meta-evidence from double-counting 37.6% of variance explained in organizational performance using separate estimates of exploration and exploitation. Third, JV's substantive application to hypothesis testing supported theoretical predictions. We discuss practical benefits of considering the reciprocality of the exploration-exploitation relationship, as well as theoretical contributions for cohering the OA empirical literature.

Keywords: Learning organizations, joint-variance, reciprocal, exploration, exploitation

Introduction

New enterprises and established firms alike pursue a common goal in the ever-continuing process of generation (variation) and support (selection) toward competitive advantage. Borrowed from biological models of evolutionary survival, the two mechanisms of variation and selection are inseparable and jointly necessary. Organizational ambidexterity (OA) theory argues, consequently, that organizations can survive, if and *only if* both exploration (variation) and exploitation (selection) processes are effectively managed.

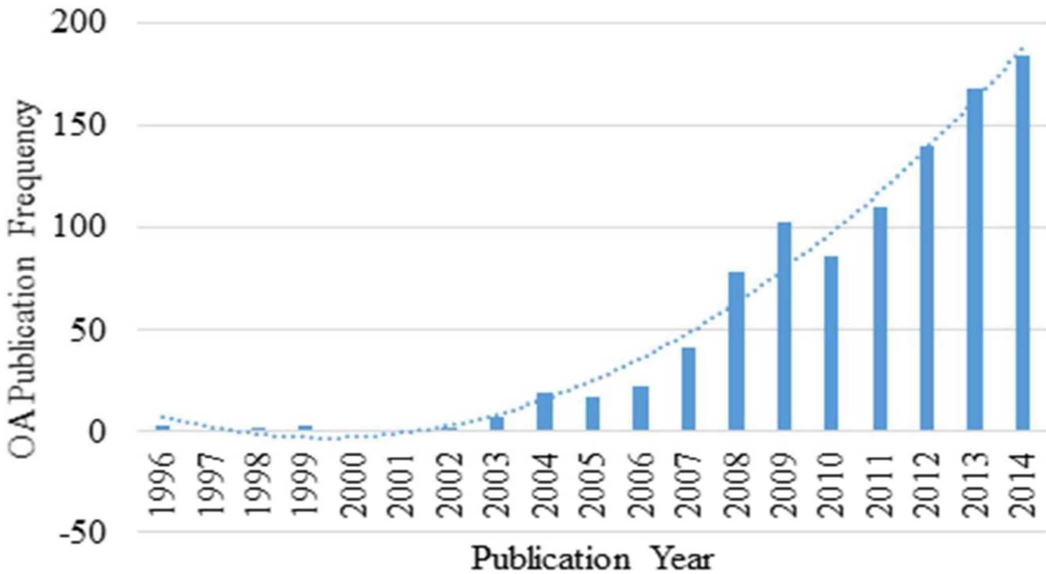
On receiving the Academy of Management's award for their seminal paper on exploration-exploitation, Benner & Tushman (2015, p. 509) reflected "there is a mismatch between our extant theory and the phenomena of organizations and innovation." Although OA research is proliferating (see Figure 1), the accelerated growth in empirical studies seems incommensurate to our meaningful understanding of the phenomenon (Birkinshaw & Gupta, 2013). A meta-analysis (MA) of the output resulted in a corrected estimate for OA-performance of only ρ = .06 (Junni et al., 2013). This juxtaposition between strong theoretical utility and underwhelming empirical utility is provocative. We believe something is amiss in OA research that may explain the current theoretical-empirical gap.

Growing skepticism from OA scholars may be warranted if amassing evidence is based on incorrect assumptions, which would weaken OA theory (Luger et al., 2015). Given its scale of applicability, we argue that OA theory is suffering from a diseconomy of scope (Panzar & Willig, 1981). That is, the relative benefit of each empirical study is outweighed by total costs to OA theory. Accordingly, continued adherence to the *status quo* is not likely to reconcile the present discrepancy between theory and empirical evidence. Instead, OA researchers must leverage novel approaches to advance our understanding of these phenomena in organizational scholarship.

The goal of this study is to cohere the existing empiricism to better align with OA theoretical propositions. First, we familiarize readers with OA and its two learning modes, exploration (eR) and exploitation (eT) (Van Deusen & Mueller, 1999) (see, Online Appendices 1 and 2). Second, we review methods currently used to operationalize the Relationship between eR and eT (eR-eT), with emphasis on their alignment with

OA theory. Third, we propose joint-variance (JV) synthesis as an empirically superior, alternative approach for examining the mutually reinforcing function of eR-eT, with respect to organization performance.

Figure 1. Summary yearly OA publication frequency. From Birkinshaw & Gupta (2013)



OA Theory Background

Historically and conceptually, eR and eT are inseparable by their commonality as search processes. In a recent synthesis of eR-eT tradeoff perspectives, Mehlhorn et al. (2015) conclude that any distinction between eR and eT is necessarily relative and limited by the level of abstraction. Tushman and O'Reilly's (1996, p. 11) extension to a between-organization focus maintains this joint necessity: "Focusing on only one guarantees short-term success but long-term failure. Managers need to be able to do both at the same time." Floyd and Layne (2000) similarly argued that eR and eT are necessary and inseparable facets of organizational learning required for organizational adaptiveness and survival. Whereas Duncan's (1976) dual structures of organizations is credited as the first use of the term OA, the longitudinal demand for examining OA's dynamism was presciently articulated by Penrose (1959, p. 5): "As management tries to make the best use of resources available, a truly 'dynamic' interacting process occurs which encourages continuous growth but limits the rate of growth." Foster and Kaplan (2001) convincingly illustrate this strategy of limiting growth rates using historical stock market data to indicate that the longest-surviving companies typically perform below-market average at any given point in time. Together, Penrose's commentary and the empirical findings are remarkably similar to precedents in evolutionary economics, where Schumpeter (1942, p. 83) observed that "a system… that at every given point of time fully utilizes its possibilities to the best advantage may yet in the long run be inferior to a system that does so at no given point of time." In OA terms, exploration's inefficiency is necessarily benefitted by existing organizational exploitation.

Recognizing the joint demands of static and dynamic efficiency for survival, management scholars argued for coordinated, interdependent mechanisms to optimize performance (van de Ven et al., 1976). Duncan (1976) articulated OA as two interrelated stages of initiation and implementation for organization innovation. The initiation stage pertained to organization search and information gathering (eR), and the implementation stage was characterized by organization refinement and formalization (eT). Importantly, Duncan qualified this distinction by quantitative degrees along a common underlying continuum. Moreover, Duncan recognized that the effectiveness of distinct stages was necessarily contingent on this underlying continuity.

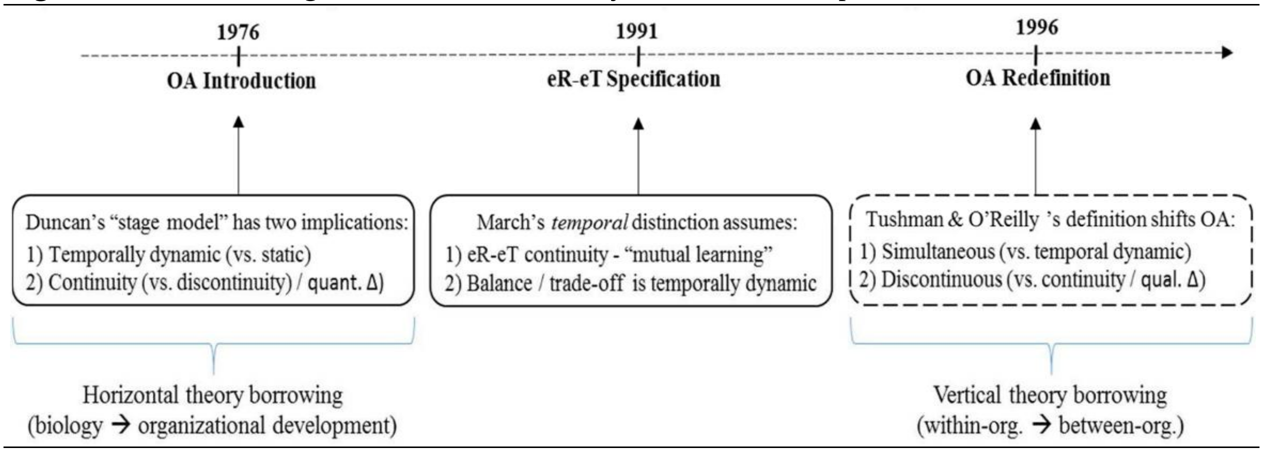
OA's functional interdependence was conceptually confounded, however, in Tushman and O'Reilly's (1996, p. 24) definition as "the ability to simultaneously pursue both incremental and discontinuous innovation and change." Firstly, simultaneity negates Duncan's stage model. Secondly, discontinuity implies a qualitative distinction between processes. Raisch and Tushman (2016, p. 1237) recently concluded that "to date, studies of ambidextrous designs have taken a static perspective." Regardless of reason, the shift from OA's functional-temporal foundation to structural-spatial may have seeded such static views. Consequently, static preconceptions pit the complementary processes of eR and eT as incompatible. For example, classical empiricism regards 'complementarity' to imply 'mutual exclusivity' (i.e., eR-eT are uncorrelated; see Katsumori, 2011). A similar assertion has been made by

Nonaka et al. (2014, p. 139), who argue, "the separation between exploration and exploitation is merely artificial; and that does not exist in actual practice."

