



9-1-2011

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Recommended Citation

Gregory N. Mandel, *To Promote the Creative Process: Intellectual Property Law and the Psychology of Creativity*, 86 Notre Dame L. Rev. 1999 (2011).

Available at: <http://scholarship.law.nd.edu/ndlr/vol86/iss5/9>

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TO PROMOTE THE CREATIVE PROCESS:
INTELLECTUAL PROPERTY LAW AND
THE PSYCHOLOGY OF CREATIVITY

*Gregory N. Mandel**

INTRODUCTION

Intellectual property is the primary area through which the law seeks to motivate and regulate human creativity. The U.S. Constitution grants Congress the power “[t]o promote the Progress of Science and useful Arts,”¹ and Congress responded by enacting patent and copyright law in an effort to spur technological and artistic innovation. Because innovation usually requires some form of creativity as an antecedent, intellectual property law generally should also promote, and certainly should not impede, creativity. Despite the value of facilitating creativity for intellectual property law, understanding creativity is hardly something within the competent domain of law and legal analysis. Not surprisingly, the legislative and judicial development of intellectual property law has paid remarkably little attention to modern knowledge concerning how to promote creativity. Over the past several decades, however, a wealth of psychological research has provided new insights into creativity and the creative process. This research yields valuable lessons for intellectual property law and indicates that certain areas of patent and copyright law may counterproductively hinder the very creativity that the law is designed to inspire.

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1 U.S. CONST. art. I, § 8, cl. 8.

Psychological research on creativity provides insight into at least three cognitive domains pertinent to the task of intellectual property law: motivation, collaboration, and convergent versus divergent thought processes. A variety of psychological research explores differences between convergent and divergent thinking, and, relatedly, between problem-finding and problem-solving creativity. Problem-finding creativity concerns identifying a new problem that no one has recognized before, while problem-solving creativity involves solving an identified problem. Research indicates that these two types of creativity can involve different cognitive processes and can lead to different types of creative achievement. Intellectual property law, however, generally treats both types of creativity identically, producing legal doctrine that does not motivate or reward either type optimally. Patent law, for example, applies the same nonobviousness requirement to both problem-finding and problem-solving innovation, even though the activities that produce such innovation can be significantly different, can result from differing motivation, and likely could best be promoted by different manners of reward.

Experimental cognitive research also reveals that intrinsic motivation is highly conducive to creative productivity, while purely extrinsic motivation tends to decrease creative function. This robust finding sounds a note of caution across intellectual property law—law's ability to promote creativity not only may be limited, but could even be detrimental to the extent it turns an artist's or inventor's internally motivated activity into one conducted primarily for the copyright or patent prize. Experiments reveal that certain types of extrinsic motivation can enhance intrinsic motivation, although the line that separates positive from negative extrinsic influences is subtle.² In general, extrinsic motivation that confirms the creator's competence without instituting control can synergistically enhance intrinsic motivation, while extrinsic influences that are perceived as controlling counteract intrinsic motivation, and can reduce creativity. While certain aspects of intellectual property law may successfully leverage the extrinsic motivation of a creativity prize, other aspects are more troubling and should be revised in light of these creativity studies.

Additional psychological research highlights the dynamic value of collaboration to creativity. Studies reveal that group collaboration can allow group members to build on each others' ideas in ways that synergistically enhance individual and overall creativity.³ Similarly, various

² See *infra* notes 67–74 and accompanying text.

³ Andre W.B. Hargadon & Beth A. Bechky, *When Collections of Creative's Become Creative Collectives: A Field Study of Problem Solving at Work*, 17 *ORG. SCI.* 484, 484 (2006).

research finds that artists and scientists generate more creative outputs when exposed to a greater variety of input references, an outcome that is more likely in collaborative research. Problematically, the laws of joint authorship and joint inventorship in intellectual property actually dissuade certain collaboration. The reasons for this development are not easy to trace, but appear to be due in part to popular, stereotyped views of differences in the creative process between “left-brain” scientists versus “right-brain” artists. Though modern research has debunked these myths about disparate creative function, intellectual property law remains moored in stereotypes of creativity that continue to influence the law.⁴ The disincentive effects of joint inventor and joint author law on collaboration are highly problematic because a substantial proportion of technological innovation is the result of collaboration, and a significant and growing amount of artistic work is as well.

The import for intellectual property law of the various strains of psychology research discussed above intersect at an area vital to development at the forefront of creative achievement: the coordination of large-scale collaborative creativity. Large-scale collaborative projects have become critical in many areas of twenty-first century research due to the need for multidisciplinary expertise and substantial resources to push the envelope of human knowledge. Large-scale collaborative projects have become common in and across private, government, and university research, as well as in a new form of complex creation termed “open and collaborative peer production.” Open and collaborative peer production involves widely dispersed contributions to a project by vast networks of individuals working towards a common goal. These individuals may be spread across the globe, may rarely interact, and may not even know each other. Open and collaborative peer production is revolutionizing fields as diverse as software, film, music, and biotechnology.

