

Creativity at the Margins: Exploring Social and Technical Marginality in Novel Idea Generation

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Abstract

If an individual on the edge of a problem's context can generate creative solutions to that problem, does this capacity emerge in spite of their marginality...or because of it? How can this marginality be leveraged in a collaborative context? The purpose of this paper is to explore the link between marginality and creativity through untangling of technical and social marginality. We advance the sociocognitive processes that lead marginal individuals, more so than those who are more embedded, to positively impact individual and group-level creative performance. We derive implications for a collaborative context.

1. Introduction

Marginal individuals, those on the margins of a problem space relative to those embedded in the core, are often touted in popular literature to generate ideas that contribute to creative outcomes. Marginality gained our attention via counterintuitive results from online science tournaments and idea challenges; the academic literature on the social psychology of creativity is largely indifferent to the concept of marginality. Jeppesen and Lakhani found that a disproportionate number of winners of online scientific challenges were individuals affiliated with different technical and social domains than that from which the challenge originated [1]. Researchers have demonstrated the 'paradox of density', a decline in innovation in a densely populated subfield notwithstanding the greater effort applied [2], as well as the 'paradox of embeddedness' wherein moderately connected entities outperform those who are more central [3]. Indeed, ground-breaking inventions are often made by outsiders [4]. "Inspired amateurs" [5] offer "focused naiveté: a useful ignorance" [6], implying alternative approaches to those of experts as well as reprieve from the burden of prior assumptions. Topological metaphors (overlaps, interconnections, breaks, and cracks) describe marginality as it relates to academic scholars

at the intersection of specialties, borrowing and lending at disciplinary frontiers to generate new paradigms [2]. Thus a range of evidence indicates that unexpected, non-expert individuals can develop creative solutions. To capitalize on this association across contexts, we need a clear understanding of the mechanisms that bring creativity from the margins.

So far, organizations struggle to develop capabilities that leverage marginality. This may be partly because the relationship of marginality is not well understood in the context of an individual's identity. Individuals are rarely encouraged to select problem domains where marginality might confer an advantage. In the modern economy, knowledge workers frequently choose the content of their daily work but rarely do they define their advantage in terms of marginality. Even in the presence of high extrinsic rewards, previous successes and strengths dominate decision processes, leading self-governing individuals to choose tasks that reinforce current identities (where they perceive that they have and are recognized to have an advantage). Individuals enlist themselves in and are recruited to the professional domains in which they are deeply embedded. Yet embeddedness often leads to incremental rather than radical solutions.

We seek insights about the connection between marginality and idea generation, a first step towards a creative outcome and the step for which the value of marginality is perhaps greatest. In pursuit of sources for novel ideas, there is a need to understand under what conditions the self-concept of marginality is evoked and how it operates to support creativity in idea generation. In the rest of the paper, we provide insights explaining why marginal individuals may be more capable of generating creative solutions than individuals who are more central to a focal domain. We relate marginality to the generation of novel ideas by connecting both social and technical marginality to domain-relevant skills, creativity-relevant skills, and creative task motivation. We derive theoretical propositions and implications for a collaborative context.

2. Conceptual Foundations

2.1. Marginality

Marginality is sociological distance and/or technical distance from the central tendencies of a domain or group. It is a cognitive and emotional belief about the orientation of the self relative to others that emerges from the interaction of an individual and a particular context [7]. Marginality is context-specific, based on perceptions of status, roles, and criteria, and among other things, tied to one's identity [2]. Cognitive and social independence as well as acceptance of risk and ambiguity have been associated with marginality [2,8]. *Technical marginality* is a function of the solver's perceived expertise distance from a problem field [1]. Sociologists and scientific historians have used the concept of technical marginality to identify those likely to contribute to scientific and intellectual innovations with new perspectives [6]. Louis Pasteur offers an example of technical marginality: he was trained as a chemist but would realize that microorganisms caused infection and disease, shaping modern medicine. His discovery owed in part to his early and unrelated scientific career, a doctoral thesis in crystallography, which provided the insight to use lenses (i.e. a microscope) to search for microbes [2].