Analytically, complementary conceptions of eR-eT are recommended to be assessed as opposing ends on a continuum (Gupta et al., 2006). Classical scoring of such data, however, requires ipsative assessment that mathematically constrains eR-eT to be negatively correlated. To illustrate this logically, when forced to choose between eR and eT, choosing one precludes choosing the other. Mathematically, this forces a negative correlation between eR and eT, regardless of OA theorization of a positive relationship.

It is plausible, we argue, that eR-eT incompatibility is a false dilemma. Illustratively, primary study evidence negates neither side of the productivity-innovator dilemma, so that innovation positively affects subsequent productivity (Martin & Nguyen-Thi, 2015). Still, the artifact contaminates aggregated meta-analytic estimates (Junni et al., 2013). More substantively, the artifact propagates as a framing misattribution in subsequent definitions of OA, such as, "the capacity of an organization to address mutually conflicting demands" (Birkinshaw et al., 2016; p. 37). The conceptual development of OA is summarized with the event timeline illustrated in Figure 2.

Figure 2. Timeline of Organizational Ambidexterity Construct Development.



Notes: Hashed-outline denotes between-organization focus, and solid-outlines denote within-organization focus. Neither March (1991) or Tushman & O'Reilly (1996) reference each other.

In the current study, we examine the plausibility for eR-eT's dilemmatic relation. As Piao and Zajac (2016, pp. 1444-1445) conclude on the scarcity of eR-eT reciprocality research, "the tension may, in practice, be a moving target rather than an immovable barrier." In the next section, we elaborate on how eR-eT's tension may be artefactual from static misconceptions of OA noted above. In turn, a concrete link between OA's construct ambiguity and empirical inconsistency can be established (Visser et al., 2018).

eR-eT Function

March (1991, p. 71) articulated eR as "search, variation, risk-taking, experimentation, play, flexibility, discovery, innovation," and eT as, "refinement, choice, production, efficiency, selection, implementation, execution." He further recognized eR-eT's substantive interdependence by explicating their "joint function of potential return" (p.73). March's (1991) time-invariant identification of these constructs was subsequently misinterpreted as static conceptions (Tushman & O'Reilly, 1996). As Levinthal and March (1993, p. 101) observed, however, "There is no guarantee that short-run and long-run survival are consistent."

Early OA scholars similarly recognized the temporally distinct demands of static and dynamic efficiency for survival. This analogous reasoning served as the initial plausibility for incorporation of eR-eT into OA theory. Ghemawat and Costa's (1993) temporal-extension of March's (1991) model concluded that fixed and variable strategic decisions, over time, both imply a relative importance of dynamic (vs. static) efficiencies. Only recently, however, have more dynamic perspectives of OA been empirically studied, and initial findings support the synergistic effects of dynamic OA (i.e., temporal integration of eR-eT) in a 9-year longitudinal sample (Luger, et al., 2015).

In sum, we posit that ambidexterity in organizational science was a structuralist solution to an ontological problem. March's (1991) time-invariant distinction of eR and eT was later misappropriated as a static conception under OA theory (Tushman & O'Reilly, 1996). In turn, static views empirically frame eR and eT as incompatible, which is untenable given earlier conceptualizations of eR and eT as reciprocal (see Table 1). Because reciprocality is theorized, but absent in current analyses, the empirical account is incomplete (cf., Knott, 2002). Having reviewed OA theory, we overview the primary methodological approaches currently used for eR-eT, elaborating on the congruence between each eR-eT method and OA theory.

Table 1. Theoretical Specification of eR-eT Reciprocal Reinforcement

Source	Excerpt
Penrose (1959)	"…but the development of the capacities…is partly shaped by the resources…The full potentialities for growth provided by this *reciprocal* change will not necessarily by realized by any given form" (p. 79)
March (1991)	"ambiguous usefulness of learning…[stems] from *the relation between* knowledge and discovery" (p. 85)
Tushman & O'Reilly (1996)	"These structures and systems are *interlinked* so that proposed changes become more difficult … this results in *structural inertia* - a resistance to change rooted in the size, complexity, and *interdependenc*e in the organization's structures, systems, procedures, and processes." (p. 18)
Gibson & Birkinshaw (2004)	"reflecting our argument that these two capacities are *nonsubstitutable and interdependent*" (p. 217)
Haibin & Atuahene-Gima (2007)	"The *interaction* of exploitation and exploration… generates an ambiguous resource, the value of which only exists in their interrelationship" (p. 5)
Im & Rai (2008)	"…the explorative process can invoke exploitative processes, or exploitative processes can invoke explorative processes, leading to cycles of reinforcement" (pp. 1292-1293)
Simsek (2009)	"Put simply, *reciprocal* ambidexterity is best portrayed as being a synergistic fusion of complementary streams of exploitation and exploration that occur across time and units." (p. 887)
Stadler et al. (2014)	"*reciprocal interdependence* in which the outputs of exploitation from unit A become the inputs for exploration by unit B and the outputs of unit B cycle back to become the inputs of unit A" (p. 35)
Papachroni et al. (2015)	"viewing exploration and exploitation not as necessarily opposing…but as dynamically *interrelated* or even complementary activities, enables us to conceive prescriptions that move beyond structural or temporal separation towards synthesis or transcendence" (p. 4)
Cembrero & Sáenz (2018)	"Considering that exploration and exploitation have to be recombined to create value, the mere coexistence of exploratory and exploitative activities is not enough: both exploration and exploitation should be complementary and mutually reinforcing" (p. 3)

Note: Selected excerpts listed in order of publication.

Methods for eR-eT

Here, we address common methods of operationalizing eR-eT. Specific approaches are organized under two conceptual views of eR-eT: (a) Balance and (b) Combined. Notably, these two views are outgrowths of static OA divides that prioritize one of two values to eR-eT for methodological estimation, namely (a) distinctive value (eR-eT *balanced* differentiation) or (b) continuity value (eR-eT *combined* integration).

Trade-off / Balance View

Absolute-Difference (AD)

The eR-eT 'trade-off' or 'balance' perspective figures prominently in March's (1991, p. 74) seminal text, "the trade-off between exploration and exploitation in mutual learning involves conflicts between short-run and long-run concerns." Unfortunately, the major premise for eR-eT's joint-function was subsequently neglected, which may be attributable to March's separate modeling of eR and eT functions for illustrative purpose. In other words, the 'trade-off' was implicative to temporal dynamics, and the oversight inherent to overly static views is epitomized by AD operationalizations of an organization's focus on eR *or* eT as |eR–eT|.

March (1999, P. 5) later acquiesced: "Balance is a nice word, but a cruel concept." The use of AD for eR-eT is inadequate to test OA theory, because AD estimates impose equality constraints on eR and eT. The interpretative implication is equivocality for eR-eT. In other words, their non-equivalence is informative only when process is deemed unimportant. AD effectively ignores the functional distinction between eR and eT, which violates OA's conception as an integrative construct comprising distinct processes.

Combined View

The heuristically labeled 'combined' view, owing to roots in dynamic capabilities paradigms, emphasizes the recombination of eR and eT over time (O'Reilly & Tushman, 2008). It encompasses both classical arguments of structural separation and contemporary counterarguments for individual-level 'contextual' ambidexterity. Notably, this approach recognizes the need for continuous adjustment between eR-eT in response to environmental or market changes. Although this approach recognizes the potential for eR-eT's integrative complementarity, its static basis requires untenable assumptions, such as exclusivity or independence between eR and eT.

Sum or Average (∑/μ)

As a probability axiom, summation assumes exclusivity and independence of eR and eT by operationalizing the additive combination of eR or eT as $p(eR) + p(eT)$. In ignoring the intersection (eR *and* eT), such operationalizations contradict OA's theoretical definition pertaining to eR- eT integration and interdependence, respectively. Empirically, violation of exclusivity results in positive bias from double-counting redundant information (i.e., the $p(eR \cap eT)$ term), whereas violation of independence results in larger error of the additive term (Mela & Kopalle, 2002). Regarding averages, because scores are impacted by variability of component terms, OA's theorizing for systematically greater variability of eR than eT implies a disproportionate weight of eR in averaged terms.

