1-2022

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Journal:	*Academy of Management Annals*
Manuscript ID	ANNALS-2020-0203.R4
Document Type:	Article
Keywords:	CREATIVITY, PERSONALITY, INFORMATION PROCESSING

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Acknowledgments
We would like to thank Stuart Bunderson for his encouragement and Elizabeth Wolfe Morrison for her eye for detail and overall excitement about the ideas in this paper. This paper was written during the Covid-19 pandemic by a team of coauthors that spanned the globe and had never met in person. It required patience, compassion, and teamwork and we're grateful that this paper serves as an artifact of the trials and victories of that collective experience during this uncertain moment in history. Finally, we would like to note that the first two authors contributed equally (in this case we eschewed an alphabetic author order and instead followed the order of when each author joined the project).

ABSTRACT

This paper focuses on the emergent importance of curiosity at work for individuals and organizations by reviewing management research on curiosity at work. We start by leveraging prior reviews on early and contemporary foundations of the curiosity construct in the larger psychological literature, with a focus on definitional clarity, dimensionality, and differences with other constructs in its nomological network. Next, we review different streams of management research on curiosity at work (i.e., broad generative and nongenerative effects, curiosity as a catalyst for personal action, curiosity as a catalyst for interpersonal action, curiosity as a catalyst for leadership, curiosity as an organizational or professional norm, and curiosity as a catalyst for organizing). Interweaving these diverse literatures and research streams gives us the wherewithal to provide conceptual clarity in curiosity research and highlight how curiosity has not only generative effects at the individual level but acts also as a more dynamic, interpersonal, and organizational property. In addition, our review brings attention to the potential dark side of curiosity. We end by outlining how the more nuanced insights of the role of curiosity at work generated by our review provide an impetus for future research.

KILLING THE CAT? A REVIEW OF CURIOSITY AT WORK

Curiosity *is the desire to know, to see, or to experience that motivates exploratory behavior, information seeking and learning* (Berlyne, 1954; Litman, 2005; Loewenstein, 1994; Mussel, 2013a). In recent years, the business world has touted curiosity as a superpower for individuals and companies for lifelong learning, innovation, entrepreneurship, social relationships, change, and ultimately competitive advantage (Gino, 2018). Firms like Merck, Nike, Disney, Target, GE, and Dell have claimed curiosity as a value. Due to the ever-increasing speed of change and information, curiosity is assumed to become even more important in the future.

In the broader psychological literature, the nature, experience, expression, and situational determinants of curiosity has been studied for decades; indeed, although there exists a sizable management literature related to curiosity at work in organizations, the body of literature that underpins curiosity has received relatively little attention by management scholars. Our review of this body of management research shows that curiosity serves as a fundamental attribute of organizational life. Curiosity is interwoven into crucial organizational tasks like socialization (e.g., Harrison, Sluss, & Ashforth, 2011), learning (e.g., Reio & Callahan, 2004), creativity (e.g., Hardy, Ness, & Mecca, 2017), leadership (e.g., Browning, Beyer, & Shetler, 1995), and, because it is often described as a rationale for founding an organization (e.g., Scott, 2014), it is also interwoven into organizational and professional values (e.g. Bechky, 2020).

To date, there has not been a detailed and systematic review of research on curiosity at work in organizations, suggesting that management research has not kept abreast of major developments in the definition, dimensionality, and nomological network of curiosity. This points directly to the urgency for such a review. Accordingly, in management research, the

conceptual distinctions between curiosity and similar constructs (e.g., openness, interest) have not always been clear, thereby slowing down progress to better understand the role of curiosity at work. Thus, the goal of our review is twofold. First, our review will leverage reviews on the foundations of curiosity in psychology to provide definitional clarity. We will build on this foundation by outlining the nomological network of curiosity. Second, our review provides the first ever review of evidence of curiosity at work, in organizations, and in professions**.**

In pursuing these goals, our review makes the following three contributions. Conceptually, our review leverages the latest theory and research findings to bring clarity to the definition of curiosity, and to explain how and why curiosity is unique, distinct and not derivative of other constructs that it sometimes gets confounded with (c.f., Montgomery & Monkman, 1955). Moreover, our review makes the strong case that curiosity should no longer be seen as a second-tier personality construct; it is worthy of study on its own. This provides a vital, generative foundation because connecting management research with this core of curiosity research in psychology allows future research to conceptually distinguish curiosity from similar constructs, thereby also allowing management scholars to fully leverage what is unique about curiosity.

Second, interweaving the curiosity literature in psychology with reviewing management research on curiosity at work and in organizations gives us not only the wherewithal to provide conceptual clarity in curiosity research; even more critically it shows that management research goes beyond seeing curiosity as an individual difference but also highlights the benefits of a contextualized view of curiosity in management research. This view elucidates how curiosity is a catalyst of social interactions and accordingly gives rise to more collective forms of curiosity.

Third, our integrative review illuminates several new, refreshing perspectives in curiosity research. Our integration of the different literatures reveals that curiosity has not only generative ("bright side") effects but also nongenerative ("dark side") effects. Additionally, in contrast to many concepts that help promote the stability of organizations, our review shows that curiosity might act as a destabilizer: it brings new organizations to life and allows individuals to question the assumptions of existing organizations. This is because we will show that over time curiosity can be embedded as a central value in the relational and cultural fabric of the collective pursuit of organizations. The re-enactment of curiosity as a collective expectation then creates room for new thought patterns.

In sum, our review opens space for a more nuanced, refined, and rigorous study of curiosity from what may be considered the more traditional, individual-focused framework. Our integrative review anchors curiosity in foundational research in psychology while also revealing how management research has created a more diverse angle for exploring curiosity. Woven together, our review of these different streams not only clarifies curiosity as a unique concept within its nomological network, but it also positions curiosity as a crucial aspect of organizational life and provides a more fine-grained view of the roles that curiosity plays in it.

We use the metaphor of the "earth," with its three layers of core, mantle and crust, as an organizing structure for our review. As shown in Figure 1, the "core" is comprised of the psychological literature focused on defining trait and state curiosity and its dimensionality. We see the core analogy as fitting because clarity on curiosity's definition and conceptualization is fundamental to the study of curiosity. The "mantle" is comprised of the psychological research related to curiosity's commonalities and distinctions with other related constructs (i.e., curiosity's nomological net). We refer to this body of literature as the mantle because it deals

with constructs that are conceptually related to, albeit different from, the core of what curiosity stands for. Hence, just like the mantle circles around the core, these conceptually related constructs circle around the key construct of curiosity. Although the core and mantle are beneath the crust and do not focus on curiosity in work settings, ambiguity related to these issues will almost certainly "surface" in empirical research on curiosity in the workplace and risks impeding further knowledge advancement on that front. Together, these sections of our review leverage foundational insights from large-scale reviews conducted outside of the world of work, namely in the broader psychological literature. The "crust" is the final layer and is comprised of the diverse research steams relating to curiosity in the workplace. On earth, the crust constitutes the largest surface area where there exists tremendous ecological diversity and where things grow and are built. That is why we see it as a fitting metaphor for the research on curiosity at work. Our discussion of the crust is the largest section of our review, offers the greatest diversity in approaches and offers the greatest opportunity for future research. As noted, these three layers serve as organizing structure for our review. Our review will start at the center (core) and move outward to the mantle and crust, respectively.

REVIEW SCOPE AND PROCESS

A Web of Science search[1] using the key word "curiosity" yielded over 3,500 publications since the 1950s. The majority of these publications related to research on curiosity in the psychological literature (general psychology, educational psychology, social/personality psychology, clinical psychology, and neuropsychology). We do not aim to provide an exhaustive review of this voluminous literature on curiosity in these various domains of psychology. Several

[1] This search was done on November 1, 2020.

reviews (Grossnickle, 2016; Litman, 2019; Shin & Kim, 2019; Silvia & Kashdan, 2009) have already synthesized that literature and we leverage these reviews to provide a definitional springboard and conceptual foundation for reviewing and discussing curiosity at work.

To identify relevant articles for our review of the research on curiosity at work, we followed guidelines to specifically search in the Web of Science for articles from management journals with high impact factors. To identify that list of journals, we used the following procedure. We used the SJR journal lists which benchmark journals according to impact factor (along with other impact statistics). We inspected the lists of journals under the following categories: "Organizational Behavior and Human Resource Management", "Strategy and Management", "Leadership and Management", "Business and International Management", and "Management of Technology and Innovation." We examined the top 30 journals per category and selected empirical journals (excluding method/review journals) that appeared on at least two of these lists thereby creating a list[2] with high impact and broad coverage of the management domain. We then searched for articles containing the terms curiosity, curious*, inquisitive*, search*, explore*, investigate*, discover*, and puzzle*. As our search terms were broad, we kept only articles empirically examining curiosity in the findings, producing a final sample of 175 journal articles.

[2] Our list of journals included: *Academy of Management Journal, Academy of Management Perspectives, Administrative Science Quarterly, Global Strategy Journal, Human Relations, Human Resource Management, Information and Organization, International Journal of Operations and Production Management, Journal of Applied Psychology, Journal of Business Venturing, Journal of Human Resources, Journal of International Business Studies, Journal of Management Studies, Journal of Product Innovation Management, Leadership Quarterly, Organization Science, Organization Studies, Research Policy, Strategic Entrepreneurship Journal, Strategic Management Journal, Strategic Organization,* and *Technological Forecasting and Social Change*. Our final journal list is slightly broader in part because we included articles that were cited by the articles found through this process. We also included *Academy of Management Discoveries,* which at the time was too new to have an impact factor, and *Academy of Management Review* to capture any additional empirical articles about curiosity described by management theorists.

THE CORE: EARLY AND CONTEMPORARY CONCEPTUAL FOUNDATIONS OF CURIOSITY

In this first section, we leverage several comprehensive reviews (e.g., Grossnickle, 2016; Litman, 2019) to discuss prior and contemporary conceptualizations of *trait and state curiosity,* especially intellectual (i.e., epistemic) curiosity, which is of particular relevance to the workplace (Lauriola & Hoffman, 2015; Litman, Crowson, & Kolinski, 2010; Mussel, Spengler, Litman, & Schuler, 2012). We start with a brief recapitulation of some of the foundational work, then transition to discuss more contemporary theory and research findings on trait and state curiosity, and finally summarize definitions of curiosity that have been proposed. Figure 2 presents a timeline of curiosity research that depicts milestones in the history of curiosity research. In particular, this timeline exemplifies the concepts (and accompanying measures) that over the years have sparked fruitful applications in various domains.

Early Debates

Although debates about the nature of curiosity can be traced back to the ancient Greeks, scientific investigation started with the seminal work of Daniel Berlyne (1954, 1966). Berlyne laid much of the groundwork upon which all subsequent study of curiosity has been based, including the fundamental distinction between epistemic and perceptual curiosity; *epistemic curiosity* referring to preferences for learning new intellectual knowledge, and *perceptual curiosity* describing desire for novel sensory information, which motivates visual and sensory inspection. The latter is less commonly experienced in the workplace, although it can be a relevant motive in jobs involving sensory experiences, such as within the visual, performing or culinary arts. More recent research on the nature and dimensionality of curiosity has shown that curiosity manifests distinctly in regard to seeking specific forms of information, namely seeking

information about other people in the social world or knowledge about one's inner-self (Hartung & Renner, 2011; Kashdan, Disabato, Goodman, & McKnight, 2020a).

Berlyne (1960) also distinguished between diverse and specific exploration. Against the backdrop of theories of optimal arousal that were predominant at that time, he conceptualized diverse exploration to be initiated by under-arousal, such as feelings of boredom, and directed toward stimuli that are more arousing, such as entertainment or play. However, such states are better considered as a facet of sensation-seeking than curiosity, as Berlyne (1966) himself acknowledged later. Specific exploration, on the other hand, is motivated by curiosity (whether epistemic or perceptual) to gain new information and to reduce uncertainty (e.g., solving a puzzle, reading an unknown theory).

Further Developments

Berlyne's (1954) work focused on curiosity as a transient, emotional-motivational state. He was, thus, especially interested in situational variables which elicit curiosity, such as novelty, ambiguity, and complexity (which he called collative variables). Since then, this perspective has changed. Building on the concept of specific curiosity, researchers have also considered curiosity as a stable individual difference variable. Correspondingly, measures such as the Melbourne Curiosity Inventory (Naylor, 1981) were developed to assesses such individual differences. Example items include "I am curious about things" and "New situations capture my attention". Spielberger and Starr (1994) integrated these perspectives in their state-trait theory of curiosity, acknowledging that curiosity can be both a state and a trait. Additionally, Silvia (2008a) further refined the concept of collative variables that elicit curiosity. Rather than being properties of the situation, he considered them as *appraisals* of an individual.

The approaches reviewed so far viewed curiosity as a positive affective experience which motivates exploration for the inherent joy of taking interest in new experiences or obtaining new information. However, curiosity may also manifest as a more urgent motive, accompanied by negative emotions, in which individuals feel deprived of needed information. This perspective was advocated by Loewenstein's (1994) information gap theory. Here, the essence of feeling curious is based upon the *metacognitive* evaluation of the gap between what one currently knows and what one desires to know. Wanting to fill in an information gap reflects the core nature of curiosity as a fundamental motive to learn and to know. Building on the classic work on motivational salience, which posits that the intensity of motive states reaches peak intensity as one approaches attainment of one's goal (Miller, 1944), Loewenstein predicted that the smaller the gap, the higher the state curiosity will be until a tipping point where there is no appreciable gap and all of the relevant information is known (Chater & Loewenstein, 2016).

Studies that applied the information-gap approach to scaling novelty/complexity typically focused on linguistic information, and asked respondents to try and answer fact-based trivia questions (e.g., "What is the name of the science that is the study of coins?"). If they could not answer these questions, respondents were asked to make a metacognitive appraisal of the extent to which they felt that they knew (or could guess) the answer. For example, Litman et al. (2005) instructed inquisitive participants to report whether they *know* the correct answer (no appreciable gap), or whether it is on the *tip-of-the-tongue* (very small gap) or whether they simply *don't know* the answer at all (very large gap). Consistent with information-gap theory, individuals experienced little curiosity when they determined no gap, intense levels of state curiosity for very small information gaps, and intermediate levels of curiosity for very large information gaps.