Technical distance can promote abstraction of problem specifications; construals of a problem at higher levels allow for the transfer of heuristics from one area to another, driving idea generation and creativity in problem-solving through shifts in cognitive processing [9]. Abstraction supports the idea search process, as information stored in easily-accessible and broader categories widens the range of solutions upon which solvers may draw [10]. In professional domains, marginality originates technically but is often maintained by social forces. For example, a nurse may feel marginal when he or she approaches a group of surgeons, partially because of differences in experience and training but also because of long-enduring medical social norms.

Technical marginality is connected to but distinct from *social marginality*. The latter refers to sociologically-created distance from a core establishment, rooted in differences in age, gender, background, ethnicity, affiliation, education [6], professional status, or experience [8]. Social marginality may indicate some level of adversity, or refer to an individual at the lower limits of acceptability within a context, perhaps with a deficiency or burden that distinguishes them from a typical member of that particular social establishment. A socially marginal individual

belongs simultaneously to two or more groups [11]. Gender provides an example of how social distance influences marginality. Female scientists are often lumped in the outer circle of scientific communities and academic institutions, yet female solvers generated significantly more successful solutions in online science problem-solving contests [1]. Exclusion from prestigious thought circles may bring an advantage in the form of an inclination towards distinctive views and less normative intellectual pressure [12].

2.2 Creativity and Marginality

Creativity has been studied from four primary perspectives, as a *product*, both novel and useful, a *process*, of individuals and groups engaging in creative acts, a characteristic or ability of the *person* who creates, and a *place*, where creation occurs [13]. Following a dominant paradigm in creativity research, we focus on the first of these perspectives, considering creativity as an outcome: a novel and appropriate, useful, correct, or valuable response to the task at hand [14]. Most definitions of creativity involve two dimensions, novelty and utility. For the purposes of this paper, we focus on novelty and originality to explore the impact of marginality on idea generation, a first step towards creative outcomes and processes of innovation. Both individual- and team-level creativity are usually distinguished from innovation in the extant literature [e.g. 15]. Creativity includes idea generation and concept formulation while innovation describes the execution and implementation of ideas within an organization and beyond [e.g. 16, 17]. Creativity may be considered as part of a design or generation phase or a sub-process of innovation. We build theory around marginality and novelty in idea generation at the individual level, with implications for creative outcomes involving individuals, groups, and organizations.

Across contexts, individual-level creativity is impacted by three primary components [18]. *Domain-relevant skills* consist of local and subject-matter knowledge, technical expertise, and specific competencies, together creating an individual's "network of potential wanderings" [19]. *Creativity-relevant skills* are cognitive styles that enable new perspectives and reveal new cognitive paths [10], stemming from personality characteristics and behaviors that promote creativity across domains. The third component is *intrinsic task motivation*, internally-driven engagement in a creative task. Motivation is essential for creativity as it enhances positive affect, cognitive effort, and risk taking [20]. The literature offers few connections between

marginality and creativity. Of Amabile's three components, a clear theoretical connection to marginality is perhaps most lacking around domain-relevant skills. On one hand, research has shown that domain-relevant knowledge is useful for creativity, as an individual needs some knowledge of the status quo in order to move beyond it [21]. On the other hand, experience leads to an emphasis on working solutions and incremental ideas at the expense of novel ones [22]. Marginal individuals may be hindered by a lack of domain-specific knowledge but that liability becomes an asset when creativity is required: their solutions will not be shaped by routine. Creative work such as new product development is inherently non-routine, with shifting specifications and goals; it is often unclear how to apply past experience [23]. Experts accrue assumptions along with their domain-relevant skills, determining the cognitive frame with which they will likely approach a problem. "It is not possible to have too much knowledge, but it *is* possible to have algorithms that are applied too inflexibly" [10]. Technical marginality also implies *some* level of contiguity with the problem space; a marginal individual's own domain-relevant skills are not completely orthogonal to the domain from which the creative task originates. If an individual's technical distance is too great (for example, if they do not speak the language in which a problem is articulated), then creativity is unlikely. It is important to consider that idea generation is an essential part of creativity and innovation, but certainly not the only part. The role of domain expertise in creative outcomes may become more salient in post-generative phases of an idea's lifespan.