Multiplicative Interactions (MIs)

One operationalization that attempts to account for the interplay of eR-eT is the multiplicative interaction (MI). Conceptually, MIs estimate the conditional synergistic effects of eR-eT, but neglect their unconditional interrelation. For example, MIs entered into hierarchical regression assume that eR-eT are essentially uncorrelated (e.g., no reciprocality), as multicollinearity may lead to misestimation of regression weights. Unfortunately, many researchers doggedly pursue orthogonalization of eR and eT ($r = 0$) for analytic convenience. Even when predictors are modestly correlated, the computation of an MI requires the specification of a new predictor that is necessarily correlated with observed component predictors. While useful for estimating simple main effects in a regression-based model, MIs do not directly capture the shared predictive power of two independent variables. Therefore, MIs are suboptimal proxy estimators of reciprocal relationships between predictors such as those specified by OA theory. Notably, Conlisk (1971) elaborated several conditions wherein collinearity improves precision for predictive models (e.g., eR-eT). We summarize these conditions in online Appendix 3 with links to substantive examples encountered in OA research.

Summary of OA Theory-Methods (Mis)alignment

Our overview of eR-eT operationalizations reflect two contrarian perspectives to these two modes of learning (balanced or combined). The two general methodological approaches are retraceable to two historical premises of OA. The balance perspective maintains eR-eT's underlying continuity, whereas the combined perspective maintains eR-eT's complementary distinction. To accommodate the static reframing of OA, however, both approaches are principally compromised; The 'balanced' approach sacrifices eR-eT distinction via ADs, and the 'combined' approach sacrifices eR-eT continuity via Σ / μ (exclusivity) or MIs (independence). The approaches are neither exhaustive nor contradictory, but incomplete.

A static-structural view may pit eR-eT processes as incompatible, but OA theory postulates reciprocality (cf. Lavie et al., 2010). This omission qualifies the two methodological approaches above (balanced or combined) as a fallacy of exhaustive hypotheses. A third, alternative explanation for correlational findings is reciprocality (eR←→eT). Although reciprocality has been theorized, it has not yet been formally tested. This is consistent with Benner and Tushman's (2015) observation that organizational phenomena and organizational theory are often incongruent. As we argue above, there is also a large mismatch between theory and methods within the realm of OA. Ideally, reciprocality should be studied longitudinally. In cross-sectional designs that predominate OA's empirical record, however, JV can serve as a robust and appropriate tool for estimating effects of eR-eT reciprocality.

JV-Synthesis Solution

Although the reciprocal nature of eR and eT is specified by OA theory, their joint contribution for predicting organizational performance remains untested. Given the scarcity of longitudinal data for testing eR←→eT, we propose a parsimonious JV strategy suitable to cross-sectional designs. We briefly elaborate the contributions of JV to previously identified weaknesses in OA theory and evidence.

JV Conceptual Rationale

Schoen et al. (2011, pp. 688-689) observe in their original publication of the JV-synthesis procedure adopted here that “most studies published today in the organizational sciences discuss a series of constructs and their unique relationships with the criteria of interest. Little or no consideration is given to how two or more predictors may be interrelated through mechanisms such as developmental sequences and reciprocal causation.” This observation is apt for summarizing the current approaches to studying eR-eT.

A number of functional models are candidates for examining JV as a theoretically meaningful assumption. For example, self-reinforcing cycles, classic simplex patterns, and reciprocal causation are all functional systems to which JV synthesis may be applied. Extending from our definition of OA, our working conceptual model for eR-eT is depicted in Figure 3A.

Summarizing our rationale, previous research has demonstrated that managing the successful interplay between eR and eT is critical for firm performance (Luger et al., 2015). As reviewed above, current operationalizations of OA are insufficient for addressing eR←→eT. If reciprocality is theorized, but absent from methodological models, then we can expect confounded and biased results from misspecification.

JV Technical Derivation

As Schoen et al. (2011) point out, computing JV from two variables (e.g., eR-eT) is straightforward. Specifically, JV may be derived simply from the difference between the total variance explained and the sum of squared-semipartials, such that → JV (*eR*, *eT*) = ($R^2_{y.eR}$ + $R^2_{y.eT}$-$R^2_{y.eTeR}$). The expression is illustrated with a Venn diagram in Figure 3B below, such that JV = (A + B + D) **-** (A + B).

Figure 3A A Mutually Reinforcing System of Exploration-Exploitation on Performance

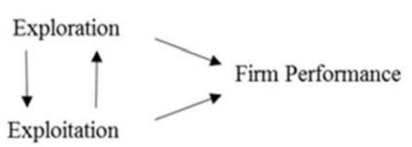
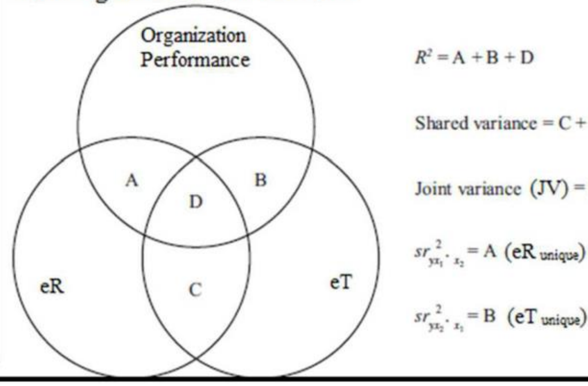


Figure 3B Shared Variance Diagram of eR-eT Components and Organization Performance



JV Hypothesis Formulation

In order to strengthen substantive inference from the proposed JV, we develop hypotheses based on OA theory. Given the novelty pertaining to our proposed JV, hypothesis generation is guided by representative scope of diverse research domains. Specifically, three hypotheses are formulated to span research perspectives from: 1) organizational ecology, 2) organizational psychology, and 3) industrial economics.

Because most new enterprises fail early (Kenny, 2006), our secondary analysis of convenience samples may merely cap the observation of eR-eT's JV in younger, unsustainable organizations (i.e., a ceiling effect from 'unsurviving organizations'). This relates to theorized 'liability of newness,' which has been postulated to predispose new enterprises' disproportional usage of eR and eT (Benner & Tushman, 2015). Empirical findings support the longitudinal, performance-stabilizing effects of eR-eT specialization in a sample of entrepreneurial enterprises (Parida et al., 2016). Similarly, the joint effect of eR-eT is expected to be greater in older organizations with longer established routines and clearer management structures (Chen, 2014; Nelson & Winter, 1982). Rooted in resource-based views of the firm, absorptive capacity (Rothaermel & Alexandre, 2009) and organization capital (Na & Morris, 2014) offer indirect evidence for establishment's positive impact on the OA-performance relationship. More direct, empirical evidence also supports the positive effect of organization 'age' on the OA-performance relationship (Yamakawa et al., 2011). Taken together, our first JV hypothesis is formulated as:

H1. *JV of eR-eT is greater for established firms compared to young enterprises (startups / new ventures).*

Secondly, OA theory predicts that eR and eT are dynamic functions that manifest over time (Lavie et al., 2010). This prediction is complemented by findings for below-average performance in the longest surviving organizations at any point in time (i.e., static underperformance yielding dynamic survival). More recent evidence from a 20-year panel study of 2,300 manufacturing firms supports the positive impact of long investment horizons on subsequent performance (Souder et al., 2016). Extrapolating, if JV is a valid estimator of the interplay between eR and eT, then we would expect JV to be larger when eR and eT are evaluated over a longer timeframe (Luger et al., 2015). Specifically, we formulate our second JV hypothesis as:

H2. *JV of eR-eT is greater for long-referent compared to short-referent performance timeframes.*

Third, organization ecologists emphasize the impact that various external factors (e.g., industry, economic, environment) have on organization performance. A primary factor characterizing the organization-environment relationship is dynamism, defined as "change that is hard to predict and that heightens uncertainty for key organizational members" (Dess and Beard, 1984; p. 56). Dynamism was also elaborated in the temporal functions of eR and eT processes when March (1991; p. 72) observed, "Effective selection … is essential to survival, but so also is the generation of new alternative practices, particularly in a changing environment." Subsequently, OA researchers postulate that eR-eT is more effective for performance in high-dynamic environments (Tushman & Anderson, 1986). Simulation evidence has supported dynamism's increased demand on both eR and eT (Kim & Rhee, 2009). Dynamism's moderation of eR- and eT-performance relationships has received consistent empirical support, ranging from financial service firms (Jansen et al., 2006) to high-tech product development units (Yang & Li, 2011). Recent longitudinal findings extend environmental dynamism's impact for eR and eT effects on performance (Bernal et al., 2016). Taken together, our third JV hypothesis is formulated as:

H3. *JV of eR-eT is greater for high-dynamic environment versus low-dynamic environments.*

Summary for Study of JV

Having introduced JV's conception, detailed its technical derivation and formulated theoretically aligned hypotheses, we turn toward our methods for testing JV's unique contribution and substantive value. First, we preface our methods with a brief, justificatory note for undertaking a new systematic synthesis of OA's empirical findings. As mentioned earlier, the previous MA of OA (k=25) resulted in an OA-performance estimate of r=.06 (Junni et al., 2013). As reviewed here, one explanation for the low correlation may be operational confounding from inconsistent methods to eR-eT. As Martinko et al.

(2014; p. 1056) note, "when studies have large samples and relatively small effect sizes, the potential that significant effects may be the result of empirical confounds is especially strong."