Contemporary Perspectives

The I/D-model by Jordan Litman (2008) resolved the controversy regarding whether curiosity is a positive affective experience which motivates exploration for the inherent joy of taking interest in new experiences or obtaining new information, vs. a motive to reduce unpleasant experiences of feeling deprived of new knowledge that is accompanied by negative emotions. Taking a psychometric approach, Litman suggested that curiosity can be both, namely a desire for new information anticipated to increase pleasurable feelings of situational *interest* (I) or a motive to reduce unpleasant experiences of feeling *deprived* (D) of new knowledge (Litman, 2008; Litman & Mussel, 2013; Piotrowski, Litman, & Valkenburg, 2014). In day-to-day life, I-type curiosity is expressed when individuals find themselves able to learn something new that they anticipate being entertaining or aesthetically pleasing (e.g., getting to hear a new anecdote expected to be amusing). Conversely, D-type curiosity is activated when individuals become aware they have an incomplete understanding of something they feel they need to make sense of, with the aim of eliminating a knowledge-discrepancy to improve comprehension (e.g., being able to figure or find out the solution to a stymying logical problem); if the missing information is found, it can be incorporated into the relevant repertoire of knowledge ("I feel frustrated if I can't figure out the solution to a problem, so I work even harder to solve it."; Litman, 2005; 2008). D-type curiosity is experienced as an uncomfortable "need to know" that becomes increasingly bothersome until satisfied by obtaining the desired, specific pieces of missing information ("I work like a fiend at problems that I feel must be solved"). By contrast, I-type curiosity is expressed in a more relaxed "take it or leave it" attitude towards new information, and the aim is for the simple enjoyment of it ("I enjoy learning about subjects that are unfamiliar to me"; "I find it fascinating to learn new information."). These subjective differences between I-

type and D-type curiosity experiences manifest in very different learning outcomes, information seeking activities and behavioral patterns (see below).

As interest in curiosity seems to be increasing, a concomitant push toward crafting instruments for measuring curiosity has also occurred. Some recent curiosity models tend to be eclectic and summarize diverse aspects such as stress tolerance under the umbrella of curiosity (Kashdan et al., 2020b). Wagstaff, Flores, Ahmed, and Villanueva (2020) observed that organizational scholars have used thirteen different scales that attempt to directly measure some variant of the intra-psychic nature of curiosity. In addition, Wagstaff et al. (2020) noted that a variety of measures are often used where curiosity is treated as a sub-dimension of another construct, or where curiosity is simply labeled as another construct[3]. To avoid so called jingle-jangle fallacies ("jingle" refers to erroneously assuming that different constructs are the same because they have the same label, whereas "jangle" refers to erroneously assuming almost identical constructs are different because they have different labels), there is a need to delineate where the construct space of curiosity ends and that of other constructs (e.g., intrinsic motivation, interest, see below) begins. Therefore, our next sections will clarify the essence of the curiosity construct and its overlap/differences with other constructs.

Definitions

Across the history of curiosity research, the definition of curiosity has also evolved. Table 1 gives a concise summary of old and modern definitions/theories of curiosity. These

[3] For example, Savickas and Portfeli's (2012) *Career Adapt-Abilities* (2012) Minson, Chen, and Tinsley's (2020) *Receptiveness to Opposing Views,* and Tse, Lau, Perlman, and McLaughlin's (2020) *Autotelic Personality Questionnaire* included curiosity as a sub-dimension. In addition, in other studies, items explicitly measured curiosity but the construct was titled differently. For instance, a construct was labeled "autonomy", with items like "In government decisions about research funding, the scientist's intellectual curiosity should be much more important than the potential of the research to improve people's lives" (Schuelke-Leech, 2013).

definitions refer to both state and trait curiosity and reflect theoretical models and assumptions of their time and, thus, diverge considerably. Nonetheless, several aspects have been repeatedly mentioned (Grossnickle, 2016). To clarify these aspects, we organize them according to the ABCDEs of personality (Wilt & Revelle, 2015), which refer to affect, behavior, cognition, desire (or motivation), and environment. With regard to affect, curiosity is defined in terms of positive emotions such as interest, joy, or feelings of wonder, as present in the concept of I-type curiosity and the role of curiosity in positive psychology (Kashdan & Steger, 2007; Neff, Rude, & Kirkpatrick, 2007). Conversely, negative emotions such as uncertainty and anxiety have also been proposed, for example in the context of the information gap theory. As noted above, these two aspects can be integrated by considering the obtaining desired information as rewarding, with joy reflecting the anticipatory reward and negative affect reflecting the effort when striving for that goal.

Predominant behaviors related to curiosity include exploratory behavior such as observation, asking questions, and seeking knowledge or sensory stimulation. Cognitions are most prominently mentioned when referring to knowledge gaps; here, the gap between what one knows and what one desires to know is conceptualized as a metacognition. Other cognitions that are ascribed to curiosity are the process of knowledge acquisition and learning. Desire or motivation is a central feature. Curiosity is seen as an approach-related motive by itself, expressed as a desire for information, knowledge, or learning. Finally, regarding the environment, situational properties that may activate curiosity refer to the collative variables of novelty, complexity, ambiguity, challenge, and uncertainty.

As the core of these aspects, we define curiosity as *desire to know, activated by collative variables such as novelty, ambiguity or complexity, that motivates rewarding exploratory*

behavior to learn and fill pressing knowledge gaps. This definition goes beyond classic approaches of conceptualizing curiosity by encompassing the I/D-type curiosity distinction. Hence, it offers a nuanced, inclusive conceptualization of curiosity as a construct that management researchers can use as a starting point in their future research endeavors.

THE MANTLE: CURIOSITY'S CONCEPTUAL SPACE AMONG OTHER CONSTRUCTS

Given our review of the definition of curiosity and its key underlying features, it is equally important to review how curiosity as a construct is similar to or different from other related constructs. By clearly delineating how curiosity operates as compared to other constructs that might feel synonymous and yet are different, we aim to forestall construct proliferation. Therefore, this second section ("mantle") leverages prior reviews on the conceptual space of curiosity (e.g. Mussel, 2013b), providing a review of curiosity's nomological network and thus its differences/similarities with other constructs.

Nomological Network: Curiosity and the Big Five.

Prior reviews (Mussel, 2013b) show that curiosity as a unitary construct can be allocated as a lower order construct in the most current model of personality (the Big Five, Goldberg, 1990). Specifically, it pertains to openness to experience, the broadest and most diverse factor. On the facet level, openness to experience includes perceptual aspects such as openness to feelings, aesthetics, or fantasy (McCrae, Costa, & Martin, 2005) which can be related to perceptual curiosity as well as epistemic aspects such as intellect and openness to ideas (DeYoung, Quilty, & Peterson, 2007), which can be related to epistemic curiosity. Regarding intellect, epistemic curiosity relates to the operation "learn", rather than to the operations "think" or "create" (Mussel, 2013a). Thus, trait curiosity can be allocated as a narrow personality trait in

the Big Five model, although there are also key differences between curiosity and Openness. For example, curiosity is more active, whereas openness to experience is more passive (Harrison & Dossinger, 2017). Additionally, research shows that curiosity is moderately correlated with other Big Five domains (i.e., conscientiousness and extraversion) and cognitive abilities, especially verbal ability (Mussel, 2010).

Similarities and Differences Between Curiosity and Related Constructs

We build on the conceptual clarity from the prior sections to distinguish curiosity from related constructs. To this end, Figure 3 lists various constructs that are often mentioned in the same space of curiosity, with constructs most strongly associated with curiosity depicted further on top. Per construct, Figure 3 also specifies the major differences and similarities with curiosity.

Regarding distinct but related traits, our review shows that curiosity is most closely related to constructs that also relate to epistemic behavior. Curiosity and "*learning goal orientation*" both share the aspect of learning. Whereas the former is concerned with obtaining new information, the latter focuses on acquiring new skills, developing capabilities, and learning from experiences, especially failures (Dweck, 1999; Mussel, 2010; Olson, Camp, & Fuller, 1984). The two constructs "*need for cognition*" and "*typical intellectual engagement*" have been developed against the background of different theories and in different areas (social psychology vs. intelligence) but are highly similar in terms of construct validity. At their core, need for cognition and typical intellectual engagement relate to preferences for thinking, whereas curiosity emphasizes the aspect of inquisitiveness and learning new information. However, these two aspects are often interwoven, for example when reading a complex scientific paper (Cacioppo & Petty, 1982; Goff & Ackerman, 1992; Mussel, 2010).

The "*intrinsic motivation*" construct describes the motivation to engage in activities in the absence of external reward (Deci & Ryan, 1985). As with behavior out of curiosity, such activities might be carried out due to interest; however, intrinsic motivation also includes preference for activities that are enjoyable, regardless of whether any new information might be learned, and is thus broader in scope (Harrison & Dossinger, 2017; Reiss, 2004).

Situational "*interest*" as well as "*passion*" may co-occur with curiosity; however, these constructs are usually tightly bound to a specific subject or objective, whereas curiosity as a trait refers to a general capacity for the pleasure of learning (Chen, Yao, & Kotha, 2009). Interest can be seen as the emotion accompanying curious states (Silvia, 2008b). Again, curiosity is always associated with gathering new information, whereas this is not a prerequisite for situational interest or passion (Grossnickle, 2016; Hidi & Anderson, 1992; Litman, 2019).

Other constructs share aspects with curiosity but can be more clearly distinguished from curiosity as compared to the constructs discussed so far. For example, "creative personality" is a compound trait that includes curiosity, but also many other dispositions that are beneficial for coming up with novel and useful ideas, such as independence, confidence, and unconventionality (Batey & Furnham, 2006). Additionally, curiosity is about learning something new, whereas creative personality refers to the behavioral tendency to create something new (Mussel, 2013a).

Finally, "sensation seeking" shares the element of exploring, but the object aimed for is not new information but rather perceptual stimuli, which may include an element of risk taking (Zuckerman, 1979). Despite the shared mechanism of seeking out and exploring, these constructs are empirically virtually uncorrelated.

Specific Correlates at the Facet Level

Apart from the correlates of curiosity in general (see above), a lot of research has also examined the correlates of I-type and D-type curiosity. Table 2 summarizes this body of research. As a general conclusion, the nomological network of I-type and D-type curiosity plays out differently according to the aforementioned theorized differences. That is, I-type curiosity is associated with novelty seeking and being more tolerant of ambiguity; self-regulatory strategies that involve optimistic appraisals about seeking the unknown with greater risk taking in doing so; and setting learning-goals aimed primarily at learning new knowledge just for fun. I-type curiosity is also associated with positive affect and openness, lower intensity curiosity states, and less effort to seek out new information. Conversely, D-type curiosity is associated with using caution and deliberation in self-regulatory strategies; setting learning-goals that define achievement on the basis of gaining knowledge. D-type curiosity shows small associations to negative affect and is uncorrelated with positive affect. Apart from openness, it shows equally strong or stronger overlap with conscientiousness (i.e., persistence). D-type curiosity is associated with intense curiosity states and greater effort to seek out new information.

In sum, I/D-type curiosity is differentially related to orientations toward new knowledge, self-regulatory strategies, choices in setting self-directed learning goals, expression of affectivity, intensity of curiosity states, and resulting information seeking behavior. This knowledge base is informative for current management research because it sheds light on key antecedents and underlying mechanisms through which both types of curiosity affect work outcomes. For example, both types of curiosity and their underlying mechanisms might be linked to different types of exploration/learning (motivated by frustration of trying to solve a problem vs. the excitement of playing around with ideas) or different modes of performing one's job (performance on prescribed tasks vs. job crafting, career exploration).

THE CRUST: REVIEW OF RESEARCH ON CURIOSITY AT WORK

Whereas the prior sections (core and mantle) discussed insights from the broader psychological literature and provided the foundational basis for our review, the crust encompasses the growing number of empirical studies on curiosity at work. Just as the earth's crust has the largest surface area of the three layers, our review of relatively recent research on curiosity at work is the largest section of our review and is its culminating point. Apart from having the largest surface area, the earth's crust also showcases ecological diversity. In our review, this diversity plays out in the content domains in which curiosity has been studied as well as in the research methodologies used.

Figure 4 categorizes these diverse research streams along two axes. The horizontal axis covers the content spectrum from individual curiosity to organizational curiosity, whereas the vertical axis characterizes the methodological diversity, ranging from more quantitatively-oriented towards more qualitatively-oriented. As shown in Figure 4, the first group of studies (left block) can be described as an "internalized" curiosity perspective, because the focus in these studies is on curiosity as an internal property of an individual. This breaks down into research streams on curiosity as a catalyst of intrapersonal action, curiosity's broader functional and

dysfunctional effects, and curiosity as a catalyst of interpersonal action. All of these three streams will be discussed below. Most of the studies under the umbrella of internalized curiosity perspective examined curiosity as an individual difference that engendered various "bright side" and "dark side" effects. Although most studies were work-related and quantitatively oriented, other qualitative studies examined curiosity in context. In some cases, we included studies conducted outside the work-context (e.g. education, social, clinical, and health psychology) that have clear implications for work and organizational behavior.

The right block in Figure 4 showcases what we describe as an "externalized" curiosity perspective, because the focus in these studies is on curiosity as a shared or symbolic property of a group which resorts under the umbrella of curiosity serving as a catalyst of organizational action. We start with reviewing research on curiosity as a catalyst of leadership, then move to discussing research on curiosity as a professional and organizational norm. We end with studies that cover curiosity and organizing. Across these streams, we review a more diffuse, multilevel literature, with topics as diverse as comparisons of applied and basic science, technological transfer, innovation, organizing, leadership, user communities and early adopters, and organizational connections to these communities. In these studies, many of which are exploratory in nature, a portion of which include a qualitative, inductive orientation, curiosity emerges as a complementary element of larger puzzles.