Creativity-relevant skills are based on aspects of personality and actions that construct new cognitive pathways. Creativity requires the ability to think divergently, to see things from different perspectives, and to combine previously unrelated concepts or objects [24]. The creativity literature offers examples of marginality in creative problem-solving although marginality as a construct is not specified as a focal construct in such studies. For example, managerial ratings for creative tasks improved when employees applied non-work experiences to solve work problems [25]. Solutions incorporating category combination significantly influenced quality and originality in new product assessments [26]. Laboratory studies showed that people generate more creative ideas for distant others than for themselves or proximate others [9] because they represent sociological distance with abstraction and analogy. Analogical reasoning allows the transfer of useful knowledge and insights from experiences in domains other than that of the focal problem [27].

Analogies provide the kind of high-level construal of a problem towards which a marginal individual is naturally inclined [28]. Broadly, marginality supports creativity-relevant skills because simultaneous and diverse knowledge structures in the technically marginal mind introduce analogies and heuristics that are novel to the problem space.

Personality characteristics associated with marginality (independence, a tendency toward nonconformity, feelings of distinctiveness, less sensitivity to rejection) [8] have also been linked to creative outcomes. Researchers have depicted creativity as counterintuitive, contradicting 'what is expected' [29]. Marginality, or willingness to differentiate oneself from the group, resonates with definitively uncommon creative solutions with potential to elicit controversy [30]. A unique sense of self or profound idiosyncrasy can inspire something new or 'off the wall'. Marginal individuals are less likely to be risk averse, a trait shown to hinder creativity. Independent people are less sensitive to rejection and social influence because of diminished needs of a sense of belonging [31]. Design school study participants who expressed hope for self-employment, implying a need for autonomy and independence, scored higher on creative tasks than those who expressed no such desire [13]. Marginality and creativity are also impacted by situational factors. Social marginality can emerge as a function of hierarchical and role interactions. For example, a middle manager is marginal to both upper-level management and the workers they supervise as they are involved with but also detached from both groups [7]. Occupying the fringes provides an outside perspective. The experience of living abroad has been positively associated with creativity measures for insight, association, and idea generation [32]. Outsiders may be creative via cognitive effort expended to adapt to a new culture and also by continuing to assert independence.

Intrinsic task motivation is the third element of Amabile's componential model. Intrinsically motivated individuals see a task as an end in and of itself, rather than a means to another end [33]. Compared with extrinsically-motivated others, individuals motivated intrinsically by a creative problem will generate a wider range of possibilities, depart more frequently from familiar heuristics, and make more unusual connections [10]. Motivation encompasses an individual's baseline assessment of a creative problem and also their reasons for undertaking that problem; both of these elements link to marginality via domain- and creativity-relevant skills. Individuals who define themselves as creative want to exhibit their creativity, maintaining positive self-regard and reinforcing a self-concept. Creativity

also requires perseverance, or some source of momentum that moves an individual to search for novel ideas and then investigate to what extent the ideas may lead to creative solutions. *Task autonomy*, the extent of choice around a task and how it is carried out [34], or *creative self-efficacy*, self-assessed ability to engage in creative actions [35], could motivate creativity in the marginal individual.

What explains how and why marginal individuals generate novel ideas? To summarize, technically marginal individuals who are prone to be creative have developed domain-relevant skills (albeit in a different domain) and also have creativity-relevant skills that boost confidence in the search for a familiar solution to apply in an unfamiliar domain. Creativity is most likely to originate in individuals who have developed experience in some domain and a creative identity. We propose marginality to a problem's context as an origin of new cognitive pathways to a creative solution. Yet the mechanisms by which marginality impacts creativity are not clearly specified in existing studies. So far, we have tried to untangle social and technical marginality and to connect these constructs with each of the three components in Amabile's model for creativity [18]. We focus on understanding marginal individuals' potential to generate novel ideas but our propositions also have implications for creativity in a collaborative context.