Method

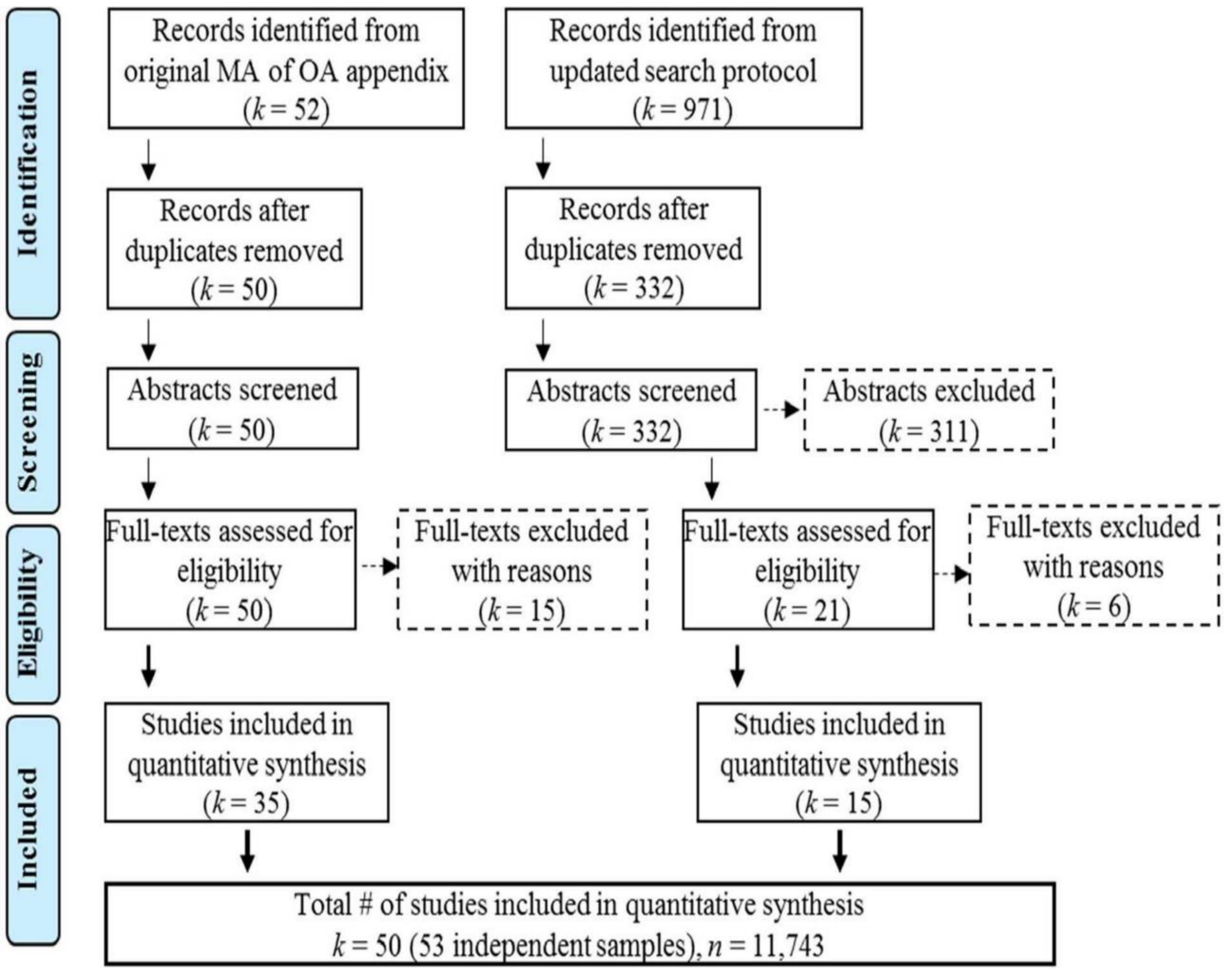
Literature Search

First, all primary studies from Junni et al.'s (2013) original MA of OA were retrieved. After removal of two duplicates, 50 full-texts were subsequently reviewed for inclusion eligibility. Second, we repeated the original search protocol to include the most recent years of publication. Specifically, databases were searched with chronological delimitations from 2013-2016. After removal of duplicates, 332 new abstracts were screened for retention. After excluding 311 abstracts sourced beyond the organizational sciences (e.g., organic chemistry, physics), 21 full-texts remained for inclusion eligibility review.

Inclusion Criteria

To be eligible for inclusion in the current JV synthesis, studies were required to meet four primary criteria: 1) sufficient statistical reporting to extract convertible effect size data, 2) identifiable focal variables of eR, eT, and performance, 3) sample relevance in terms of employees and organizations operating in normative economic markets, and 4) non-ipsative measurement of eR-eT. Applying the four-rule criteria to the 71 full-texts resulted in the identification of 21 studies as ineligible. Ineligibility was due primarily to ipsative measurements and irrelevant samples (e.g., college students). The search protocol and decision-process for obtaining studies is illustrated in Figure 4.

Figure 4. Summary flowchart for obtaining studies for joint-variance computations



Study Coding

Included studies were coded for study characteristics as well as substantive elements for hypothesis testing (Table 2). Coding categories constituted a mix of theory- and data-driven approaches. For example, environmental dynamism is theorized to impact OA-performance relations, but categorization into low versus high groups was data-driven (using a median split). To ensure reliable and accurate classification based on our coding scheme, the first-author and a Ph.D. candidate with prior MA coding experience independently coded a subsample of 8 studies (15%). Cohen's kappa score for inter-rater agreement was estimated at .87 and .73 for study characteristic and substantive elements, respectively, indicating strong agreement. Remaining disagreements were resolved through three rounds of iterative discussions until complete consensus was reached. A summary of all coded studies is provided in Online Appendix 4).

Table 2. Coding Scheme of Primary Studies by Characteristics and Substantive Categories

Study Characteristics	**Operational code**
Sample size	*Continuous*
Observation year/s	*Continuous*
Response rate	*Continuous*
Design	1 = cross-sectional, 2 = longitudinal
Level-of-Analysis	1 = micro, 2 = meso/macro
Industry	1 = high-technology, 2 = manufacturing
Level-of-Analysis	1 = micro, 2 = meso/macro
Industry	1 = high-technology, 2 = manufacturing
eR-eT index	1 = AD, 2 = Sum / Mean, 3 = MI, 4 = none, 5 = custom

Substantive Aspects (*JV Hypothesis*)	**Operational code**
(H1) Establishment status	1 = yes (public-offered), 2 = no (new enterprise) Performance timeframe
(H2) Performance timeframe	1 =< 12-months, 2 =>12-months
(H3) Environmental dynamism	1 = low-median, 2 = high-median

Statistical Analytic-Approach

JV computations were conducted using MS Excel 2013 macros. Basic descriptive and observation-level analyses were conducted in SPSS v25. Meta-analytics were conducted in Comprehensive Meta-Analysis v3 (Borenstein et al. 2014). Random-effects modeling is implemented for all meta-analytics (see, Online Appendix 5 for summary-publication bias evaluation). The majority of primary studies reported sufficient correlations for inclusion, otherwise, summary descriptive statistics were converted into generic point-estimates with local standard errors for input to meta-analytic models.

Results

Generally, we observed inconsistency in eR-eT methods across the literature. About 17% of studies (k=9) used a customized index of eR-eT, 26% (k=14) used multiple indices, and 30% (k=16) used redundant indices (e.g., ʹMI x ADʹ terms for eR-eT). Of the 36% (k=18) of studies that do not operationalize eR-eT (separate estimates), nearly half explicitly cite OA theory in formulating hypotheses (k=8; 44%). The heterogeneity in eR-eT operationalizations was supported by results of a random-effects

MA model of eR-eT and performance, r=.23; 95% CI [.13, .33]. Specifically, the significant Q = 806.52(23), $p < .001$ and I^2 = 97.15% indicate the presence of substantial heterogeneity and potential moderation. Subgroup analyses based on the four approaches to eR-eT (Table 3) resulted in comparable group estimates of performance, $Q(3) = 2.021$, p=.57.