So far, these different research streams and traditions have been loosely coupled. As such, they have neither been juxtaposed against each other nor been integrated. Therefore, Figure 4 is a first attempt to categorize these diverse research streams. Figure 4 already highlights that the importance of curiosity in the world of work goes beyond curiosity as an individual trait/motivation connected to a host of critical individual-level outcomes. In fact, the externalized (organizational/collective) curiosity research streams offer a broad canvas for the role of curiosity at work, often connecting it to meso- and macro-level phenomenon and outcomes that require longer time horizons. At the end of our review, we present another figure (Figure 5) that further integrates these different research streams, thereby generating various novel insights and research directions.

Internalized Curiosity: Curiosity as a Catalyst for Intrapersonal Action at Work

In this first stream of studies, curiosity was typically conceptualized as the independent variable at either the intra- or interpersonal level of analysis. Curiosity serves then as a catalyst of individual action or interpersonal interaction within the world of work. We start with discussing research on curiosity driving personal action at work.

Inspection of the research on curiosity as a catalyst for personal action at work shows that the similarity in contexts is striking. That is, looking across empirical settings, organizational scholars have captured curiosity in work settings where individuals are faced with the need to change or adapt or where they confront complexity and indeterminacy. Weick enigmatically suggested that curiosity acts as a motivational middle ground, between confidence and caution,

that allows individuals to dive into uncertainty: "The overconfident shun curiosity because they think they know what they need to know. The overcautious shun curiosity for fear it will only deepen their uncertainties." (Weick, 1996: 148).

Not surprisingly then, our review shows that curiosity seems to thrive in endeavors that require individuals to cope with uncertainty, complexity, and ambiguity in the business world. Indeed, sometimes the uncertainty itself becomes part of the pleasure of doing the work. As shown below, these contexts include socialization, where newcomers are confronted with the need to adapt to new organizational routines and colleagues, when leaders and employees begin operating in global settings or on expatriate assignments, when employees are attempting creative or innovative tasks, when individuals engage in entrepreneurial activities or other activities necessitating discovery like science (whether professionally or through "citizen science"), and when individuals face technological developments, start-ups, or more recently the switch to remote working. These contexts require that individuals have the ability to engage with puzzles, surprises, and novelty – whether as "problem finders" that proactively look to construct puzzles for themselves, or as "problem receivers" that engage with puzzles that are assigned to them by others (Unsworth, 2001).

Knowledge acquisition and learning. Curiosity has been referred to as an "investment trait" (Powell and Nettelbeck (2014) or a trait that guides "when, where, and how people apply and invest their intelligence" (von Stumm, 2013: 82). Hence, there is ample evidence that curiosity contributes to knowledge acquisition in academic and work settings. von Stumm, Hell,

and Chamorro-Premuzic (2011) found meta-analytic support for curiosity's incremental validity over intelligence and conscientiousness in predicting academic achievement. As the size of the correlation of curiosity was similar to that of conscientiousness (i.e., the most intensively studied personality trait for academic performance), curiosity was regarded as the third key pillar for predicting academic performance (see also Gatzka & Hell, 2018; Mussel, 2013b). Given knowledge acquisition and learning are crucial for effective work performance (Kuncel, Hezlett, & Ones, 2004), curiosity was also found to predict performance through its effect on knowledge acquisition (Jeong and Lee (2019).

Apart from promoting knowledge acquisition in academic and work settings, there is also evidence that curiosity serves as a catalyst for socialization-related learning at work. Reio and Callahan's (2004) cross-sectional study provided some evidence that curiosity serves a mediator between negative emotions (anger and anxiety) newcomers might feel during socialization and the learning they engage in that ultimately predicts their job performance (see also Reio & Wiswell, 2000). Using a longitudinal design, Harrison, Sluss, and Ashforth (2011) further established and refined the importance of curiosity during socialization. They examined both I- and D-type curiosity and found that they were associated with distinct learning strategies (information seeking and positive framing, respectively), which in turn predicted distinct outcomes (job performance and role taking).

Moreover, there is evidence that the catalyst effects of curiosity extend beyond the more structured moments of socialization. That is, curiosity affects people's adaptability throughout their career so that they can better navigate changes in their work role, team, organization, or in the broader environment. For example, curiosity predicted adaptability due to learning new skills (Abukhait, Bani-Melhem, and Shamsudin (2020) and helped to maintain a life-long learning mindset (Drewery, Sproule, & Pretti, 2020). Similarly, curiosity was found to predict the maintenance of balanced psychological contracts (e.g., seeking developmental opportunities that enhance one's value to one's employer or accepting increasingly challenging performance standards (Hassan, Bashir, Raja, Mussel, & Khattak, 2020). Even in a career transition phase like job loss, Van der Horst, Klehe, and Van der Heijden (2017) found curiosity to promote adaptability. Finally, the same adaptability effects of curiosity have been confirmed in the adjustment process to international/expatriate assignments (Cseh, B. Davis, & E. Khilji, 2013; Harvey, Novicevic, Leonard, & Payne, 2007).

These effects of curiosity on life-long learning might be explained by the fact that curiosity is positively correlated with deep learning strategies and negatively with shallow learning strategies (Arteche, Chamorro-Premuzic, Ackerman, & Furnham, 2009; Richards,

Litman, & Roberts, 2013). Thus, as curious individuals are willing to expend extra time and effort to maximize understanding, they set learning goals that involve intrinsic interest, and they strive for personal satisfaction. Contrary, less curious individuals show a preference to expend as little effort and time as possible to learn only what is believed to be absolutely necessary. Additionally, individuals varying in curiosity differ in their appraisal of learning situations. More curious individuals estimate cognitively challenging tasks as rather coherent, easier to understand, and comprehensible, whereas less curious individuals appraise them as more incoherent, hard to understand, and incomprehensible (Silvia, 2008a). Thus, curious individuals might get more value out of learning opportunities.

Despite the generally functional effects of curiosity on life-long learning throughout one's career, one study related the effects of curiosity to turnover and job-hopping. Woo, Chae, Jebb, and Kim (2016) found curiosity-related individual differences to predict turnover speed increasingly better as time progressed. Although this finding matches curiosity's exploratory tendencies to seek varied, stimulating environments, it also points to possible negative effects from the employer perspective in that curious employees might leave to explore other organizations or jobs.

Creativity and innovation. Besides facilitating socialization-based learning and life-long learning, curiosity has been posited for a long time to play a central role in fostering

creativity and innovation (Barron & Harrington, 1981). Amabile highlighted that a product or response is judged as creative to the extent that "it is both a novel and appropriate, useful, correct, or valuable response to the task at hand" (Amabile, 1983: 360). Curiosity may contribute to the generation of such outcomes by fostering people's knowledge acquisition (i.e., a prerequisite of creative solutions), by immersing them in an unsolved problem to come up with an answer, and by letting them ask the right questions in the first place.

Schutte and Malouff (2020) meta-analytically aggregated 10 studies that investigated the relation between curiosity measures and creativity. Their weighted effect size estimate of r=.41 indicates that the two constructs are indeed considerably related. With regards to sub-dimensions, the exploration dimension of curiosity (I-type curiosity) was more strongly related to creativity (r = .48) than the deprivation sensitivity dimension (D-type curiosity; r = .20). Higher effect sizes were also found between curiosity and self-report creativity measures as compared to other-ratings of creativity (.52 vs. .16).

Apart from these general effects, primary studies reveal the intricacies of how curiosity affects creativity. Using a marketing task simulated in an experimental setting, Hardy et al. (2017) examined the relationship between I-type curiosity, D-type curiosity, and creativity in different stages of the creative process. They found that I-type curiosity had an effect on creativity markers like solution quality and originality. Moreover, the effects of I-type curiosity

on creativity were mediated by information seeking. Conversely, there was no evidence that D-type curiosity would relate to later stages of the creative process, especially idea generation. The connection between I-type curiosity and creativity seems to be the most intuitive, since by its nature, I-type curiosity impels broad exploration. It seems reasonable then, that I-type curiosity would bring individuals into contact with novel information that would provide a wellspring of raw materials for future creativity. Another mechanism might be related to how highly curious people think about the reactions of others to their ideas. As they might be more interested in novel information for the sake of the information, they are less interested in whether seeking that information is socially acceptable. Peng and Finn (2010) studied consumer feedback for innovative products. Their results confirmed, in part, that highly curious individuals (measured as exploratory information seeking) were more likely to provide feedback without having social desirability concerns. Hence, they were willing to make more links in their feedback without editing themselves or constraining their own new ideas.

However, there is evidence that D-type curiosity may be valuable for creative thinking through mechanisms other than brainstorming; recent research has found that D-type curiosity is associated with actively "connecting the dots" between pieces of information to create new, and comprehensive knowledge-networks in real-time (Lydon-Staley, Zhou, Blevins, Zurn, & Bassett, 2021). Hagtvedt, Dossinger, Harrison, and Huang (2019) examined the role of D-type curiosity and creativity over 4 studies including both laboratory studies and experience sampling using a sample of artisans selling hand made goods. They found that when individuals were trying to solve a very narrow problem but could not (i.e., trying to figure out how Houdini made an elephant disappear) their D-type curiosity led to "idea linking" – that is, generating an idea and

then using it as a springboard to connect to another idea. Unlike brainstorming, where the goal is to generate a diverse array of ideas, individuals motivated by D-type curiosity seem to naturally use idea linking. As a result, the breadth of ideas from brainstorming may be sacrificed for generating innovative solutions by connecting and re-structuring existing ideas in new ways.

Notably, research also revealed that there exists a tightly coupled reciprocity between curiosity as a drive to explore and the outcomes (rewards) that emerge from that exploration in that they affect subsequent rounds of exploration. Interestingly, such research speaks to the identification of "conditions" that guide curiosity towards creative products. For example, in a study of industrial scientists and their patent production, Giarratana, Mariani, and Weller (2018) surmised that pay for performance rewards for patents that were categorized as "low quality" subsequently led to a downturn in scientists' curiosity on their next project. Lam's (2011) study of the motivations of scientists engaged in commercializing their discoveries triangulates with these findings. She discovered that, although scientists are motivated by financial gains, their intellectual curiosity is the stronger motive: "a one unit increase in the former [curiosity] is associated with 43% increased chance of commercial engagement, while the same increase on the latter [financial gain] is associated with only 28% increased chance" (1363). This suggests that if individuals feel that their curiosity continues to reward them by revealing pieces of information they are seeking or they find themselves making progress toward solving a problem then a reinforcing loop develops. As further evidence, an experiment (Law et al., 2016) to explore ways to motivate individuals involved in crowdsourcing tasks asked individuals in the experimental condition to complete tasks in a way such that each task revealed a portion of a puzzle obscuring a famous person's face. Individuals that became curious to figure out who the face belonged to persisted in the crowdsourcing tasks for a longer period of time. The researchers

noted that organizations have keyed into this way of incentivizing individuals. For example, LinkedIn couples revealing hidden profiles with upgrading to premium accounts and HotWheels creates "mystery cars" to induce curiosity-motivated buying. However, these examples are ways of incentivizing consumers, thereby raising questions about how organizations might use "information … as a currency for incentivizing workers" (Law et al., 2106: 4107). In another example, Milkman, Minson, and Volpp (2014) found that bundling exercise with movies that individuals were curious about watching – a process they called "temptation bundling" –led individuals to being more motivated to exercise to satisfy their curiosity to watch the films.

Yet, curiosity need not be guided by an organizational mandate, or a cleverly designed temptation bundle. Dane's (2020) inductive study of epiphanies is helpful in this regard. His informants detailed that experiencing an epiphany included a sense of mystery – "how did this happen?" – which led them to be curious about the process of the epiphany itself. This curiosity prompted them to investigate what they were doing at the time of the epiphany. They described that part of the epiphany was a serendipitous confluence of circumstances for which they could not take credit. At the same time, they also realized they were likely curious, in that moment of epiphany itself, allowing them to be open to re-assessing their world view.

Entrepreneurship. Similar to creativity and innovation, curiosity has been ascribed as the "most important tool" for entrepreneurship (Wilkinson, 2015) and research attests to its importance. For example, the meta-analysis of Rudolph, Lavigne, Katz, and Zacher (2017) confirmed that curiosity was the strongest predictor of entrepreneurship. In a study examining the adaptability of entrepreneurs (Tolentino, Sedoglavich, Lu, Garcia, & Restubog, 2014), of the four subdimensions measuring career adaptability, individual curiosity had the largest impact on

adaptability four months later. Curiosity was also found to be a motive for starting a business (Bosman, Duval-Couetil, Mayer, and McNamara (2019). In addition, Geum, Kim, & Jang (2020) investigated the degree of curiosity among those preparing or starting their own business. Curiosity was higher in those who prepared or started a business, compared to those who only thought about it. New theorizing continues to push connections between curiosity and entrepreneurship (Arikan, Arikan, & Koparan, 2020).

Internalized Curiosity: Curiosity as a Catalyst for Interpersonal Action at Work

Beyond catalyzing intrapersonal motivation and action, curiosity seems to also offer social glue that drives interpersonal interactions that are key to individuals performing their roles at work. We start with reviewing basic research on the role of curiosity in interpersonal relations and then delve into research on curiosity as a dynamic, social property at work.

Social relationships. Curiosity has been touted as beneficial for improving social relationships and reducing group conflict (Gino, 2018). Generally, social psychological research results confirmed these claims, even when controlling for positive affect or physical attraction (Kashdan, McKnight, Fincham, & Rose, 2011; Kashdan & Roberts, 2004). Curiosity was found to facilitate building close and intimate relationships because curious people engage in behaviors (e.g., being more responsive, seeking more self-disclosures among interaction partners) that are particularly relevant for increasing the likelihood of positive social outcomes and healthy social

relationships. Along these lines, there is also marked convergence in the positive traits and adaptive behaviors ascribed to curious people (Kashdan, Sherman, Yarbro, & Funder, 2013). Examples of such positive traits include tolerance of anxiety and uncertainty, positive emotional expressiveness, humor and playfulness, unconventional thinking, and a non-defensive, non-critical attitude.

Curiosity driving interactions within and outside one's group. Curiosity can be a driver of social interaction both within and between groups. In a study of coordination within small groups in the context of modern dance, Harrison and Rouse (2014) revealed that curiosity acted as a catalyst to collective exploration. In particular, dancers were selected for the groups, in part, because of their curiosity and then, used that curiosity to recognize moments where they had pushed against the boundaries of the group, allowing them to recognize these deviations and explore them for potential new ideas and sources of creativity. Hence, the dancers' curiosity drove a great deal of the creative interaction with the dancers within their groups.