3. Theoretical Development

Technical marginality refers to a self-assessed expertise distance from a problem field [36] and describes an individual associated with a related but different domain. Marginal individuals have distinctive identities forged by a different set of domain-relevant skills, unburdened by paradigmatic assumptions that may be the starting point of the expert. Creative solutions mean avoidance of frequent responses; thus, in pursuit of a creative solution, more of the same may not prove as fruitful as changing direction. Indeed, a solver's perspective contributes to the problem's perceived difficulty and thus the ruggedness of the solution landscape [1]. For example, some intractable mathematics problems may be fundamentally simplified if the solver re-orient problem specifications from the Cartesian to polar coordinates system [1, 37]. While domain-specific experience is useful on a problem landscape, the marginal individual offers vantage points to new pathways.

Exposure to different perspectives underscores creativity-relevant skills such as cognitive flexibility [10] and new forms of

combination [38]. Because new ideas must originate in some sense from existing knowledge structures, processes of combination and re-organization of knowledge are essential components of creative cognition [39]. Exploration of remote and unusual ideas increases the likelihood of serendipitous discoveries [2]. When individuals tap into a broader range of stories, analogies, or potentially relevant experiences, they are more likely to make creative connections [21]. Creativity skills are conceptualized as part of our identities: "being creative involves several aims – to be in control of one's identity, to see that identity more clearly, to free it from everyday limits" [40]. Actions reflect valued aspects of identities; an individual with a creative personal identity will seek to reaffirm this part of their identity [25] by applying their particular domain-relevant experience in new ways. Thus a lack of domain-relevant skills in a situation (i.e. technical marginality) positively contributes to creativity-relevant skills in that situation. Expertise distance leads to greater abstraction of a problem's parts, another elevation of creativity-relevant skills. Abstraction expands the idea search process. The key for generating novel solutions is how knowledge is stored and accessed. If information is operationalized "according to rigid algorithms...more likely for an old-timer than a new arrival...creativity is less probable" [10].

Technical marginality is also related to task motivation. Marginal individuals are poised to employ creative processes afforded by their technical distance, but they must make the effort to move a search beyond the other domain-relevant experiences upon which their identity has developed. Novel idea generation is more likely when technical marginality is embodied in an individual who relates tangentially to the domain requiring a creative solution. But the creatively marginal individual will have expertise in *some* domain. Those who have never developed any domain-relevant expertise are unlikely to employ the kinds of cognitive processes that support creativity-relevant skills. For example, analogical reasoning is a creativity-relevant skill that assumes that an individual has developed a deep knowledge structure in one problem domain that then can be leveraged in the less familiar problem domain. Technically marginal individuals who deliver ideas distinguished by their novelty and originality will also have developed *some* aspects of their identity around creativity, leading them to seek out opportunities to be creative. Positive reinforcement of identity builds intrinsic motivation around a task [25]. The technically marginal yet creatively-inclined individual will be motivated to engage in solving a

problem (despite their lack of domain-relevant skills) because this action offers a chance to be creative.

In summary, technical marginality contributes a source of novelty by the activation of distinctive identities in multiple domains, the abstraction of problems transcending domains, and the discovery of new cognitive paths unencumbered by existing categories.

Proposition 1: Technical marginality relates positively to novel idea generation.

We propose that technical marginality can contribute to an individual's generation of novel ideas, but when is this relationship likely to emerge? Creative self-efficacy is the belief that one is capable of generating creative outcomes, a precondition for creative effort [35]. Creative self-efficacy has potential to crowd out feelings of inadequacy from a lack of domain-relevant skills that might dissuade a technically marginal individual from taking on a creative problem. Creative self-efficacy both emerges from and supports creativity-relevant skills, motivating a stretch across domains to reaffirm creative identity. Creative self-efficacy is a form of self-evaluation that drives actions and the creative behaviors undertaken, including levels of effort and persistence [41], filling the gap between what one can do and what one will do. Self-efficacy within a particular domain is related to self-identification; therefore creative self-efficacy comes from creative self-identification [42]. Creative self-efficacy will lead a technically marginal individual on an extended search, increasing the likelihood that they can find a familiar idea to serve as a novel solution to an unfamiliar problem. Lacking creative self-efficacy, a technically marginal individual may not conceptualize that they could generate a creative solution by mapping something they do know to the new domain. Creative self-efficacy is a catalyst for cognitive energy from the margins, through mechanisms of creative identity affirmation and as a source of motivation to overcome idea inertia.