Table 3. Subgroup Analyses of OA-Performance Relation by eR-eT Approach

Subgroups	**Effect Sizes, Fail-Safe N's, & 95%CIs**				**Null-test**	**Heterogeneity**		
eR-eT Approach	***k***	***N***	***E.S.***	**Conf. Int.**	***Z***	**p-val**	***Q***	**p-val**
M.I. (eR x eT)	13	2,217	.206	[.07, .34]	2.97*	.003	2.021	.57
Sum (eR + eT)	2	292	.457	[.13, .79]	2.70*	.007		
A.D. (|eR-eT|)	4	1,480	.194	[-.04, .43]	1.63	.104		
Custom	5	1,160	.214	[-.02, .45]	1.79	.073		
Total between					2.02	.57		
Overall	24	5,149	.236	[.11, .36]	3.72	.00		

Note: $^{*}p$ .05, k = number of independent samples cumulated; N = cumulative sample size; E.S.= raw, generic point-estimate; Conf. Int. = 95% confidence interval; Q = Cochran's (1954) heterogeneity Q statistic

eR-eT Compatibility

Despite the various operationalizations of eR-eT, inspection of bivariate relations indicated a positive association in 51 / 53 (96.22%) independent samples. MA random-effects estimation (correcting only for sample size variability) yielded a significant positive effect, r = .37; 95% CI [.21, .43]. Although eR-eT's positive correlation refutes assumptions for exclusivity (i.e., $r_{eR\text{-}eT} = 0$), the secondary analysis of correlational designs limits strong inference of meaningful non-zero correlations. To strengthen inference for eR-eT's substantive relation, a more conservative test was conducted comparing the bivariate correlations between: 1) eR-eT, 2) eR-performance, and 3) eT-performance. Paired sample t-tests indicated that the eR-eT relation (r = .37) was significantly greater than the eT-performance relationship(r = .26, $t_{(52)} = 3.11$, $p < .01$) or the eR-performance relationship (r =.28, $t_{(52)} = 2.43$, $p < .05$). This finding strongly refutes exclusivity assumptions for eR-eT effects on performance. The two findings reported above converge in support of eR-eT's substantive collinearity. Given that over 1/3 of studies in our sample (k=18, 36%) report separately estimated effects for eR and eT, it is informative to examine whether results could be impacted by ignoring eR-eT collinearity.

First, we examined what effect (if any) the separate estimates for eR and eT might have on variance inflation. This relates to Online Appendix 3, wherein, we specified conditions when collinearity would strengthen the precision of predictors, conversely, omitting collinearity may weaken eR-eT precision. Formulaically, eR and eT parameter variance estimates are strictly increasing in $r_{eR\text{-}eT}$, if ($r_{perf\text{-}eR}$ * $r_{perf\text{-}eT}$) > $r_{eR\text{-}eT}$ [1 - $r^2_{eR\text{-}eT}$ - 2D) / (1 - $r^2_{eR\text{-}eT}$)], where D ∈ [0,1] is the determinant of the correlation matrix of eR, eT, and performance. We applied this formula to our 53 samples, and results indicated support for variance-inflation in separate estimates of eR and eT. This finding reduces the generalizability of separate estimates for eR and eT. It also complements conditions outlined earlier in Online Appendix 3, whereby collinearity is desirable for improving precision of interrelated predictors.

Second, related to generalizability, we examined the potential impact of eR-eT collinearity for variable-omission bias in separate parameter estimates. Intuitively, separate estimates of eR and eT would be biased upward if performance variance shared between eR-eT were redundantly attributed as separate effects (i.e., double-counted, recall the Venn diagram in Figure 3). To elaborate, if eR and eT are orthogonal, then omission bias will be absent, and separate estimates of eR and eT will be uninflated. In contrast, if eR and eT are correlated, then omission bias will be indicated by inflation of separate eR and eT estimates. Formulaically, for $r_{y.eR}$; $r_{y.eT} > 0$, the bias in separate estimates of eR or eT is strictly increasing for $r_{eR\text{-}eT} > 0$, if $r_{y.eR} / r_{y.eT} > 2r_{eR\text{-}eT} / [1 + r_{eR\text{-}eT}]^2$. Applying this formula to our 53 samples indicated the presence of omission bias for all samples (*k*=53; 100%).

JV Technical Applications

First, returning to our previous finding for eR-eT heterogeneity, we pursued a continuous covariate unlimited by subgroup size for explaining between-study variability in performance effects. Specifically, we used the JV of eR-eT as a covariate that might explain between-study heterogeneity. Entering JV as a continuous covariate in a meta-regression resulted in a significant positive association with predicted performance effects. This was supported by the Knapp-Hartung test, $F_{(1,22)} = 7.90$, $p=.01$.

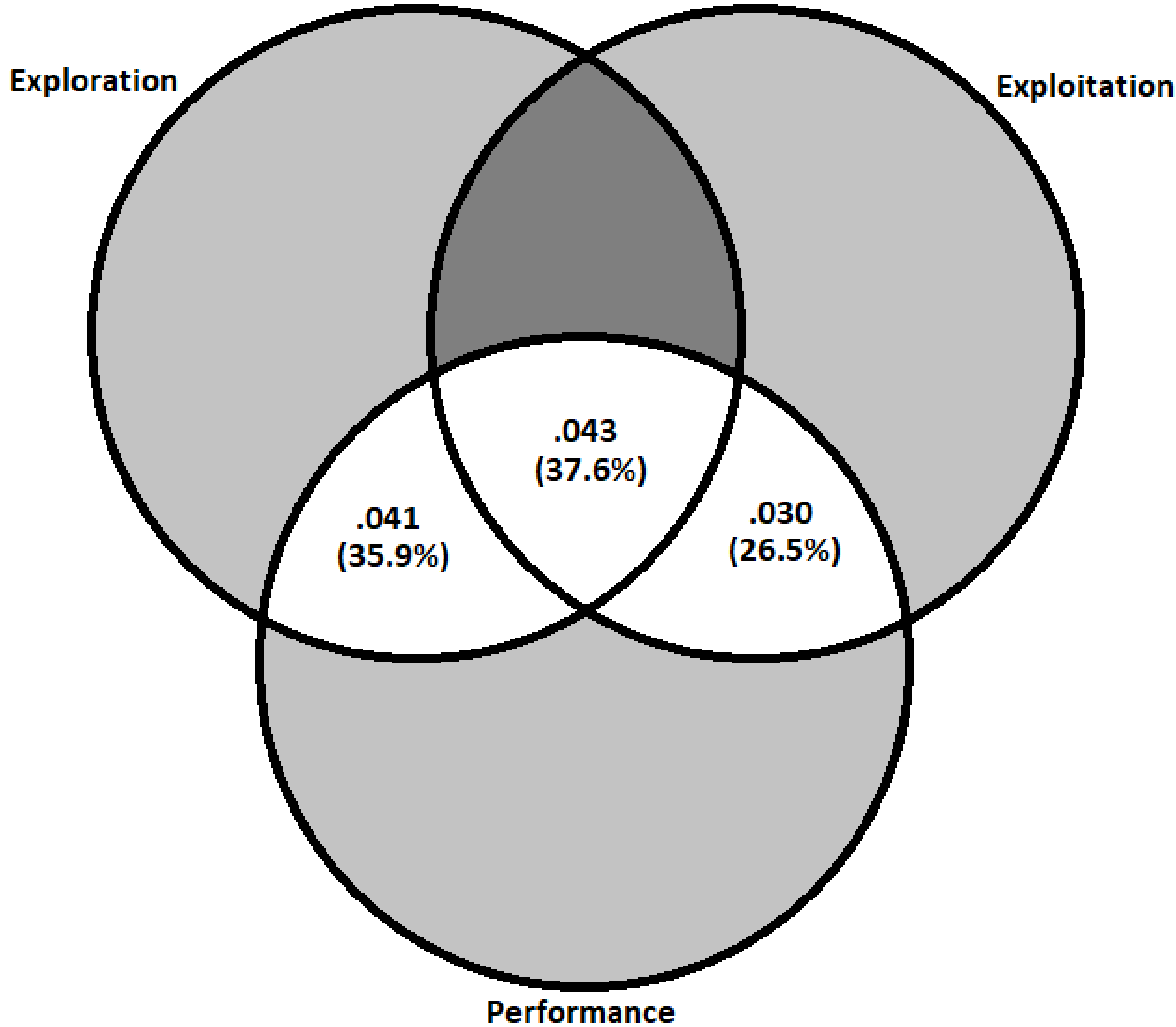
The analogue R^2=.45 indicates that the JV of *eR-eT* accounts for approximately 45% of total between-study variance in performance estimates.

Second, in order to determine if the detected omission bias could be considered negligible, we quantified the relative inflation from double-counting eR-eT's JV in performance. The joint variance component accounted for up to 68.9% of the total R^2 in the samples analyzed, accounting for at least 10% in 39 of 53 samples (73.6%), at least 20% in 28 of 53 samples (52.8%), and explaining more variance in performance than eR or eT in 15 of 53 samples (28.3%). The presence of any predictive power for JV indicates that models not accounting for the eR←→ eT component are somewhat misspecified. The strong relative importance of the eR←→ eT component suggests that existing OA research is neglecting an important aspect of the predictive power of eR and eT.

Figure 5 displays the percentage of average variance explained by eR, eT, and eR←→eT computed using uncorrected random-effects meta-analytic summary effect sizes to estimate relationships between eR, eT, and performance across the 53 analyzed samples. Results indicate that independent interpretation of $r^2_{perf.eR}$ and $r^2_{perf.eT}$ would double-count 37.6% of the variance explained by eR and eT.

Finally, we briefly note tests of methodological assumptions for satisfactorily conforming to OA theoretical predictions. For space considerations, the full results are summarized in supplementary online Appendix 6.