However, these interactions do not take place only *within* the boundaries of groups. Two studies by Harrison and colleagues (Harrison & Dossinger, 2017; Harrison & Rouse, 2015) also reveal the prevalence of curiosity in feedback seeking interactions about creative work with people *outside* of one's group. Harrison and Rouse explored formal feedback interactions captured on video in both an R&D department of an outdoor sports manufacturer and in a developmental program for modern dance choreographers. Their emergent model revealed that moments of shared curiosity (i.e., when the creator was open or interested in the ideas of the feedback providers, and when the feedback providers were interested in the possibilities for the

prototype they were evaluating) led to feedback shaping the new products. Harrison and Dossinger examined the development of t-shirt designs in an online forum. They found that more curious t-shirt designers asked expansive, open questions (e.g., "what would you do with this idea?") as opposed to limiting, narrow questions (e.g., "which shade of brown do you prefer?"). By asking expansive questions, the more curious designers ended up receiving more feedback from more feedback partners. The inductive study of Hollywood pitch meetings by Elsbach and Kramer (2003) showcased similar dynamics. They found that writers' pitches were more likely to be accepted when they were presented as open, as an invitation to engage in mutual curiosity, a sort of "seduction", between themselves and the producers evaluating their pitches. One of their informants noted: "You wanna get them in a mode of them asking you questions as quickly as possible. Because then you're controlling the meeting. Now you did the pitch, now they're asking the questions and you're filling in the gaps with more good stuff.… You want to stimulate them, you want to get their curiosity going. And then you want them to be a team player with you... That's what you want to happen." (Elsbach & Kramer, 2003: 296). In all of these studies, a key element is that curiosity serves as the social bridge between an individual's pursuit and others: between a creator and evaluators, between an insider to a group and outsiders that can provide knowledge and resources. Strikingly, in all these studies, success is contingent upon generating curiosity with individuals from outside of the original project.

Curiosity driving interactions in diverse organizational contexts. Whereas the studies outlined above hint at the prevalence of curiosity as a driver of social interaction in creative contexts (both within and outside one's group), curiosity also drives interaction in a wider array of organizational contexts. For example, Ness and Riese (2015) conducted an ethnography of multidisciplinary groups. Given "different disciplinary perspectives prohibit understanding

(Pennington, 2011) and can make communication difficult" (36) they observed it was only when group members showed curiosity toward each other and thus created a sort of "reciprocal curiosity", that the groups began developing a common understanding of how to use each other's knowledge. Golden-Biddle's (2020) study of the emergence of a new patient care model discovered a similar "reciprocal" situation. Participants became curious about the changes in the system, this curiosity led them to find surprises, experience doubt, and engage in inquiry, which fueled future curiosity. The outcome of each sequence was new knowledge that allowed informants to adapt the activities to map onto the new changes. In these cases, curiosity enabled the sharing of knowledge, but it was also fundamental in shaping the structure of social interactions, allowing resources beyond knowledge to emerge, like a sense of social support. In this vein, Heaphy's (2017) inductive study of patient advocates in hospitals expands the range of resources that curiosity avails through interaction. Her study revealed that advocates often bear the brunt of clients' frustrations. Their peers, aware of advocates' "emotion rich" cache of experiences, express curiosity about these experiences and the ensuing dialogue enables the advocates to process the emotions. In this context, the sharing of knowledge (in this case stressful experiences) was not used to generate new solutions per se, at least initially, but to elicit social support to manage stress and thereby provide space for processing difficult situations.

An important theme emerges across these studies of curiosity as a catalyst for interaction: Individuals seem to be curious about information first and this leads them then to be curious about the individuals that might have access to this information. For example, in a study of knowledge sharing in an online community (Hwang, Singh, & Argote, 2015), informants admitted to being more curious about what other community members might know before they became curious about others on a human level: "According to interviews with the organization's

employees, most participants in the online knowledge community seek out user profile information of question posters before posting a reply message. The main reason for checking is curiosity, but interviewees also emphasized that checking question posters' user profile information helped them to gather additional information about the context of the question" (1600). A dramatically different context leads to a strikingly similar conclusion. In an ethnography of counselors at a summer camp (Livne-Tarandach & Jazaieri, 2020), researchers discovered that counselors began using bread bag tags to decorate their shoes. The odd juxtaposition inevitably catalyzed others' curiosity and as they sought to understand the use of this symbol it led them to form new relationships, exchange new information, and coordinate with the counselors in new ways to better address the needs of their customers.

Overall, this hints at an enigmatic dynamic. Although individuals may be distrustful of others when an interaction is based on instrumental needs, curiosity may act as a social salve, ameliorating the instrumental nature of the interaction by creating a moment of mutual exploration.

Boundary objects invoking curiosity and interactions. The final example in the paragraph above indicates another important element of curiosity: it can also be evoked, not only by verbal requests and actions and behaviors, but also through materials, places, and physical objects. Such objects seem to act as boundary objects (Carlile, 2002), or material symbols of the epistemic realities of two groups, and the curiosity inducing function of boundary objects seems critical. When knowledge boundaries and the workers representing them collide, their knowledge itself feels "at stake" (Swan, Bresnen, Newell, & Robertson, 2007). Curiosity seems to act as a temporary, social scaffold in this regard, allowing parties from different knowledge worlds to establish a correspondence with each other to investigate the newness embodied materially in the

object that provides a common focal point for attention. As a result, each side has the opportunity for mutual exploration rather than to re-entrench and defend their boundaries.

As evidence for this process, several studies revealed that boundary objects often establish links between knowledge worlds by catalyzing a sense of curiosity in a variety of organizational contexts including designers using prototypes in design meetings (Jornet & Steier, 2015), hospital staff using colored bracelets (Melo & Bishop, 2020), community leaders using gardens, photo installations, and memory boxes to encourage collective engagement in urban communities (Phillips, Evans, & Muirhead, 2015), scientists using reports on anomalies to engage a broader community (Tapia, LaLone, MacDonald, Priedhorsky, & Hall, 2014), or researchers installing interactive technology to encourage spontaneous coordination among strangers in a public park (Balestrini et al., 2016). In each of these settings, "*When curiosity led to active exploration, a chain of interactions based on social learning would begin*" (Balestrini et al., 2016: 44).

Internalized Curiosity: Curiosity's Distal Functional and Dysfunctional Effects

Whereas the previous section focused on the effects of curiosity as an individual difference on a host of more proximal outcomes (learning, creativity, etc.), this section reviews studies about the effects of individual curiosity on more distal outcomes such as job performance, job satisfaction, well-being. This stream of predominantly quantitative studies comes not only from work settings but also from broader psychological research. We included the latter in our review for two reasons: The results have implications for curiosity at work in

organizations. In addition, these studies illuminate unexplored issues (i.e., dysfunctional effects) in the study of curiosity at work. Accordingly, just like the other research streams, this stream of research is important to paint an integrative view of the role of curiosity at work.

Job performance. Given the aforementioned effects of curiosity as an individual difference, it comes as no surprise that curiosity also contributes to predicting individual job performance. Mussel (2013b) investigated trait curiosity's predictive power with regard to several performance criteria, including supervisory ratings of job performance and goal attainment. He found correlation coefficients (adjusted for unreliability in the criterion) between .46 and .48 (see also Reio & Wiswell, 2000; Reio & Callahan, 2004). Moreover, Mussel found that curiosity had incremental validity in predicting job performance over and above general mental ability, the Big Five, integrity, achievement motivation, and tacit knowledge. Meta-analytic estimates of the predictive power of curiosity vis-à-vis job performance are lower in magnitude (Woo, Chernyshenko, Stark, & Conz, 2014), presumably because studies often failed to use a proper curiosity measure and a confirmatory research strategy which a priori links curiosity to specific job performance criteria (Tett & Burnett, 2003).

Job satisfaction, well-being, and health. Research also documents the functional (generative) effects of curiosity on individuals' quality of life (Gallagher & Lopez, 2007; Heintz & Ruch, 2020; Jovanovic & Brdaric, 2012; Kashdan et al., 2020b), which links curiosity to key organizational topics such as wellness or job satisfaction. Generally, curiosity is perceived to be one of five character strengths (besides zest, hope, love, and gratitude) that correlated most with life satisfaction (e.g. Park, Peterson, & Seligman, 2004) and overall job satisfaction. The latter result emerged across eight different occupational groups (nurses, physicians, supervisors, office workers, clinical psychologists, social workers and educators, economists, and secondary-school teachers) and six age groups (ranging from 18 years to over 60 years; Heintz & Ruch, 2020). The effect of curiosity on job satisfaction might be mediated by work engagement, an important predictor of job satisfaction (Cohen & Baruth, 2017). As one example, Doo, Zhu, Bonk, and Tang (2020) found that curiosity predicted work engagement for instructors teaching massive open online courses, presumably due to the role of curiosity in learning new technology and teaching methods.

Several studies explored other underlying mechanisms for this robust effect of curiosity on well-being. For example, Wang and Li (2015) discovered that personal initiative was a key

mediator: Curiosity helped to enhance proactive behavior and accordingly contributed to well-being and less emotional exhaustion. Seaton and Beaumont (2008) reported a positive relationship between curiosity and proactive coping. That is, for curious individuals, changes may not be perceived as stressful. Relatedly, Kashdan and Steger (2007) found that individuals high on trait curiosity show higher levels of life satisfaction and well-being due to growth-related behavior such as setting, pursuing, and achieving goals. The positive effects of curiosity on well-being have also been attributed to curious people's tendency to experience more positive emotions (Kashdan & Steger, 2007; Leonard & Harvey, 2007) and to make more positive, optimistic judgments (Maner & Gerend, 2007). Especially when combined with mindfulness, curious people seemed to appreciate what is unique in the present moment and to react less defensively to threatening situations (Kashdan, Afram, Brown, Birnbeck, & Drvoshanov, 2011).

Strikingly, these positive outcomes go beyond psychological well-being and life satisfaction and extend to objective health outcomes. For example, curiosity emerged as a protective factor for diseases such as hypertension (Richman et al., 2005) and was even associated with longevity (Swan & Carmelli, 1996). Some of these effects might be due to different coping styles because lower curiosity levels were associated with avoidance and

disengagement coping mechanisms, which are inherently detrimental to well-being and performance (Ben-Zur, 1999). Thus, fostering curiosity may be fruitful for improving individuals' health, and contributing to satisfaction in general and job satisfaction in particular. These are increasingly important outcomes for organizations, which might help to reduce illness-related costs and turnover.

Dysfunctional effects. As already mentioned, the definition of curiosity as an individual difference (construct) is predominantly characterized by bright elements. That also explains why there exists a large literature about functional effects of curiosity. Yet, in the broader psychological literature, dysfunctional effects – the so called the dark side – has also been documented. Most strikingly, specific forms of curiosity were linked to a motivation for substance use, including smoking (Gentzke, Wang, Robinson, Phillips, & King, 2019), drugs (Forgays, Forgays, Wrzesniewski, & Bonaiuto, 1992; Islam, Hossain, & Ahsan, 2000; Rahman, 1992; Wright, 1977), and alcohol (e.g. Rada & Ispas, 2016). In addition, curiosity emerged as a driver for risky sexual behavior (Odeyemi, Onajole, & Ogunowo, 2009), sexting (Gasso, Klettke, Agustina, & Montiel, 2019), spying and prying (Litman & Pezzo, 2007), and arson (Kolko & Kazdin, 1989). Finally, a morbid aspect of curiosity drives travelers to visit places of death,

suffering, violence or disaster (Brayley, 2018) and consumers to play games or watch movies dedicated to horror and terror (Harrison & Frederick, 2020)[4]. Deviant behavior at the workplace, including substance abuse, sexual harassment, or abuse of information might have severe consequences for individuals, co-workers, and companies. Thus, the question of whether such behavior might be facilitated as a byproduct of fostering curiosity is an important issue to be considered.

Another research stream focused on dysfunctional forms relating to openness (which is related to curiosity, see above). These subclinical forms might manifest in "oddity", "peculiarity" or "experiential permeability" (Piedmont, Sherman, & Sherman, 2012; Tackett, Silberschmidt, Krueger, & Sponheim, 2008). In these maladaptive openness manifestations, people are so absorbed in their own world and thinking that it leads to cognitive aberrations and perceptual illusions. Thus, extreme forms of curiosity might be problematic, which points to potential non-linear effects with work outcomes. Individuals experiencing such extreme forms might be more difficult to lead and might be less motivated to follow rules or work instructions.

[4] Interestingly, Oosterwijk, Snoek, Tekoppele, Engelbert and Scholte (2020) found that seeking out images that detail death, violence or harm activates the same brain regions that are activated by extrinsic incentives and curiosity.

Additionally, there might be circumstances under which exploratory behavior is rather detrimental. Exploration can be distinguished from exploitation (Cohen, McClure, & Yu, 2007). Whereas the former refers to investing resources to obtain more knowledge about the unknown, the latter refers to the investment in productive outcomes based on what is already known. It is assumed that these two tendencies have to be balanced, and that the effectiveness of each strategy is depending on environmental properties. Therefore, depending to the situation, there might be a trade-off point at which it is more beneficial to draw on what one knows and to apply this knowledge toward productive outcomes, rather than ever searching for new information. Ishaq, Bashir, Khan, Hassan, and Zakariya (2019) identified a potential negative implication of exploratory behavior associated with curiosity: They found that curious people's desire to look for new opportunities to explore and learn (either out of pure joy or deprivation tendencies) led to higher perceptions of workload. Such research findings might have implications for job placement: Curious individuals might show lower performance and higher levels of strain due to perceived workload. Mussel and Spengler (2015) found that under such circumstances, more curious individuals show lower levels of organizational commitment.

Externalized Curiosity: Curiosity as a Catalyst for Leadership

In this section, we review research on leadership (the role) serving as a multiplier for curiosity and curiosity amplifying leading (the behavior). This fits well with Bennis's (1989) succinct observation that, "Leaders need to be curious" (226). Perhaps, not surprisingly then, curiosity is key factor in predicting leadership potential (Dries & Pepermans, 2012) and MBA students regard curiosity as a key character trait for leaders (Wright & Quick, 2011).