Proposition 2: Creative self-efficacy will intensify the relationship between technical marginality and novel idea generation.

Factors that support and diminish creativity may also be externally derived from the sociocognitive environment. Social marginality offers an outside perspective, tolerance of risk and uncertainty, and greater resilience to social pressure. An individual's situation in the core or periphery of a social network influences the extent to which they are liberated from central tendencies. Socially marginal

individuals have access to unique sources of information and are more likely to notice aspects of a problem that might not be obviously relevant [10]. One study demonstrated that people generate more creative ideas for distant entities than those that were more proximate [9] because they represented psychological distance with a high-level construal. Near events are represented by low-level construals that draw on contextual cues. Socially marginal individuals are removed from the center in ways that make their ideas distant and potentially creative.

Social marginality is one way to identify individuals less sensitive to group influence that brings novel ideas back towards the status quo. Personality characteristics associated with creativity-relevant skills include curiosity and intellectual honesty as well as openness to risk and diverse experience [15]. Risk-taking is an inherent part of creativity in the sense that a truly creative approach explores uncharted territory [40]. Creativity also entails confidence in assuming deviant perspectives and taking action without reliance on social approval [15]. Social marginality implies a greater willingness to take risks (with less to lose as far as social capital) [41]. Marginality may originate from status incongruences based on perceived differences in rankings, roles, and other criteria that signal expertise [2]. Socially marginality compromises access to core resources [8] but provides a key advantage in removing excessive social influence that can cripple creativity. Individualism benefits creative problem-solving [32] whereas conformity reflects a tendency to work within commonly-perceived constraints. As disciplinary cores are inclined to stagnate, social marginality is a source of creative reinvention.

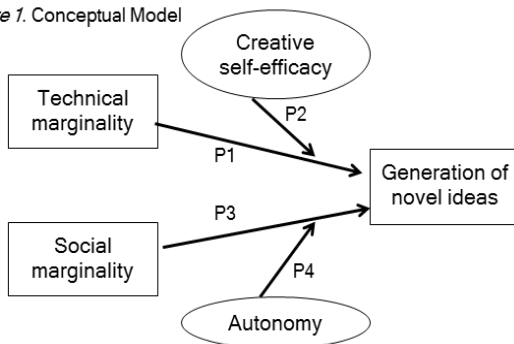
Proposition 3: Social marginality relates positively to novel idea generation.

How does an individual come to situate themselves in a problem context where marginality might make them creative? Autonomy involves "substantial freedom...and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out" [43]. Thus autonomy is derived from intrinsic incentives. Autonomy supports marginality by motivating engagement in creative processes and minimizing social influence. Autonomy implies *choice*, explaining why a socially marginal individual would make the effort to be creative. Part of creativity is just hard work, rooted in the willingness to spend time to find a better way of doing something, to focus on things that others take for granted, and to look for further ideas when others are satisfied with the status quo [44]. Motivation is a component of creativity for

which domain- and creativity-relevant skills cannot compensate, because it is motivation that drives the extent to which these skills are utilized [10]. Motivation is also considered as momentum, although this conceptualization implies social influence and commitment, or the presence of some ongoing force [45]. In addition to inciting novelty, autonomy also supports a socially marginal individual's distance from central influences that could limit creativity. Individuals tend to seek feedback and conformity is a natural tendency when seeking the approval of others [46]. Social influence will lead to the avoidance of extremes [47], limiting the novelty of ideas. Autonomy enhances creative potential because autonomous behaviors are initiated by choice as a self-expression [34]. By mitigating social influence and motivating creative work, autonomy supports creativity in socially marginal individuals. Figure 1 summarizes our theoretical propositions.

Proposition 4: Autonomy will intensify the relationship between social marginality and novel idea generation.