Figure 5. Variance explained (and relative percentage) in organizational performance by the unique effect of exploration, the unique effect of exploitation, and the joint effect of exploration and exploitation.



JV Hypothesis Tests

In preface, findings indicate the JV estimate was distributionally similar to the unique components of eR and eT, $X^2_{(2)}$ = 3.27, *p*=.20. Furthermore, a non-parametric test was conducted to examine magnitude-differences between JV and unique components of eR and eT. Results from *Friedman's* $X^2_{(2)}$ = 2.47, *p*=.29 were non-significant, indicating support for the point-estimate comparability of JV, eR and eT (of similar magnitude across our sample of studies). The results support the relative-stability of JV estimates to unique components. Hypothesis test results are presented below.

H1. JV of eR-eT is greater for established firms compared to young enterprises (startups / new ventures).

Test results indicated a significant difference in the estimates between established firms (M=.07, SD=.08) and new enterprises (M=.03, SD=.03); $t_{(19)} = 2.36$, $p < .05$.

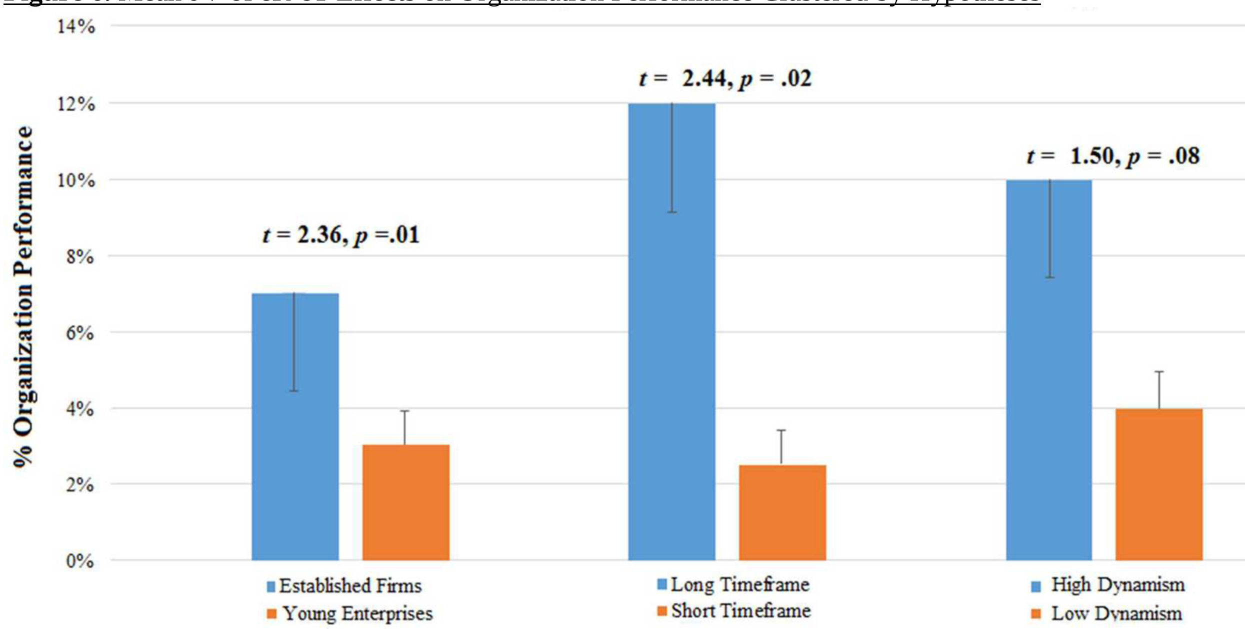
***H2**. JV of eR-eT is greater for long-referent compared to short-referent performance timeframes.*

An independent samples t-test was conducted to compare JV estimates between short- and long-referent timeframes. Test results indicated a significant difference in the hypothesized direction between short- (M=.025, SD=.04) and long timeframes (M=.12, SD=.10); $t_{(11)} = 2.44$, $p < .05$.

***H3**. JV of eR-eT is greater for high-dynamic environment versus low-dynamic environments.*

An independent samples t-test was conducted to compare JV estimates between high- and low-dynamism. Test results indicated a marginally significant difference in the estimates for high- (M=.10, SD=.11) and low-dynamism (M=.04, SD=.04); $t_{(18)} = 1.50$, $p < .10$. Results for our three hypotheses for JV of eR-eT are illustrated in Figure 6.

Figure 6. Mean-JV of eR-eT Effects on Organization Performance Clustered by Hypotheses



Note: 95% standard error bars and *t*-test values are displayed. k=20, 12, and 19, respectively.

Discussion

This study complements recent qualitative efforts to synthesize the fragmented field of OA (Nosella et al., 2012). We complement these efforts by synthesizing existing findings and filling a gap for eR-eT reciprocality. We briefly review our findings below.

First, our review of existing eR-eT approaches for generating propositions provides a prescriptive tenet to typically descriptivist OA paradigms. We proffer eR-eT reciprocality as a theoretical cornerstone of OA while solemnly recognizing the dearth of literature directly addressing this phenomenon and the inadequacy of standard research methods for observing and addressing the interplay between these constructs. We examine the feasibility of a more complete and consistent account of existing data (e.g., JV as estimator across primary studies). As McGuire (1997, p. 17) states, “Explaining relations once is not enough, the researcher should routinely go beyond a first explanation by using the ‘method of strong inference’ to test … to what extent the relation is accounted for by each of several explanations.”

Research Implications

Our impetus for conducting this study owes to the misalignment between original theoretical conceptualization and prevailing methodology for studying OA. Repeated failure to demarcate key constructs yielded overly simplistic and incomplete operationalizations. For example, researchers′ predominant use of the popular MI approach (eR x eT) pursues orthogonalization for convenient computations. Subscribing to Bobko and Roth’s (2008) recommendation for qualitative thinking in MA, we have updated and reanalyzed data presented on the putative ‘independent’ effects of eR and eT. The JV of eR-eT, which OA theorizes as reciprocality, is neglected in dominant methodological approaches.

If we consider that the original construct of OA was later outfitted with eR and eT processes from March‘s (1991) organization-level learning basis, it may be appropriate to prioritize functional equivalence. At the group level, for example, emphasis is placed on cross-functional teams for achieving innovation performance in ambidextrous organizations (Benner & Tushman, 2003). At the individual level, contextual ambidexterity accommodates the incompatible perspective of eR-eT. Before instantiating OA with employees, however, due consideration should be given to the discriminant validity of individual OA and similar emerging constructs, such as ‘systems-thinking’ (Sweeney & Sterman, 2000) or ’investment traits’ (von Stumm & Ackerman, 2013). Related to the latter, OA scholars may gain additional insight at the intersection of experiential learning and lifespan research. For example, an MA of studies comparing young-old populations on behavioral tasks of risk propensity indicated a contingency to the conventional wisdom of risk-aversion (obsolescence) with age. Specifically, learning for hazard avoidance manifested as greater risk-seeking among older adults, but exhibited traditionally greater risk-aversion for learning reward obtainment (Mata et al., 2011).

Extrapolating from our findings, we aim to provide empirical insight into existing evidence based on a theory-laden, interactive process model of exploration-exploitation for OA. Our rationale bears a striking resemblance to Arogyaswamy et al.‘s (1995, p. 494) status-assessment of the firm turnaround literature: “understanding of turnarounds is constrained by how the turnaround process has been modelled and empirically tested. In particular, most turnaround models … are time-sequential models that miss examining interactions between stages.”

Practical Implications

We recommend that managers reframe eR and eT as sequential and mutually reinforcing processes. For example, when deliberating between eR or eT strategies, it might be useful to appraise how investment in eR *now* is most likely to affect eT later, and vice versa. Considering temporal links directly between eR-eT may improve strategic decision-making by reducing contrastive appraisals from immediate choices. This relaxes the traditional integrative strategies for business decision-making, whereby, “the discrete nature of structural integration … appears to force a choice between leveraging existing knowledge or the capacity for ongoing innovation” (Raisch et al., 2009, p. 689). A complementary temporal perspective may, instead, be more functional amid rising dynamic global markets.

Another useful implication of our findings pertains to alternative conceptions of what constitutes eR and eT in different domains. For example, eR is traditionally associated with expansion toward securing new markets (Benner & Tushman, 2015). An alternative conception of eR within the product development domain may be made in quality improvements. In this conception, successful eR maintains its focus on future viability, but from a customer *retention* perspective, rather than new market entry. This alternative conception also relates to the static predisposition for production innovations, rather than process innovations. Recent empirical evidence supports synergistic complementarity in process innovations (Mothe et al., 2015).