A good starting point for our discussion of how curiosity drives leadership is Browning, Beyer, and Shetler's (1995) study of the formation of a cooperative consortium in the

semiconductor industry. Their inductive study revealed the importance of Bob Noyce, the first CEO of SEMATECH, observing that he "was a curious genius who liked to hear about almost any topic" which included him asking "five questions for every direct statement he made." They concluded, "This curiosity and his general interpersonal style made him very approachable… In this way, Noyce's curiosity indirectly increased individual commitment and cooperation" (128). The example of Bob Noyce illustrates two dynamics that are central across findings examining the intersection of curiosity and leadership. First, these leaders' actions serve as cues inviting interaction with others. Second, the nature of these interactions leaves those interacting with the leaders feeling more motivated, often curious themselves.

Leader curiosity => Leader-follower interactions. As noted, part of the power of curiosity is that it invites others to the leader. Which leader behaviors spur this on? Recent theorizing (Griffin & Grote, 2020) suggests that eliciting curiosity may be a key component of leader "opening behaviors" (e.g., "voicing doubts about an ongoing course of action, divergent thinking in decision making, improvising oneself and encouraging others to improvise, or environmental scanning for new business opportunities": 751-752). One example/mechanism of leaders inviting interaction with others has been identified by work examining curiosity as a virtue or character strength (Wright & Quick, 2011). In this vein, curiosity can be enacted as "compassionate curiosity" whereby leaders listen to others "through emotion and challenge" (Newstead et al., 2019: 9). Another key behavioral mechanism that might allow curiosity to act as an invitation is the use of questions. For example, in a study of entrepreneur behaviors (Dyer, Gregersen, & Christensen, 2008), one organizational founder reflected, "I think there's a certain personality type that just keeps asking why. Like my two-year-old son, they ask why, why, why? They don't stop. Once you discover that asking why in a different way and not being content

with what the answer is, it's interesting what happens" (323). In another study of executive strategizing, interview data revealed that asking questions like these and other behavioral forms of curiosity like travel, reading, and "real life" inevitably lead leaders to connect "to be in touch with others" (Dameron & Torset, 2014).

These findings triangulate with evidence that suggests that curious leaders serve as connection points in organizations, particularly organizations struggling with ambiguity around what performance might look like or how different functions might work together. For example, King and Zeithaml (2001) found that CEOs from hospitals and textile manufacturing – two industries they identified as dealing with ambiguity due to transformative changes – were constantly curious about their middle managers' perceptions. Similarly, the study by Albats, Bogers, and Podmetina (2020) of university partnerships found that curiosity was a key form of psychological capital for engendering collaboration between universities and corporations.

Leader curiosity => Followers' motivation and curiosity. Leaders' invitations of followers to connect with them can also become a conduit for motivating followers. For example, Evans (2020) manipulated team leader curiosity in a laboratory setting and found evidence that team leader curiosity helped motivate team level creativity. It is also possible for leaders to catalyze their followers' curiosity by showing concern or curiosity about them. Zacher's (2016) experience sampling study of curiosity and mentoring showed that when followers experienced a sense of mentorship or concern about their career, it increased their curiosity. Some of this might emerge from contagion, as described earlier in our review of curiosity catalyzing interaction. For leaders, this might also occur because leaders construct organizational structures and routines that enable others to explore more effectively. For example, research (Hahn, Minola, & Eddleston, 2019) shows that having a curious founder (in

this case operationalized as a founder having a scientific background) increases an organization's search breadth (having a wide variety of external knowledge sources used by a firm as raw materials for innovation) and search depth (having a variety of different sources from which a firm draws deep knowledge through frequent and sustained interactions; see also Heinzen, Mills, & Cameron, 1993). In a more fine-grained analysis of similar dynamics, another study found that leaders' curiosity (measured using a state-trait inventory) increased the absorptive capacity of their followers (Bourini, 2021). These findings describe mechanisms that likely help explain recent research that ties curiosity to entrepreneurial behavior (see above; Jeraj, 2014; Zappe et al., 2018).

Potential caveats. Given the positive outcomes that emerge from the confluence of curiosity and leadership, some of the research on curiosity deals with the nature versus nurture debate that is often invoked in discussions of leadership. In this case, there is strong evidence for a developmental or "nurture"-based perspective on curiosity as it relates to leadership. Some evidence suggests that children who had their curiosity cultivated by their parents during their schoolwork and learning were more likely to become leaders later on (Gottfried et al., 2011). Case studies about the development of individual leaders reveal a similar trajectory, albeit focusing on learning later in life. For example, Patel's (2016) study of Pierre Wack, an executive at Royal Dutch Shell labeled Wack as being "curious and open-minded." This led him to a global search for learning from "spiritual masters of different religions" (145). He integrated this learning with his role in scenario planning and encouraged collaboration with others but, notably, in his collaborations, "He began to really think about how to understand the person before trying to influence the executive" (147). His work is celebrated as preparing Royal Dutch Shell for the Oil Crisis of 1973. Indeed, the ability for leaders to generate curiosity seems especially powerful

during moments of crisis. For example, Page's (2010) study of Seattle's local government leaders revealed how leaders used a planning meeting, that had the potential to be openly hostile, as an opportunity to foster a shared curiosity about the future, leading to engagement across previously hostile factions.

Nevertheless, it is possible that there is a dark side to leaders' curiosity, although there is little empirical evidence on this possibility to date. For example, Nelson (2008) used a comparison of Odysseus and Aeneas to reveal that leaders' curiosity might also be dangerous, if they focus on ideas at the expense of their direct reports: Aeneas, who focused on the needs of his people and Odysseus, who had his men tie him to the mast because he was curious to hear the Sirens' song, ultimately resulting in the deaths of his men. In this vein, Rosenberg's (2009) historical study of the invention of radiology noted the centrality of Lawrence Bragg as a leader who was described as "a remarkable applied physicist whose wide ranging curiosity, energy and willingness to take high risks in his leadership role led to one of the great scientific breakthroughs of the 20th century" (241). In keeping with the themes revealed above, his curiosity magnified the curiosity of those around him, leading to the application of x-rays to organic tissue. However, as the lab was primarily a physics laboratory and not a biology laboratory "Bragg was under criticism from the nuclear physicists for not supporting their own subject more strongly in a laboratory world famous for its reputation in nuclear physics" (237). Even though Rosenberg's curiosity was important for one group in his organization, it left another feeling boxed out and angry.

Externalized Curiosity: Curiosity as an Organizational or Professional Norm

As curiosity is enacted and endorsed by leadership and as it becomes a focal point and shared resource for organizing, other studies in our review show that, over time, curiosity can

then become an organizational or professional norm (i.e., a collectively held normative expectation or performance standard). Bozeman and Rogers' (2002) study tracing the emergence of the internet posits curiosity as a shared norm in its creation:

> The history of invention shows countless cases where individuals act in a manner poorly explained by economic models. Invention and much of science has very little to do with the world of prices and material wealth. Even in the business world, the sharing of knowledge among competitors is only partly attributable to economic interest. Often it pertains to *shared norms of curiosity* and the desire to pool skill development. (776, emphasis added)

On the surface, it might seem easy to attribute curiosity to an innovative, exploratory enterprise like the development of the internet. Yet, curiosity also emerges in seemingly less innovation-oriented work. For example, curiosity is cited as a norm in an interview study (Collins & Schmenner, 2007) related to consistent improvement in manufacturing: "The more that *the factory's culture is one of curiosity and experimentation*, the better. The better performing factories are the ones more willing to change, especially those that constantly seek incremental, bottleneck breaking increases in capacity" (261, emphasis added). This is not to suggest that all organizations do or even should adopt a normative stance on the role of curiosity – indeed, one study of banks implied that curiosity was selected against (Eastburn & Boland, 2015). Rather, our review posits that there is a breadth of organizations and industries that have included curiosity as a normative component. Examples include design firms, hacker collectives, furniture design, universities and scientific organizations, forensic professionals in law enforcement, rock climbing and outdoor manufacturing, and the defense industry. Across these varied contexts, our review reveals that norms of curiosity impact work in at least two ways: Providing a filter for selection and serving as a behavioral guide.

Providing a filter for selection. Organizations attract, select, and retain new members, in part, based on the values and norms that are espoused or enacted within the organization

(Schneider, Goldstein, & Smith, 1995). As a result, it is not shocking that evidence shows that organizations with a norm for curiosity use curiosity as a filter for selecting employees. Koppman's (2015) study linking early experiences and employment decisions revealed, in part, that the advertising firms studied were selecting for curious individuals: "A creative director described his approach to interviewing candidates for entry-level positions this way: It doesn't matter, a copywriter, designer, [they need] a tremendous intellectual curiosity. A lot of times, one of the first questions I will ask is "Do you read? What do you like to do in your own time? What are your hobbies?" Because you can tell a lot about someone, about their own intellectual curiosity" (12). Likewise, companies from the automotive sector use curiosity as selection criteria for entry level jobs (Mussel, 2013b).

An array of qualitative studies reveal similar selection criteria: designers at IDEO "are selected and socialized to have intrinsic interest in product design … the kinds of people who work here are intellectually curious, inquisitive" (Sutton & Hargadon, 1996: 702); "agents" that work between technology extension organizations that help SME's develop their technological resources need broad "curiosity skills" (Kolodny et al., 2001: 219); management consultants are selected because: "We are problem solvers, so we're intellectually curious, right? That is why we are consultants. And you just have to have that innate intellectual curiosity to be able to do well here" (Reid, 2015: 8); or scientists selected to work on interdisciplinary research (IDR) teams based on the idea that "regardless of discipline, to be curious' [was] the 'most important guiding principle' when looking for IDR partners" (Siedlok et al., 2015: 103). Not surprisingly, given curiosity organizing often spills beyond formal boundaries, curiosity can become an important selection criterion for groups that exist outside of organizational boundaries.

One potential downside of selecting for curiosity is that extreme openness might make socialization hard, even though, as reviewed earlier, curious individuals should be better at socialization. For example, in the study of IDR scientists referenced above, informants noted that they struggled with the openness and with seemingly endlessly being referred to another "interesting" person. This might be compounded by the implicit nature of curiosity organizing, if it exists at the same organization where curiosity is a norm, forcing individuals to discover networks of interest rather than being able to have them prescribed. Another potential drawback that we also mentioned at the individual level is that selecting for curiosity might bestow a sense of weirdness to an organization. For example, hacker communities (Jordan & Taylor, 2001) are often regarded as potentially unethical in part because their curiosity seems unbounded to outsiders. Similarly, in Cattani, Ferriani, and Lanza's (2017) historical study of the Royal Society which selected members in part for their "curious minds", outsiders were seen as "quacks" (975).

Serving as a behavioral guide. Once individuals are selected into organizations on the basis of curiosity, they are also likely to experience curiosity as set of role expectations that serve as a behavioral guide for their performance. Curiosity as a norm seems to guide, at a granular level, how individuals are expected to engage with their tasks, almost in an aesthetic way. For example, Bechky's (2020) inductive study of narcotics analysts revealed that they held each other to standards of being efficient while using a norm of curiosity to make sure that they had been thorough in cataloging all the substances they analyzed for a given case. Similarly, in Zeng and Glaister's (2018) inductive study of internet platform companies, organizations successfully generated value from data in part due to norms of curiosity governing how employees interacted with data: "I say data cannot overtake all the jobs because there are certain aspects such as

curiosity, creativity and imagination, things we are good at but data cannot do. That's exactly what we try to get our people to do when they approach the data, be curious, ask questions, be creative and use their imaginations, use data to create different stories, to create emotional connections with our customers" (122). Using curiosity to guide these detailed interactions with specific tasks speaks to the need for curiosity to be encouraged by the environment, as Delios (2017) noted in speaking about norms of curiosity in research, "Curiosity should be as much an endogenous trait of researchers as an inculcated one" (393).

Indeed, one context in which curiosity seems to be chronically inculcated - to the point where it has almost become synonymous with the profession – is academic science. Scientists report that curiosity is a strong motivator in their work (Hawkins, Langford, & Saunders, 2015). But the individual motivation is clearly mixed with professional norms: "The scientist's curiosity is subject to social guidance. The information inputs from other scientists are important in shaping the problems which he will investigate. Similarly, he is normally interested in the approval of his peers and hence will usually consciously shape his research into a project which will pique other scientists' curiosity as well as his own" (Tullock, 2005: 25). A great deal of research focuses on the differences between curiosity-driven research (sometimes called "fundamental" or "basic") and applied research. In fact, this long-standing distinction was crystalized in an influential policy report that noted "Scientific progress on a broad front results from the free play of free intellects, working on subjects of their own choice, in the manner dictated by their curiosity for exploration of the unknown" (Bush, 1945). Since then, a great deal of research has sought to empirically disentangle the benefits of curiosity-driven versus applied research. Across studies, the results are fairly nuanced and complex. For example, in a study (Guerzoni, Taylor Aldridge, Audretsch, & Desai, 2014) of the relationship between scientific

funding and patenting, funding that embraces a norm for curiosity (in this case this meant that funding was not associated with industry) resulted in more original patents. However, a study (Goldstein & Narayanamurti, 2018) of the value of joint funding (focused on both application and curiosity) found that jointly funded projects produced more patents and publications than funding focused purely on either curiosity or application.

Rather than serving as divergent findings per se, these results reveal that the notion of "curiosity-driven" research is a socially constructed norm (Beesley, 2003), thereby enabling some narratives while disabling others. Tracing the history of curiosity as a norm in science, Agar (2017) notes that "Curiosity has come to play an important, perhaps central, role in the stories we tell about science in public, and how science contributes to the public good" (409). As a result, evidence shows that in some settings norms of curiosity enable scientists to construct a narrative of curiosity that allows "curiosity-driven" research to exist at the intersection of pure and applied science, whereas in other settings curiosity is constructed to include only pure science. For example, Senker's study (1991) of British "Directorates" set up to fund practical research found that some scientists were able to see curiosity as a norm for the process of research itself rather than a certain flavor of research: "Highly theoretical research might be motivated by 'curiosity' - or it might be undertaken for its potential contributions to practical use (42). Lam's (2007) study of firms working at the intersection of industry and university research found a similar blending of norms of curiosity. But narratives that blend curiosity are not always that malleable. In contrast to the examples above, in Balmer and Sharp's (1993) study of governmental funding of biotechnology in Britain, curiosity was used as a strong normative line, with the government "bitterly" opposing research that was not curiosity driven.