Figure 1. Conceptual Model



We have related marginality to the generation of novel ideas by connecting both social and technical marginality to each component of Amabile's model for creativity [18]. We contribute to the creativity literature by untangling the effects of social and technical marginality on creativity and its antecedents. What is also needed is a better understanding of how to identify and leverage the social and technical margins. Individuals are often steered towards work based on self-reported interests or filters of previous domain experience. Roles, certifications, job descriptions, and other conventional signals of expertise can be barriers for non-obvious participants in creative problem-solving. Individuals may also deter themselves from situations in which they would become marginalized, underscoring a need to understand the role of self-selection in creative problem-solving. Everyone is marginal in some context, but not every source of

marginality will yield novel idea generation. Individuals lacking creative self-efficacy or autonomy as motivating sources are unlikely to self-select to tasks for which they have the potential to be creative via marginality. Particularly in situations where domain-specific knowledge structures emerge with social identities, we currently find barriers for leveraging marginality. Collaborators are unlikely to configure themselves in ways that maximize creative potential. Mechanisms to encourage participation of marginal individuals in creative endeavors are needed, as is an understanding of the differential impacts of marginality on creative tasks that are assigned and those that are self-selected. Creative self-efficacy and autonomy are motivators, moderating the relationships between technical and social marginality, respectively, and novel idea generation. The implication for managers is that the promotion of creative self-efficacy and autonomy can enhance creativity. Self-efficacy may be cultivated by "enactive mastery experience" of successful episodes of creativity, "vicarious experience" of others' use of creative tools, and "verbal persuasion" regarding one's capabilities for creative action [48]. Creative self-efficacy results from cognitive processing of information about creative capacity, pointing to feedback as one means to build confidence [49] and encourage attempts to solve problems without domain-relevant experience. Managers may also promote creativity with autonomy, offering freedom and discretion in the execution of tasks [50].

4. Implications for Collaborative Contexts

Modern organizations frequently seek novel ideas to redesign products and processes that consistently outperform today's best. Problems of importance to society and enterprise demand creative solutions that exceed the grasp of any one individual. Much of creative work occurs at the group level, where marginal individuals may also contribute to collaborative creative outcomes. How might creative collaboration be designed and managed differently to harness the relationships proposed in our conceptual model? Our propositions have implications for how technical marginality leads to cognitive diversity in creative teams and how social marginality can address the negative effects of team conformity towards central tendencies.

High levels of creativity occur in teams composed of creative members but a group of creative individuals does not make a creative team. Promoting creativity in groups requires distinctive processes from those that support individual

creativity [51], including creative acts that occur in an iterative fashion between individuals and teams [52]. Team-level creativity unfolds not inside people's heads but through interactions [53] of the kind that lead to generation of new ideas and recombination of existing ones [54]. Many of the existing studies of team-level creativity are based on an input-process-outcome model [55]. An evolving literature looks beyond the characteristics of individuals to understand their interaction at the group level [e.g. 52]. Collaborative contexts can be configured in ways that allow the creative benefits of marginal individuals to accrue to groups. Is marginality a useful concept to understand how cognitive diversity within a single individual contributes to cognitive diversity at the team level?

Technical marginality is a source of diverse knowledge, but common team structures may in fact deter participation from unexpected individuals. If team composition is determined by domain specialization with little overlap of neighboring domains, the level of technical marginality on the team will be low as team members will work on tasks around which they have an established identity and extensive knowledge. Team members embedded into a problem domain's core can become too entrenched with prevailing practices, leading to ideas of limited novelty and incremental solutions [56]. Technically marginal individuals can increase the breadth of knowledge and perspectives available to the whole team, particularly when team processes support participation from all team members. Technical marginality brings diversity, unique knowledge, skills, values, and beliefs amongst team members. Creative potential is optimized when the complexity of a team's cognitive processes is better matched to the complexity of the problems they undertake. Individuals need some overlapping knowledge to communicate effectively, but diverse knowledge sets within a team provide comparable benefits to individual cognitive diversity [57]. Within a single individual's mind, diverse knowledge structures overlap to elicit unusual connections and new cognitive paths [58]. At the team level, new ideas are generated by the combination and integration of individuals' varying but overlapping pools of knowledge [59]. Research is needed to examine the dynamics of marginality, cognitive diversity, and creativity in teams [e.g. 60] as well as exploration of team structures that capitalize on members' diverse skills and experiences [e.g. 61].