Limitations

We have presented JV synthesis as a methodological solution to the need for quantification of eR-eT's essential collinearity, congruent with theoretical and definition aspects of OA. Important limitations, however, warrant cautious interpretation and future research. First, the observational study design constraint was leveraged for our application of JV in order to systematically quantify eR-eT. In turn, the decomposition of observed variances inherits many limitations common to observed score analyses. Second, as Tay et al. (2014, p. 80) observe, "covariability at a slice in time offers little insight on when and how constructs emerge. As such, our construct labels and definitions do not typically entail an elaboration of underlying processes." The limited number of longitudinal studies in our sample limits our inferences for JV estimates of eR-eT reciprocality over time. By extension, different operationalizations may be more suitable for different study designs, which may hold practical import in future OA research. Related to restrictive construct labels, it should also be noted that the constrained primary study sample compelled broad categorizations, such as non-public firms' conceptualization as a form of new enterprises. Entrepreneurship researchers may build on the current study by further probing this classificatory liberty of new enterprises. Third, we are tentative to endorse formalizations of paradoxical frameworks for elaborating organizational theory, particularly with regard to OA (cf. Smith & Lewis, 2011). There are, however, many other tensions that are often subsumed under the OA label that may be suitable for JV synthesis. For example, Raisch et al. (2009) identified four central tensions as imperatives for advancing OA research: 1) differentiation-integration, 2) individual-organizational, 3) static-dynamic, and 4) internal-external (see also Papachroni et al., 2014). Our primary focus in the present investigation concerned the first imperative. Specifically, we observed a disintegrated field and aimed to cohere its empirical works with greater consideration of OA theory‘s foundational tenets.

Conclusion

We began with Benner & Tushman’s (2015, p. 502) claim that “we risk knowing more and more about a type of innovation that is being displaced” as a point-of-inquiry to the empirical evidence for eR-eT. We concur with growing skepticism of OA from the continued accumulation of fragmented and contradictory findings. Moreover, the absence of eR-eT‘s reciprocality ensures further obfuscation of OA theory with biased empirical evidence. We leveraged this constraint to OA‘s refractory field of OA by proposing a JV solution for eR-eT reciprocality. In effect, JV synthesis of eR-eT fills a conceptual gap and bridges empirical outcrops while conforming to theoretical predictions. Only further use will reveal if it lives up to OA researchers’ expectations.

Exploration and exploitation are functionally dissimilar, yet jointly necessary. In the current synthesis, a substantial proportion of the modeled variance between eR-eT and performance was shared, consistent with OA theory. This inference was inaccessible from previous findings. We hope that our synthesis is illustrative and may complement the empirical evidence base for OA scholarship. We further hope that our findings may stimulate novel uses of JV syntheses in OA research. In summary, presuming a reciprocal theoretical model, we complement the existing field of OA with functional inferences from reanalyzed data. We further aim to generate new propositions from our empirical findings for the purpose of focusing and advancing OA scholarship. As March (1991, p. 85) put it, “the ambiguous usefulness of learning … [stems] from the relation between knowledge and discovery.”

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SUPPLEMENTARY-ONLINE APPENDICES

Table A1. Select Summary of OA Reifications

Source	**Descriptor**
Gibson & Birkinshaw (2004)	contextual OA
Lavie & Rosenkompf (2006)	cross-domain OA
Chen & Katila (2008)	sequential-simultaneous OA
Simsek (2009)	structural-temporal OA
Ramachandran (2009)	symmetrical-asymmetrical OA
Tempelaar & Rosekranz (2016)	boundary-spanning OA
Carter (2012)	zero-, first-, and second-order OA
Bøe-Lillegraven (2014)	big-data analytics for untangling OA
Luger (2014)	static (cross-sectional)-dynamic (longitudinal)
Stettner & Lavie (2014)	cross-modal (intra- / extra-organizational) OA
Stadler et al. (2014)	social-network analysis of OA
Ask & Magnusson (2015)	OA-OP (para-dexterity)

Note: Entries listed in chronological order.

Table A2. Analogous Dichotomies / Tensions Across Domains of Organization Sciences

Literature	Exploration	Exploitation
Evolutionary Learning	Variation	Selection
Organizational Adaptation	Transformation	Stability
Organization Design	Flexibility	Efficiency
Organizational Dilemmas	Productivity dilemma	Innovator's dilemma
Organizational Info-Processing	Informal systems	Formal systems
Organizational Learning	Single-loop learning	Double-loop learning
Organizational Turnaround	Recovery	Retrenchment
Strategic Management	Autonomous processes	Induced processes
Technological Innovation	Radical	Incremental

Note: Modified and extended from Papachroni (2013).

Table A3. Summary of Collinearity-Improved Predictions with Exemplary Links to OA Research

Collinearity-Improvement	**(*Illustrative Examples Applicable to eR-eT Research*)**
Expected-value intercept	(*Formal theorizing (specifications) of eR-eT collinearity may be inferred as best explanations, where eR-eT overlap is of greater / lesser determinacy for performance, e.g., organization age, size, fiscal resource, and industry predict eR-eT collinearity. Also, historical eR-eT observation. In short, this concerns point-estimates of OA across contexts*.)
Prior information utility	(*Empirically, collinearity of eR-eT priors may be inferred for model-comparisons purposes across exogenous factors (e.g., dynamism) or endogenous-replicability across multiple, eR-eT operationalizations (multiplicative-interactions vs. absolute-differences*).
Prediction of realistic collinearity	(*The non-recursive market context of organization survival is indicative of real-world collinearity (e.g., reciprocal causality of downward spirals in firm failures). More substantive, model-fidelity to real-world eR-eT collinearity is epitomized by the dramatic reductions in communication- and information-processing costs initially justificatory for 'divisional' separation of functionally dissimilar organization units (e.g., eR-eT).)*
Budgetary constraints	(Analogous to the narrow, ′closed-system′ conceptions of eR-eT operating within organizations and competing for finite resources.)
Auto-correlated residuals	(*Essentially an instantiation of the 'dynamic-complementary' argument of OA. Negative-correlated intertemporal residuals have been colloquially: Termed, the Penrose Effect.)*
Non-rectangular distribution	(*Productivity contexts where eR-eT relativity is constrained by technologic limits (remarkably similar to depictions of the 45° angle 'efficiency frontier′ depicted in arguments for contextual OA.)*

Table A4. List of Encoded Primary Studies Included for JV Synthesis (K=51)

	Study Characteristics							Substantive Elements		
Author(s), Year	N	Res%	Design	Level	Indust.	eR-eT Operat.	Perform. Operat.	Estab. Status	Perform. Timefrm.	Environ. Dynam.
Abebe& Angriawan (2014)	55	15.7	X	Agg	Man		Sub	Old	Shrt	
Belberdos et al. (2010)	126		L	Agg		MI	Obj	Old		
Bierly & Daly (2007)	98	39	X	Agg	Man	MI	Sub	Old	Long	Low
Bierly et al (2009)	180	41.1	X	Agg			Obj	Old		
Cao et al. (2009)	122	61	X	Agg	Tec	MI	Sub	Old	Shrt	Low
Cegarra-Nevaro, et al. (2011)	229	27.5	X	Agg			Sub	Old	Long	
Cui et al (2014)	238	14.3	X	Agg			Sub	Old		
Dunlap et al (2013)	76		X	Agg	Tec	MI	Obj	Old		
Gibson & Birkinshaw (2004)	41		X	Agg		MI	Sub	Old	Long	
Haas et al (2006)	96	47	X	Agg		MI	Obj	Old		
Hall (2011)	83	22.5	X	Mic	Man	MI	Sub	Old		
Han & Celly (2008)*	91	12.9	X	Agg		Cus	Sub	New	Shrt	
Hill & Birkinshaw (2014)	95	29	X	Agg		MI	Sub	New		
Hughes et al (2010)	260	19.8	X	Agg	Man	S/Avg	Sub	New		
Im & Rai (2008) (customers)	238	7	X	Agg		MI	Sub	Old		High
Im & Rai (2008) (vendors)	76	47	X	Agg		MI	Sub	Old		High
Jansen et al (2006)	283	49	X	Agg			Obj	Old		High
Jasmand et al (2012)	119	58.9	X	Mic		MI	Obj	Old		
Kostopoulos et al (2011)	142	54	X	Agg		MI	Sub	Old		
Kristal et al (2010)	174	9	X	Agg	Man	MI	Sub	Old		
Kyriakopoulos (2011)	60	39	X	Agg			Sub	Old		
Kyriakopoulos & Moorman (2004)	75	28.3	X	Agg		MI	Sub	Old	Shrt	
Lee et al (2010)	1057		X	Agg	Man		Sub	Old	Long	
Leidner et al (2011)	263	4.7	X	Agg		AD	Sub	Old		High
Levitas & McFadyen (2009)	1016		L	Agg	Tec		Obj	Old		
Li & Huang (2013)	218	36.3	X	Agg	Man	MI	Sub	Old		
Li et al (2013)	290	39	X	Agg	Man	MI	Sub	Old		
Lisboa et al (2011)	254	20	X	Agg	Man		Sub	Old		Low
Luger (2014)	546		L	Agg		MI	Sub	Old		
Matzler et al	232	5.8	X	Agg			Sub	Old		