Externalized Curiosity: Curiosity as a Catalyst for Organizing

While leaders can model and encourage curiosity, like compassion and courage, curiosity can become a shared collective resource for organizing. Although this emergence process and its organizational level outcomes has been described and confirmed for personality and other characteristics (Oh, Kim, & Van Iddekinge, 2015; Ployhart & Moliterno, 2011), much of the evidence for this in the specific domain of curiosity is interwoven in inductive studies. Taken as a gestalt, these studies describe how improvised interactions like those described above, become patterned or routinized interactions, that then become further reified through additional resources to become formal, stable patterns of organizing. The catalyst for curiosity organizing, much like the interactions described above, occurs when a new symbol is introduced that generates a new interaction, acts as a surprise that interrupts existing patterns, or fosters a bridge between previously unrelated groups. For example, an inductive study of the introduction of agile software development reveals how posting the Agile Manifesto acted as a surprise that generated curiosity and fostered a change in interaction (Wagner, Newell, Ramiller, & Enders, 2018). Another example of these beginning moments of new organizing patterns occurs in a study of the emergence of communities in online gaming and how competitions stimulated mutual curiosity and connections that developed into an online community (Rong, Ren, & Shi, 2018). Notably, the emergence of new organizing patterns need not be swift, some emerge with "cautious curiosity" (Nilsson, 2017: 177) as described by Nilsson's (2017) study of the emergence of intergovernmental organizations to help connection private and public organizations to solve grand challenges.

What shifts these momentary interactions into organizing is that curiosity becomes central to the functioning of the group. The collective "is driven by a curiosity about other people and what they know" (von Krogh, Nonaka, & Rechsteiner, 2012: 260). Neeley and Leonardi's

(2018) qualitative study of the use of social media reveals these interactions. They observed that individuals began to exhibit "generalized, self-reproducing curiosity" which led them to interact on social media and these interactions further "sparked employees' curiosity and boosted traffic to the sites, the resulting flow of messages set the stage for future knowledge sharing" (932). Eventually, curiosity became central to interactions whereby "[social media] users seldom reached out immediately to knowledge holders they did not know. Instead, they shifted from the generalized curiosity that had first drawn them to the sites to targeted curiosity—a desire to learn specific information—about particular individuals" (934). These interactions gave rise to knowledge sharing communities. Companies such as Bell Labs, Xerox, and PARC are described as emerging from a similar spiral of collective curiosity (Goldstein & Narayanamurti, 2018). While in a fledgling state, curiosity organizing can be supported by material and financial resources (Czarnitzki & Thorwarth, 2012; Gambardella & Hall, 2006; Goldstein & Narayanamurti, 2018), empirical evidence suggests that legitimating or attention attracting narratives might be just as important. Boland and Tenkasi (1995) suggested that "development of knowledge in a community is a process of posing and solving puzzles, thereby elaborating and refining the vocabulary, instruments, and theories that embody the perspective" (354). Studies of narratives, specifically in organizations looking to legitimize innovations, suggest that narratives not only attract resources but they also further "generate curiosity" (Bartel & Garud, 2009: 114) for those hearing the narrative – legitimating the nascent organizing by drawing more individuals to it (Bartel & Garud, 2009; Garud, Dunbar, & Bartel, 2011). In line with these findings, in a set of 7 experiments, Kupor, Jia, and Tormala (2020) found that leaders making references to change – which itself can be surprising – generated curiosity that allowed people to investigate the change and attract support. In some cases, the organizing cycle might simply be legitimated

with a compelling metaphor that further legitimates the need for a collective to continue exploring a puzzle (Biscaro & Comacchio, 2018).

As the Neeley and Leonardi study above illustrates, curiosity organizing can thrive in settings mediated by technology, in part because individuals can more easily share the specific information that they are curious to obtain from each other. As a result, there are many examples of curiosity becoming the central motive for collective organizing in virtual settings. The ability for curiosity organizing to emerge online offers organizations a practically important application: curiosity can help extend organizing beyond traditional, offline boundaries of organizing behavior. Lead user communities and brand communities often form from early adopters who are more likely to be highly curious (Barnes & Pressey, 2016; Mahr & Lievens, 2012; Schweitzer, Hofmann, & Meinheit, 2019; Yang & Wang, 2013). Organizations benefit from these relationships because these individuals are able to offer more novel insights in part because of how they engage with each other and answer their respective questions (Mahr & Lievens, 2012). In one field study (Füller, Matzler, & Hoppe, 2008; see also Nambisan & Baron, 2009) related to the Volkswagen's brand community, curiosity (which was measured with two items the authors titled as "motivation") had a stronger relationship with organizational involvement than identification, brand knowledge, trust, or passion.

For curiosity to truly become the epicenter of organizing a puzzle/problem of sufficient depth and wickedness seems to be required to maintain collective exploration; just like compassion organizing requires a tragedy of sufficient profundity to engender empathy and attention (Dutton, Worline, Frost, & Lilius, 2006). Organizations engaging customers and lead users to explore future products can offer these puzzles when the puzzle is not too tightly framed (Getzels, 1979). For example, hacker communities are "driven more by challenge and curiosity

than financial reward" because there is always a new piece of software to hack (Flowers, 2008: 190). Similarly, the crowd sourcing of citizen scientists has grown in popularity because the depth of the problems posed in these communities provides an endless array of avenues for curiosity. For example, Franzoni and Sauermann (2014) studied citizen scientists asked to code astronomical data on the GalaxyZoo platform. The result was a published study based on 900,000 galaxies (the previous largest study included 3,000) but the outcomes spilled over into new explorations "because participants did not simply code galaxies – they also developed an increasing curiosity for what they saw" (6).

Outcomes at the Organizational Level

Similar to individual level research on curiosity, research related to the three higher-level research streams (curiosity as a catalyst for leadership, curiosity as a collective norm, and curiosity as a catalyst for organizing) also point to various outcomes. Yet, in contrast to the individual level evidence that focused on intermediate time scales, the more collective research on curiosity shows a focus on either long duration innovation that relies on serendipity and persistence or almost immediate reactions (i.e., virality).

Long duration innovation. A great deal of policy research has sought to examine the time horizon of curiosity-based innovation, in part in an effort to determine the best use of public money in science. Generally, research suggests that curiosity leads to groundbreaking innovations like X-ray or laser technology – which emerged "because physicists were curious about an utterly esoteric question" (Rosenberg, 2009: 235) – or LED lighting which emerged from industrial labs "motivated by scientific curiosity" (Sanderson & Simons, 2014: 1733, see also Mitchell, 1991; Goldstein & Narayanamurti, 2018). But in both cases curiosity cultivated a process that "was drawn out and consisted of enormous numbers of small technological changes,

with occasional major technological breakthroughs that enlarged the practical and commercial potential of the technology. Tens of thousands of scientists and engineers were involved in this development process, and some of them stood out as having particularly important capabilities and unusual approaches that allowed them to make major breakthroughs" (Sanderson & Simons, 2014: 1743). As a result, policy researchers often urge for support "for 'unstrategic' fields of curiosity driven research, the application of which cannot be foreseen" (Pavitt, 1991: 117) The inability to foresee the outcomes of curiosity is both a result of the number of interactions required to change an insight into an application and the long time horizon needed to allow for those interactions to occur: "The results of pure basic, curiosity-oriented research referring to the fields analyzed often appear several decades before the first patent boom" (Schmoch, 2007: 1009). This is not to say that macro curiosity does not bear immediate fruit – curious organizations develop new intermediate technologies and methods before breakthroughs appear (Salter & Martin, 2001), they produce patents that are more original (even if not radically so) (Guerzoni et al., 2014), and produce higher value inventions (Suzuki, 2011) compared to those where immediate application is more highly valued or incentivized. Even so, "these benefits are often subtle, heterogeneous, difficult to track or measure" (Salter & Martin, 2001: 528) – hence, collective curiosity often seems to require a long-time horizon.

Virality. One of the reasons why curiosity seems to adhere to the social fabric of organizations is that it emotionally adheres to the individuals that experience it. That is, curiosity has the propensity to become viral, which includes a sense of contagion, whereby the emotional aspect of curiosity is transferred to others (Barsade, 2002), and a higher likelihood for social transmission of the once missing information driving the curiosity to begin with (Berger & Milkman, 2012). Indeed to look for the next wave of curiosity might be a chronic element of

modernity: "The speed of feedback from inquiry to intelligent response is so fast today that curiosity has become a normal mental state for adults" (Glenn & Gordon, 2001: 281). One reason this occurs is because curiosity can lead to new, valuable information and that information can lead to improvements in performance. Vaast and Walsham (2005) catalogued the spread of a new sales tactic going viral because individuals were curious to understand how their colleagues were improving their performance. Subsequently, this changed the way the organization valued their learning system. Similarly, a study of entrepreneurs in an incubator found that the entrepreneurs were incessantly curious about each other (Krishnan, Cook, Kozhikode, & Schilke, 2020). As mentioned, online forums seem to offer a prime habitat for curiosity to spread, in part because curiosity can proliferate so quickly and because information can be transferred in richer formats – a citizen-science based community went viral in part because of the puzzles they were solving and because the materials they were looking at, images of other galaxies, were beautiful (Franzoni & Sauermann, 2014).

Dysfunctional effects. Although the majority of research that offers insights into curiosity organizing (see our sixth research stream) suggests benefits, downsides also loom. One downside relates to the virality of curiosity that we have just described. In fact, virality is a double-edged sword. Even though virality offers the benefit of attention that might lead to additional resources and new members of a community, virality can also have a negative impact on collectives organized around curiosity. One study of communities studying neural networks revealed that participants wanted to avoid virality: "It was unanimously felt that anything that went to Time magazine would be a disaster, because they would just hype it. 'Keep it away from the media because they distort information. We don't want to get burned again like they did with AI and expert systems'" (90).

More generally, if a collective is connected mainly by curiosity, if the puzzle is taken away or under-resourced, the community itself can fracture. This was observed in an inductive study of the development of curiosity-based collaborations in scientific communities: "The untimely winding up of an initiative may result in the fragmentation of the scientific community slowly built up during the lifetime of the programme" (Senker, 1991:42). Similarly, and as we discuss in greater length in our description of curiosity as a norm, when curiosity becomes the central goal of organizing, it can serve as a barrier for activities that are deemed as not supporting curiosity. As one informant in a study of a hybrid organization meant to encourage discoveries noted: "if work in the center could not be organized to support academic freedom and curiosity-driven research, then you should "just abandon [the idea of engaging with industry] altogether" (Perkmann, McKelvey, & Phillips, 2019: 306). This fragility is likely more acute in online communities where curiosity might enable would-be members to lurk rather than to fully engage (Schneider, von Krogh, & Jäger, 2013).

NOVEL INSIGHTS AND FUTURE RESEARCH AVENUES

Novel Insights

The prior section illuminated the different foci that are relevant for research on curiosity at work. Whereas the quantitative streams in the psychology and management fields that focus on beneficial effects at the individual level have received most of the attention, we showed that other research of curiosity at work is much more methodologically varied and often broader in focus. Specifically, the qualitative studies emphasize the importance of interactions and add interpersonal as well as reciprocal effects, whereas the contextualized research stream is geared towards collective (meso-macro) outcomes.

Figure 5 integrates these various research streams and thus showcases the key role of curiosity in the world of work. For clarity, we highlight in blue the new, value-added theoretical insights that our review generated. The left part of Figure 5 presents the definition and conceptualization of curiosity that we leveraged from contemporary perspectives in the broader psychological literature on curiosity. This nuanced, inclusive conceptualization of curiosity as a construct extends traditional approaches of conceptualizing curiosity by encompassing the I/D-type curiosity distinction.

The middle part of Figure 5 highlights the role of social interactions at work to showcase curiosity's role as a catalyst to generating various proximal work-related outcomes (creativity, adaptability, learning, etc.). We put those closely related proximal outcomes in a circle because our review underscored that they are inter-related (e.g., one needs knowledge to be creative) and that through social interactions with others the short-term effects of curiosity might amplify among the parties involved (i.e., curiosity draws others into the interaction and makes them also curious, etc.). Hence, Figure 5 depicts a double arrow between curiosity and the proximal, work-related outcomes because there are reciprocal effects.

The reciprocal effects between curiosity and the host of proximal, work-related outcomes have two main consequences. One is shown by the upper part of Figure 5, which deals with the pivotal "emergence" process inherent in curiosity. That is, our review revealed that over time curiosity interactions at work give rise to organizational dynamics and organizational forms of curiosity (e.g., long duration innovation). This "collective" curiosity that emerges from aggregating individuals' curiosity, or individual curiosity transpiring from collective norms of behavior, is another important new theoretical insight from our integration of the diverse

research streams. This part thus highlights the multilevel nature of curiosity and the longer time frames in which curiosity operates. The other consequence refers to distal effects of curiosity. Importantly, our review was the first to show that curiosity has not only functional effects (e.g., job performance, well-being) but also risks having dysfunctional effects at the individual and organizational levels of analysis.

In sum, the blue boxes and blue arrows of Figure 5 demonstrate that the novel, value-added theoretical insights from our review go well beyond the traditional view of curiosity as an individual level construct (and independent variable) that was conceptualized as primarily having unidirectional and functional effects.

Avenues for Future Research

On earth, the crust is the place where things grow, where work is being done, and where there is room for future building. So, our directions for future research are firmly anchored on the novel insights that we generated from reviewing the diverse research streams as part of the crust (as summarized by the integrative Figure 5). The research agenda that we offer thus puts the emphasis on future research directions that directly flow from our review of curiosity at work. As a common theme, we need to use rigorous designs to test many of the intriguing insights gleaned from more qualitative, inductive, and contextualized curiosity research.