The creative team context may reduce the presence and perception of social marginality through isomorphic and normative forces that emerge in groups such as peer pressure and routines. New collaborators may bring an influx of novel ideas but

are quickly susceptible to social influence. When an individual joins an organization, a short window of freshness emerges from their sixth to eighteenth month wherein they understand the business but are not yet overly-embedded in the culture [44]. Teams and other group contexts wield a powerful influence [62], increasing conformity and susceptibility to group decision biases [63]. Interaction can be hazardous to creativity [e.g. 47], explaining why research and development initiatives are often operationalized as "skunkworks", under organizational auspices but separate from inertial forces. Once normative forces settle in, how can creative collaborations leverage the benefits of social marginality in the form of freedom from central tendencies? Creative teams may also alter the effects of marginality through perceptions of status and role definition. Individuals who perceive themselves as marginal in relation to other team members are also likely to be the members with the least amount of seniority, limiting the potential for autonomy and creative self-efficacy to motivate them towards creative idea generation. Leaders have opportunities to intervene in ways that promote autonomy and creative self-efficacy including frequent communication, the provision of feedback, and norms to resolve creative conflicts [64].

Marginality has greater potential to influence novel idea generation in some contexts more so than in others. Collaborative contexts that are apt to benefit from marginality depend on a problem's decomposability, or the extent to which a solution demands interaction between knowledge sets [65] personified in different individuals. The positive impact of technical marginality may be most salient in domains where knowledge is centered in an established core. Adding external elements to a saturated problem space (in the form of socially marginal individuals) may yield a novel breakthrough of the kind overlooked by those who are embedded to the extent that they cannot see the forest for the trees. Creativity connotes both novelty and utility, but these two dimensions differ in importance as a function of a problem's context and the nature of the targeted solution. Considering creative outcomes at the group level, perhaps novelty comes from those on the margins while those at the center make the novel ideas useful. We have proposed that domain-relevant expertise may be a hindrance to novel idea generation. Indeed, domain expertise is less important during initial, generative phases of a group creative process, and also when there are sources of domain expertise with which to filter generative output. Within creative groups, individuals with domain-relevant expertise could translate peripheral ideas to the vernacular of current paradigms, making

the novel idea also useful. Motivation and perseverance associated with the successful operationalization of creative ideas may also come from collaborators closer to the core of the domain relevant knowledge. Together, the group can take an idea from inception to innovation to implementation. Research shows that individual attributes associated with idea generation are negatively associated with idea implementation [66] and that individuals who excel at idea generation as well as idea implementation are scarce [67]. Indeed, generating ideas requires exploration, a rejection of 'the rules', autonomy, and flexibility while developing ideas demands exploitation, conformity, cooperation, and structure [68]. But idea evaluation processes also require creativity in shaping ideas to be successful solutions in the focal setting [39]. Thus domain-relevant and creativity-relevant skills are constant companions throughout the innovation process, alternating in consequence along with the evolution of an idea.

Additional research is needed to investigate optimal creative processes and their antecedents at various stages in a team's trajectory. Such work should include how technical and social marginality impact individual self-selection and self-organizing processes in the team formation stages. Research can explore different configurations of teams with members high and low in social and technical marginality in problem relevant domains. Once teams are formed, research needs to explore the distinctive role that an individual's technical and social marginality plays at different junctures of creative collaboration given that the leverage of novel ideas (and the value of marginality) shifts along with the nature and aims of team creative processes [69]. Research should also explore how technical and social marginality relate and how these interactions impact team-level creative processes. Although here we have limited our exploration of marginality in team processes by focusing on marginality as an individual characteristic, future research should also explore marginality as a dimension of teams. With a focus on group dynamics, our theories of marginality can support a multi-level model of the impact of individual-level marginality on team-level creativity.

5. References

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