(2013)										
Menguc & Auh (2008)	104 ,104	26.5, 26.5	X	Agg	Man	MI	Sub	Old	Long	High
Morgan & Berthon (2008)	160	20	X	Agg	Tec	MI	Sub	Old	Shrt	
Moss et al (2014)	92		X	Agg	Tec	Cus	Obj	Old		Low
Patel et al (2012)	876	11.7	X	Agg	Man	S/Avg	Obj	Old		Low
Patel et al (2013)	219	14.4	X	Agg	Man	AD	Obj	New		High
Rothaermel (2001)	32		X	Agg	Tec	S/Avg	Obj	Old		
Russo & Vurro (2010)	732		X	Agg		MI	Obj	Old		
Sirén & Kohtamäki (2015)	182	16	X	Agg	Tec		Sub	Old		
Siren et al (2012)	206	18	X	Agg	Tec	MI	Sub	Old	Shrt	High
Su et al (2008)	79	40.4	X	Agg	Tec	MI	Sub	Old		Low
Subramani (2004)	131	33	X	Agg			Sub	Old	Long	Low
Thongpapanl (2012)	232	24	X	Agg			Sub	Old	Long	
Torres et al (2015)	67		X	Mic		MI	Obj	Old		
Tu et al (2010)	96	15.9, 10.4	X	Agg	Man		Sub	Old		Low
Vorhies et al (2011)	169	42	X	Agg		MI	Obj	Old		
Wang & Rafiq (2014)	392	11.5	X	Agg	Tec	Cus	Sub	Old	Long	
Yalcinkaya et al (2007)	111	22	X	Agg	Man		Sub	Old	Shrt	
Yang & Li (2011)	289	64	X	Agg	Tec	MI	Sub	Old		High
Yu et al. (2014)	214	21.4	X	Agg	Tec		Sub	Old		Low
Zahra et al (2000)	321	23.8	X	Agg			Obj	New	Shrt	
Zhan & Luo (2008)	102	23.1	X	Agg	Man	MI	Sub	Old		High

Note. *k*=50. X=cross-sectional, L=longitudinal; Agg=meso/macro level, Mic=micro level; Tec=Technology, Man=manufacturing; AD=Absolute-Difference, MI=multiplicative-interaction, Cus=custom, Sub=subjective, Obj=objective; Old=public-offered corporation, New=new enterprises, ventures, or startups. Shrt=short.

Table A5. Summary Publication Bias Assessment

eR-eT Bivariate

The trim and fill procedure (Duval & Tweedie, 2000) indicated that no studies were imputed to the left of the mean for eR-eR correlations, suggesting publication bias did not artificially inflate the estimates in the current study. There was also no evidence of publication bias according to non- significance from Egger's intercept test (β = .52, p = 0.60) or Begg and Mazumdar's (1994) rank- correlation test (Kendall's $\tau_{(Z)}$ = 0.66, p = 0.51). Last, results from a cumulative MA also indicated unlikely publication bias based on observed insubstantial drift.

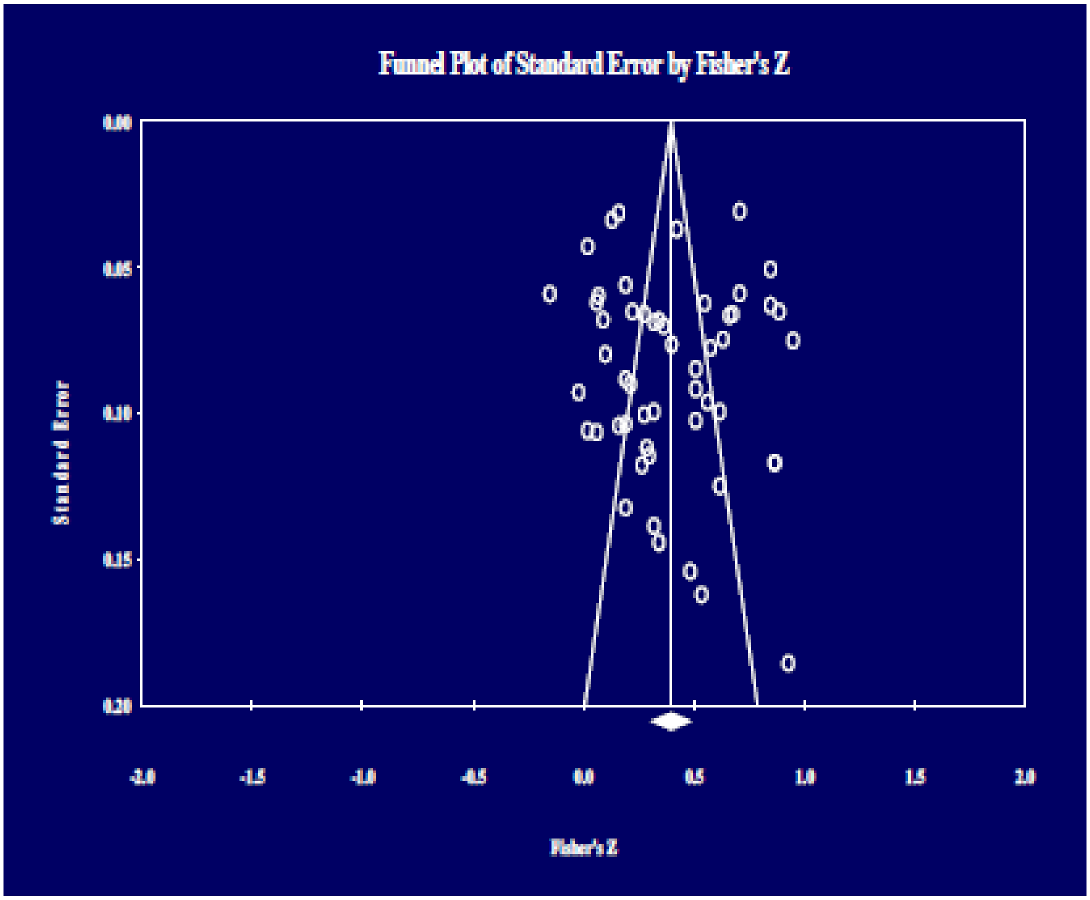

Table A6. Empirical Evidence Results Appraising Alignment of OA Theory Predictions-eReT Method Assumptions

Method and Assumptions	Theoretical Prediction	Test Procedure and Results
"Balanced" View		
Absolute-Difference (AD) → OA = |eR-eT|	Prediction: eT will be greater than eR (eT > eR).	Procedure: A paired-samples t-test for eR-eT was conducted across all sample studies.
Assumption: equal weights for eR and eT, $Y'_{(org\ perf)} = b_0 + b_1\|eR - eT\|$ → $Y'_{(org\ perf)} = b_0 + b_{1(eR)}\text{-}(\text{-})b_{1(eT)}$	Organizations tend toward eT compared to eR over time, leading to "suboptimal stable equilibria" (March, 1991, p.71).	Results: Estimates of eT (M_{eT}= 4.64, SD = 2.98) was significantly greater than eR (M_{eT}= 4.40, SD = 3.26); $t(44) = -2.33$, $p < .02$. Interpretation: Theory supported: Organizations to tend toward eT, relative to eR, negating the equality-assumption of ADs.
"Combined" View		
Sum $\sum_{(eR\text{-}eT)}$ → OA = eR+eT Assumption: eR and eT are exclusive.	Prediction: eR and eT are *inter*dependent. (March, 1991; Tushman & O'Reilly, 1996)	Procedure: Mela & Kopalle (2002) tests for inflated error were conducted. Results: (see, JV technical application in main-text). Interpretation: Theory supported: eR-eT are essentially correlated, negating the independent-assumption of $\sum_{(eR\text{-}eT)}$
Average $\mu_{(eR\text{-}eT)}$ → OA = ([eR + eT] / 2)	Prediction: eR variability > eT variability	Procedure: Sample-matched F-ratio for equality of s^2.
Assumption: equal variances for eR and eT	March (1991) articulated the differences in variability between eR and eT, such eR is postulated to be systematically more variable (temporally distal), relative to eT.	Results: The average s^2 of eR (SD = 1.13.) was larger than for eT (SD = 1.07), but only reached marginal statistical significance, $F(42) = 1.32$, p=.09. Interpretation: Theory partially supported.
Multiplicative Interaction (MI) → OA = 'eR x eT' Assumption: eR and eT are independent. Corollary: Mean-centering achieves orthogonality. Corollary: Measurement-error of new term is stable.	Prediction: MIs will *over*-estimate performance effects compared to JV. "reciprocal interdependence in which the outputs of exploitation…become the inputs for exploration…and the outputs…cycle back" (Stadler et al., 2014 p35).	Procedure: A paired-samples t-test was conducted to compare performance estimates between MI and JV specifications of eR-eT. Results: There was a significant difference between the multiplicative-interaction specification (M=.23, SD=.25) and JV -estimate (M=.08, SD=.12) conditions; $t(7) = -2.43$, $p < .05$. Interpretation: Theory supported.