Curiosity about ideas vs. people. One takeaway from our review is that so much of the evidence about curiosity at work suggests that the target of curiosity is information first. Curiosity about people seems to come later. Curiosity, by its nature, is instrumental: individuals seek new knowledge to satisfy their feelings of interest or deprivation. If so, how can curious

individuals avoid the risk of their interaction partner feeling reduced to just a means to an end (e.g., "I'm only speaking to you because of the knowledge that you have")? On the flip side, if humans themselves are treated as the object of curiosity, are they even more likely to see curiosity as an unacceptable reason for interaction (e.g., "I'm only speaking to you because I am curious about you")? Indeed, research on the curiosity about others suggests that direct social interaction isn't a necessary feature of interpersonal inquisitiveness; you can simply observe others indirectly without communicating at all (Litman & Pezzo, 2007).

Considering the first question, in organizations, other people are often the containers of the very knowledge that a curious person seeks. Yet, research shows that when interactions occur for purely instrumental reasons individuals feel dirty (Casciaro, Gino, & Kouchaki, 2014). Notably, our review strongly suggests that curiosity can become an anchor for repeated interactions, enough so to engender organizing and the creation of new organizations. What is missing is empirical evidence that describes how curiosity sustains interaction without making the partners in the interaction feel used but instead feel an interest in repeated interaction and sustained partnership. This might include better understanding the behavioral and verbal cues that announce curiosity to others. It might also include understanding the contextual factors that

encourage or discourage curiosity and thereby make reaching out to others feel organizationally appropriate or inappropriate. Bearing this in mind, an important aim for organizational research is to explore how curiosity impacts a workplace in terms of its sense of *community.* A workplace where individuals feel comfortable inquiring about and sharing information might facilitate harmony and improve cohesion by fostering a cooperative problem-solving environment for coworkers. It might also encourage employees to second guess long held assumptions, ask leaders questions that reveal gaps leaders' knowledge, and seek information that punches holes in the myths and ceremonies that provide organizations their stability. The potential duality in these outcomes opens fertile new ground for future research.

Considering the second question, members of organizations are likely to be curious people: about their leaders, customers, or competitors, etc. For example, leaders are often glorified and removed from the day to day work of many employees, hence, curiosity about what leaders do and "what makes them tick?" can abound. In addition, organizations might want to foster "curiosity about customers" as a way to create foster customer-centricity or empathy to improve sales, product design, or customer service. Similarly, organizations might want to foster curiosity about competitors to determine strategies to engage with or forestall competitive

moves. In each of these cases, as our review suggests, curiosity can motivate reaching out to others, but curiosity also motivates behavior that might be off-putting or perceived to be creepy like voyeurism and lurking. Voyeurism and lurking might be useful for curiosity about competitors but potentially damaging for curiosity about fellow employees and leaders or customers. Future research can explore the tipping points in curiosity motivated interactions that explain when curiosity is mutually endearing versus when curiosity is disturbing. As with the first question, methods that attend to the nuances of interaction and the nature of the situation might shed light on these dynamics.

Immediacy vs. persistence of curiosity. The temporality of curiosity provides another puzzle that offers ample opportunities for future research. The history of innovation shows that curiosity makes its mark over long, non-linear sequences requiring patience and distant time horizons. However, in the moment, curiosity can feel strong and overwhelming, leading to rapid learning and the viral spread of ideas. As shown by our review, research on long-term versus more immediate effects of curiosity have been separated by methodological and epistemological firewalls.

To understand the full impact of curiosity at work, future research needs to build theory and use appropriate methods to connect both the momentary and enduring aspects of curiosity. Such studies could occur within or across levels of analysis. For example, experience sampling studies might provide a way to examine momentary states of curiosity, perhaps incorporating the notion of metacognitive judgments (e.g., "the information is on the tip of my tongue!"), and connecting these moments to larger events like the conclusion of a strategic project, the socialization of new employees, or the launch of a new product. Similarly, qualitative methods privileging individuals' sensemaking might reveal how they sustain or generate moments of curiosity over the course of longer projects. Studies such as these would allow organizational scholars to understand how curiosity builds over time, and how state and trait curiosity relate to one another: Is it a process of accretion where moments of curiosity build like a coral reef (e.g., the states of curiosity strengthen individuals' propensity toward trait curiosity)? Or do cycles of curiosity provide moments of energy that then recedes like waves on a beach (e.g., state curiosity, however strong or intensified by organizational events, has little impact on trait curiosity)?

Similarly, longitudinal designs that combine multiple methods aimed at different levels of analysis might capture individual moments of curiosity that lead to collective action, that distills into normative expectations, which in turn promote future moments of curiosity. Capturing the full cycle from micro to meso to macro to micro can enrich our understanding of curiosity at work. For example, understanding how curiosity moves across levels of analysis might reveal new relationships between curiosity and other aspects of work, for example it might reveal that how we value curiosity is likely heavily determined by how we value time. That is, in the moment, a distraction from a task might be seen as a detriment to work, but it might engender a future interaction that precipitates a macro innovation (see also the 3M example below). Hence, attending to curiosity over time and paying attention to its ebb and flow will allow scholars to better catalog the costs and benefits of curiosity and to better understand how the promise of curiosity might need to be re-weighted against its costs.

Internalized versus externalized curiosity. Our review of the different streams of management research shows that curiosity goes beyond the individual level. At the collective level, curiosity that engenders organizing or collective norms of curious behavior offers important new theoretical insights. At the same time, it provides a grounding for future studies to

adopt a multilevel lens on curiosity to explore when curiosity is experienced as an individual motivation – "internalized" – versus when it is experienced as a property of a collective – "externalized". The relationships between the two might offer practical insights for organizations interested in cultivating and sustaining curiosity, while also outlining the limits to which curiosity might be catalyzed by organizational actions. For example, as curiosity becomes normatively embedded within an organization and grows to be associated with a set of symbols, narratives, and prescribed behaviors, it seems plausible that these symbols, narratives and behaviors could encourage curiosity while also limiting what actions are deemed to be appropriate. Although this is meant as a thought experiment based on the empirics of our review, it suggest an irony -- that encouraging curiosity might simultaneously limit it. However, the opposite might also be true: externalized symbols of curiosity might evoke social comparison leading to competition to be even more curious than others.

These potentially contradictory dynamics seem especially apt for qualitative approaches to more deeply understand curiosity as a normative experience within the world of work. Narrative, case, and interview studies, among others, might provide a richer understanding of how symbols, narratives, and norms of curiosity are externalized by collectives and subsequently

influence group and individual action. Examples of such contexts include blue collar and white collar, in virtual and face-to-face contexts, and cross cultural settings. Similarly, field experiments, nudges, action research, and other methods might be used to examine how to encourage "internalized" curiosity within groups or departments of organizations by establishing "externalized" examples of curiosity. In addition, scholars might build new measures that directly address how context influences curiosity, whether curiosity is collectively enabled or sanctioned.

The bright vs. dark sides of curiosity. Our review reveals that studies on the "bright side" effects of curiosity have dominated research of curiosity at work. Yet, research in psychology shows that curiosity has not only functional but also dysfunctional effects (see also Figure 5). So, building on the stream of curiosity research in psychology, there is opportunity for studies on "*dark side"* effects of curiosity at work so that we can understand the full range of benefits and costs of curiosity in organizations.

In particular, we envision five broad avenues for future research on potential dysfunctional effects of curiosity. First, curiosity has been found to be a driver for deviant behavior like alcohol or drug abuse, with potentially severe consequences for workplace behavior. As most of the studies that we reviewed about these and other deviant behaviors (including risky sexual behavior or arson) were qualitative in nature, it remains unclear to what extent these tendencies pertain to epistemic curiosity.

An additional avenue would be to examine the "too much of a good thing" effect, where extreme variants of curiosity might lead to maladaptive effects. We described some examples in the form of "peculiarity" or "oddity". Such extreme forms of curiosity might constitute a challenge for leadership, team climate and contact with customers. They also suggest potential non-linear relations between curiosity and work-related criteria.

Third, we highlighted that the consequences of curiosity in terms of bright and dark effects might depend on the situation, thereby drawing upon the distinction between exploration vs. exploitation (Cohen et al., 2007). As an example, curious individuals were found to have higher levels of perceived workload, pointing to a tipping point beyond which it might be more beneficial to draw on what one knows and to apply this knowledge in productive outcomes, versus always searching for new information.

Fourth, curiosity might be related to higher turnover, which aligns well with curious people's tendency to search for new stimulation, potentially also related to boredom-susceptibility. However, these results do not match well with other research on the role of curiosity for being adaptable in one's career and investing in growth opportunities within one's organization (e.g., Abukhait et al., 2020; Hassan et al., 2020; Van Der Horst et al., 2017). Notably, in the scarce research linking curiosity to turnover (Woo et al., 2016), the conceptualization of curiosity was not in line with the contemporary curiosity perspectives that we discussed. So, a much more fine-grained examination is in order.

A final avenue deals with "idle" curiosity or employees' curiosity directed at what organizations might view as "wrong" targets in light of their goals and norms. Yet, this opens the door to considering the dubious distinction between "good" vs. "bad" forms of curiosity. The invention of Scotch tape is perhaps one of the best historic examples that this might be a fallacy

because this tape was developed despite the engineer involved (Richard Drew) being given the clear advice to stop "experimental doodling" and work on important projects. We encourage researchers to design studies, inductive or deductive, that provide more balanced models of curiosity, testing for both functional and dysfunctional outcomes.

Curiosity as a dependent variable with reciprocal effects. Our review of quantitative research on curiosity at work shows that curiosity typically served as an independent variable. However, in qualitative research on curiosity at work, contextual factors were given much more attention and it became clear that such factors can affect people's curiosity levels. Taking a contingency approach, we need quantitative studies that specify situational factors and organizational interventions that have direct effects on curiosity. This should be done at the task (incentives, routine variability, leaders' intellectual stimulation via questions and stretch assignments), team (physical and online platforms to improve diverse interpersonal interactions), and organizational (e.g., curiosity climate wherein experimentation is encouraged and errors are allowed) levels. In the end, at a practical level, such studies can illuminate how work and organizations can be designed to be in sync with the characteristics of a curious workforce.

Related to curiosity serving as an independent variable in quantitative research, our review also reveals that only unidirectional effects of curiosity have been proposed on work-related outcomes. Yet, research on curiosity as a catalyst to interpersonal action attested to

potential dynamic, reciprocal effects. Hence, we encourage future studies to also conceptualize and examine reciprocal effects of curiosity. This recommendation also flows from the growing psychology research of work and occupational environments affecting personality development (for reviews see Tasselli, Kilduff, & Landis, 2018; Woods, Wille, Wu, Lievens, & De Fruyt, 2019). These reciprocal effects from work to personality have already been found for openness to experience (which is closest to curiosity). For example, Niess and Zacher (2015) found that upward mobility into managerial professions was positively predicted by openness to experience, and these vocational experiences in turn deepened this personality trait (see also Wille & De Fruyt, 2014; Wu, 2016). So, similar to bottom-up processes in personality development, events (at the task, team, and organizational levels) might affect employees' curiosity levels. Relatedly, an intriguing avenue for future research consists in scrutinizing when and how individuals differ in their trajectories of curiosity development. Frameworks from the work domain, for example Holland's circumplex model of career interests (Holland, 1997) or Hall's research on protean careers (Hall, 2004), might help to explain trajectories of curiosity development. Along these lines, organizations' interventions for fostering curiosity (in terms of personal growth or to develop key competencies) also deserve attention.

CONCLUSION

Our review opens space for a more nuanced, refined, and rigorous study of curiosity from what may be considered the more traditional, individual-focused framework. Our integrative

review anchors curiosity in foundational research in psychology while also revealing how management research has created a more diverse crust for exploring curiosity. Woven together, our review of these different streams not only clarifies curiosity as a unique concept within its nomological network, but also positions curiosity as a crucial aspect of organizational life and provides a more nuanced and deeper view of the roles that curiosity plays in it. All of this should encourage scholars from multiple levels of analysis to be "curious" about the role of curiosity in organizations, as a key competency that individuals can enact and that can become infixed in the organizational context itself.

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TABLE 1
Overview of Early and Contemporary Definitions/Theories of Curiosity

Late 19th to Early 20th century (Curiosity as a Heritable "Instinct")
• Curiosity is a response to an inconsistency or gap in knowledge (James, 1890) • Curiosity reflects feelings of wonder that may underlie many of human kind's greatest achievements (McDougall , 1921). • The use of language to engage explorations through questions and appeals to other individuals for information (Dewey, 1910).
Mid 20th Century (Curiosity: Drive Reduction vs. Optimal Level of Arousal)
• To reduce uncertainty after encountering novelty, investigation is motivated. After, the novel becomes familiar, curiosity is satiated. Exploration may be expressed through seeking sensory stimulation (e.g., visual or auditory inspection) epistemic observation or asking questions, in order to acquire new information (Berlyne, 1966). • Seeking or avoiding knowledge is explained by arousal: Whereas novelty increases arousal, the absence of novelty leads to boredom; To want stimulation one seeks out novelty. Preference is for an optimal level of arousal level (Fowler, 1965).
Late 20th century (State & Trait Curiosity)
• Spielberger and Starr (1994) states of curiosity are transient emotional-motivational experiences that vary in intensity; curiosity traits correspond to the relative frequency that states are expressed. Traits are theorized to predict the likelihood and intensity that states are experienced and expressed. Novelty can trigger state curiosity, which motivates exploration as well as state anxiety, which motivates avoidance. An optimal level of novel stimulation will generate relatively greater curiosity than anxiety. Individuals who are higher in trait curiosity should respond to the same novel situation with greater curiosity than anxiety. • States of curiosity arise when we discover a gap in our knowledge, which is an uncomfortable state. Curiosity motivates seeking new knowledge to close gap and eliminate discomfort. The closer you are to closing the gap, up to closure, the greater the motivation (Loewenstein, 1994).
Early 21th century (State & Trait Curiosity Revisited)
• State and trait curiosity can be experienced and expressed as a desire to seek new interests *and* a desire to reduce uncertainty– both are rewarding but reflect either relatively modest or intense appetites for new knowledge. As with other appetites, such a hunger, information seeking and consumption may be motivated strictly for the anticipated pleasure of discovery, or to reduce a more intense need-like condition of desire for missing information, as when one is trying to meaningfully connect ideas and fill in gaps in an incomplete network of interconnected knowledge (Litman & Jimerson, 2004). • A desire for knowledge or information in response to experiencing or seeking out collative variables, which is accompanied by positive emotions, increased arousal, or exploratory behaviour (Grossnickle, 2016).

TABLE 2
Nomological Net of I-type Curiosity and D-type Curiosity

	I-type curiosity	D-type curiosity
Personality traits	Openness	Openness, but also Conscientiousness (i.e., persistence); compliance and modesty
Orientations toward knowledge	Novelty seeking and being more tolerant of ambiguity	Being increasingly uncomfortable with not knowing something
Self-regulatory strategies	Optimistic appraisals about seeking the unknown; greater willingness to take risks	Cautionary approach in the self-regulation of thinking and reasoning; less willingness to take risks
Learning goals	Learning new knowledge just for the fun of it	Goals that define successful achievement and gaining knowledge that is objectively accurate and useful
Expression of affectivity	Positive affect	Uncorrelated with positive affect; small positive associations to negative affect
State curiosity levels	Generally lower intensity	Very high intensity
Resulting information seeking behavior	Exertion of less effort to seek out new information	Exertion of greater effort to seek out new information
Action phase	Pre-action; situation selection	During action; sustaining attention
Hypotheses about work related behavior	Job crafting, career exploration; creativity, trying out new procedures, self-initiative, starting new projects, being open for change, taking challenges	Task performance, diligence, output-driven, bringing tasks to an end; successfully implementing new procedures

FIGURE 1
Organizing Structure of Review

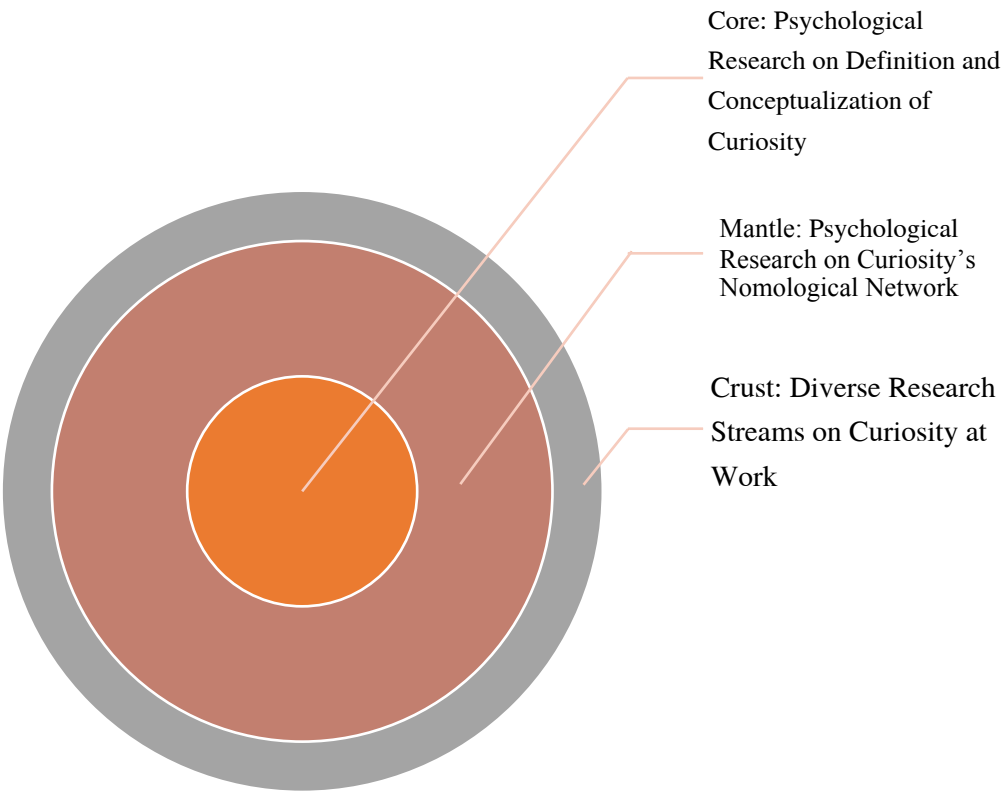
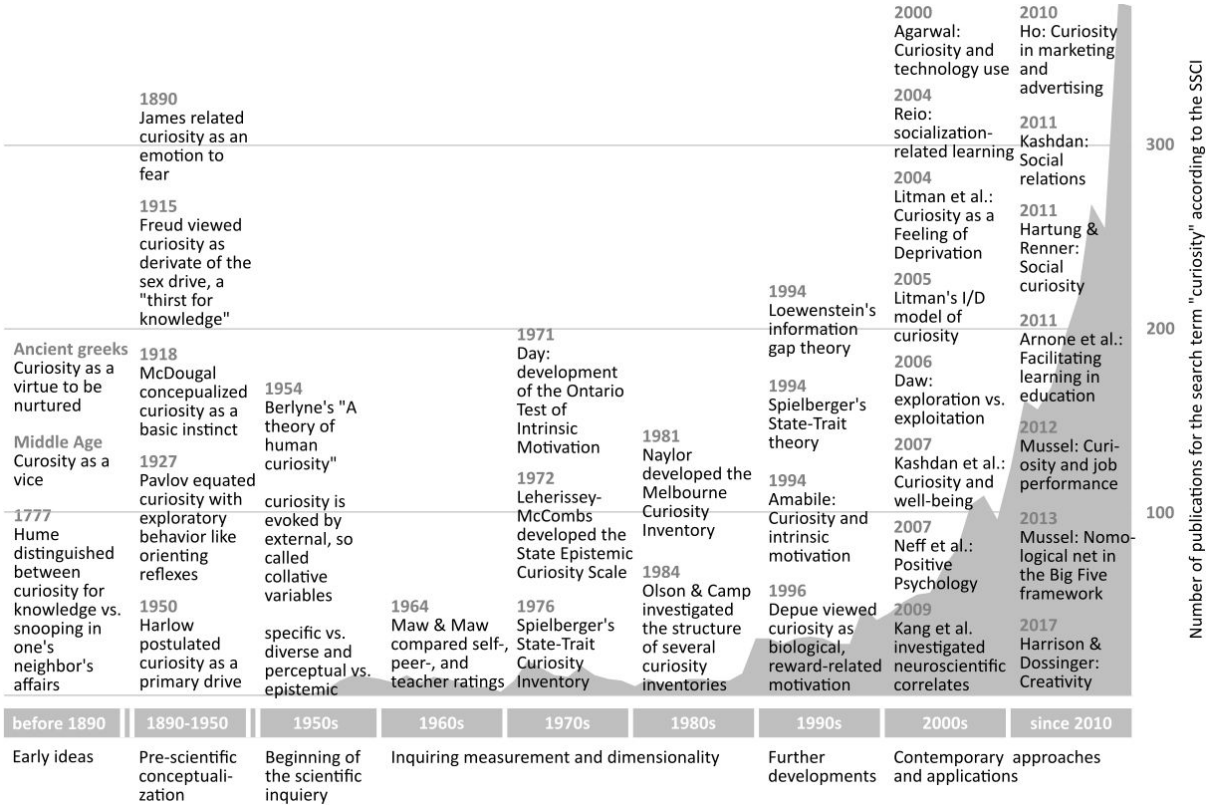
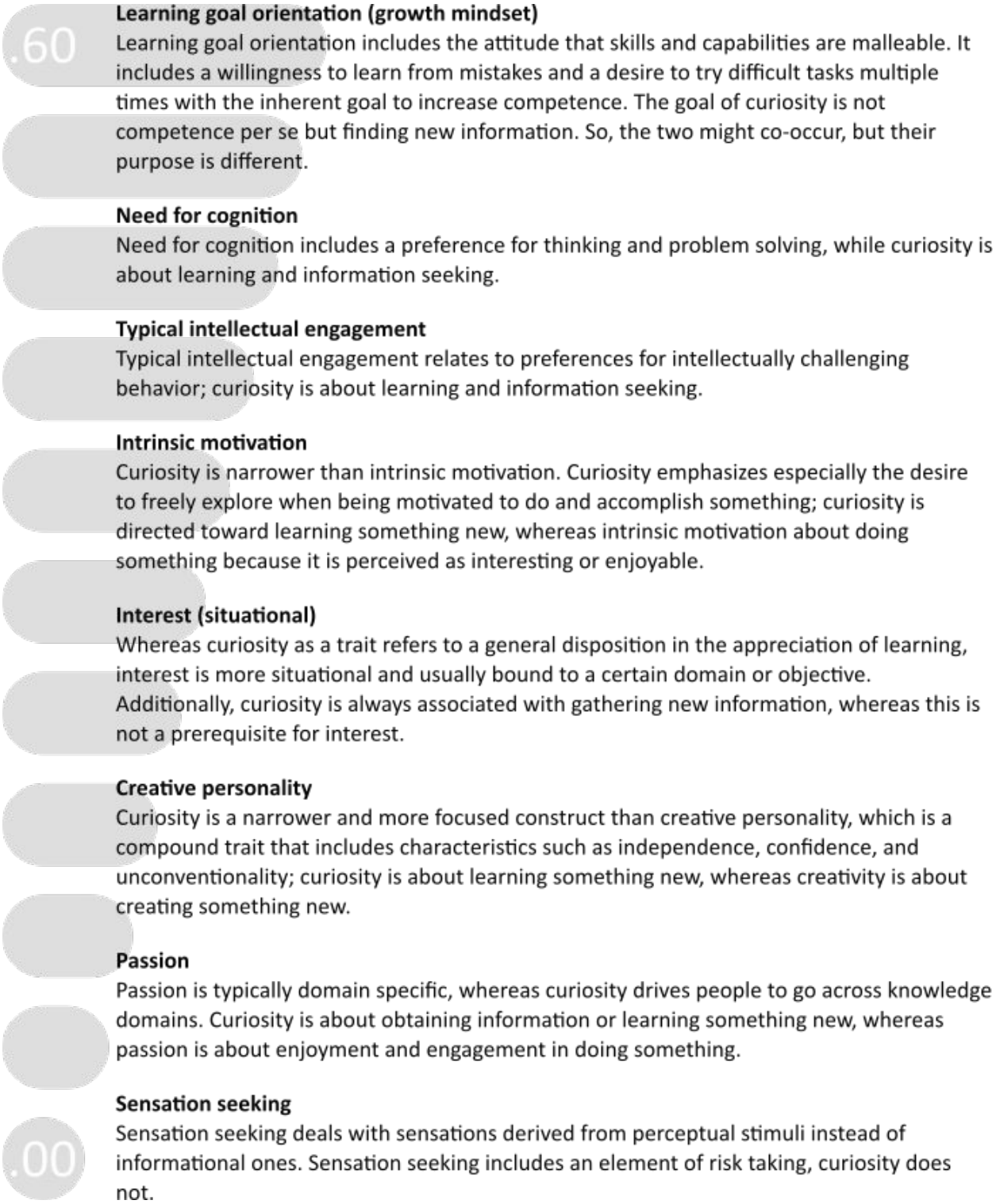


FIGURE 2
Timeline of the History of Curiosity Research



Note. Data are based on a Web of Science search (using the term "curiosity") in the Social Science Citation Index (SSCI).

FIGURE 3
Differences and Similarities Between Curiosity and Related Constructs



Note. Constructs more closely associated with curiosity are depicted towards the top of the figure.

FIGURE 4
Categorization of Diverse Research Streams on Curiosity At Work

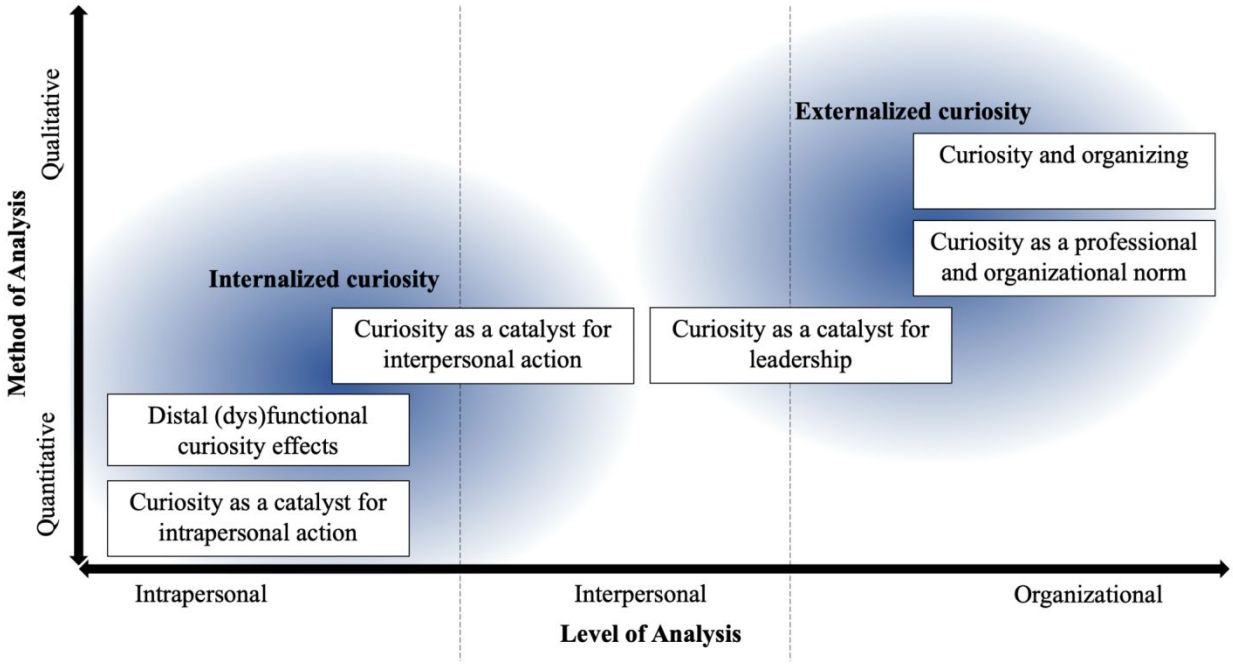


FIGURE 5
Integration of the Role and Effects of Curiosity at Work