Promoting large-scale collaborative creativity presents a complex challenge. Psychological theories of creativity were developed primarily in the context of individual and small-group settings. Those theories face challenges in large-scale settings because creativity in such situations necessarily entails significant degrees of formal organization and anonymity for the contributor. Contributions in such circumstances raise issues under motivational theory because they require individuals to be motivated for individual creativity but also to

4 ROBERT W. WEISBERG, *CREATIVITY* 57 (2006); Gregory N. Mandel, *Left-Brain Versus Right-Brain: Competing Conceptions of Creativity in Intellectual Property Law*, 44 U.C. DAVIS L. REV. 283, 315–43 (2010).

embrace certain extrinsic organization and a lack of individual autonomy, both of which can detract from creativity. Investigating the motivation and promotion of creativity in large-scale circumstances raises issues at the forefront of psychological research that are critical to the goals of intellectual property. The potential for large-scale collaborative projects to succeed likely depends on the potential for individuals to identify themselves with the social group organizing the project, such that the individual's social identity causes them to internalize the group goals, producing a form of intrinsic motivation. Understanding this internalization process, and how to support it, has important implications for intellectual property law, as intellectual property doctrine can significantly affect how large-scale collaborative work is conducted and who takes part in it.

Though legal analysis of intellectual property law has long been economic, the psychology of creativity also plays a central role in the success of any intellectual property regime. Psychological and economic analysis of intellectual property law are not contradictory endeavors, but should complement each other to develop as deep and nuanced an understanding as possible of how to optimally promote progress. By incorporating current psychological understanding of cognitive thought processes, motivation, and collaboration, it is possible to adapt intellectual property law to more effectively support large-scale collaborative creativity in order to promote the creative process throughout technology and the arts.⁵

I. DIVERGENT VERSUS CONVERGENT THINKING

Psychological studies of creativity yield valuable lessons in three diverse areas highly pertinent to intellectual property law: divergent versus convergent cognitive thought processes, motivation, and collaboration. The following sections examine each of these areas sequentially, followed by a discussion of the import of the combined findings for promoting large-scale collaborative creativity.

Psychologists commonly view creativity as possessing at least two, and possibly three, characteristics.⁶ Creativity requires the production of something that is both novel and appropriate.⁷ Novelty for psychol-

⁵ See Peter Lee, *Patent Law and the Two Cultures*, 120 YALE L.J. 2, 8 (2010) (explaining that expanding patent analysis beyond law and economics to include psychology and sociology "can illuminate many features of the legal architecture of innovation").

⁶ Portions of the following several paragraphs are drawn from Mandel, *supra* note 4, at 334–36.

⁷ Richard E. Mayer, *Fifty Years of Creativity Research*, in HANDBOOK OF CREATIVITY 449, 449 (Robert J. Sternberg ed., 1999) (noting that "the majority [of authors who

ogists, which is also referred to as “originality,” is remarkably akin to the novelty requirement in patent law and the originality requirement of copyright law.⁸ Reproducing past work or repeating existing knowledge is not novel, and therefore not creative.⁹

Appropriateness, also referred to as “adaptivity,” requires that an idea be recognized as socially useful or “valuable in some way to some community.”¹⁰ The value of appropriateness can be derived from any of a number of characteristics, such as utility, merit, importance, uniqueness, or the desirability of a product, service, process, or idea.¹¹ How appropriateness is achieved can vary between science and the arts. For a technological invention, appropriateness will often require functionality; for artistic expression, it may require the ability to keep the audience’s attention or cause a powerful emotional effect.¹²

Some psychologists add a third element to the specification of creativity, requiring that a creative accomplishment be heuristic rather than algorithmic.¹³ Algorithmic tasks are projects where the

offer definitions of creativity in this book] endorse the idea that creativity involves the creation of an *original and useful product*”); Robert J. Sternberg, *What Is the Common Thread of Creativity? Its Dialectical Relation to Intelligence and Wisdom*, 56 AM. PSYCHOLOGIST 360, 362 (2001) (citing numerous sources). *Contra* WEISBERG, *supra* note 4, at 53 (arguing that creativity does not require true novelty or appropriateness). In addition to a conceptual account of creativity, creativity could also be defined by consensus: “A product or response is creative to the extent that appropriate observers independently agree it is creative. Appropriate observers are those familiar with the domain in which the product was created or the response articulated.” TERESA M. AMABILE, *CREATIVITY IN CONTEXT* 33 (1996). Note how closely the consensual definition tracks the nonobviousness requirement in patent law—based on whether an invention would have been obvious to “those familiar with the domain” in which the invention was achieved.

8 R. Keith Sawyer, *Creativity, Innovation, and Obviousness*, 12 LEWIS & CLARK L. REV. 461, 462 (2008). See generally DEAN KEITH SIMONTON, *ORIGINS OF GENIUS* 5–6 (1999) (discussing the nature of creativity).

9 SIMONTON, *supra* note 8, at 5–6. Novelty, for creativity purposes, is defined within a particular sociocultural group. Thus, Galileo’s “discovery” of sunspots is considered novel (to his civilization) even though the Chinese had identified sunspots over a thousand years earlier. *Id.*

10 Sawyer, *supra* note 8, at 462; see also Gregory J. Feist, *A Meta-Analysis of Personality in Scientific and Artistic Creativity*, 2 PERSONALITY & SOC. PSYCHOL. REV. 290–91 (1998) (“To be classified as *creative*, thought or behavior must also be socially useful or adaptive.”).

11 Katherine A. Lawrence, *Why Be Creative? Motivation and Copyright Law in a Digital Era*, 1 IPCENT. REV. 1, 2 (2004), available at <http://ipcentral.info/review/v1n2lawrence.pdf>.

12 SIMONTON, *supra* note 8, at 6; Sawyer, *supra* note 8, at 462.

13 AMABILE, *supra* note 7, at 35.

“path to the solution [or goal] is clear and straightforward.”¹⁴ Heuristic tasks, in contrast, are ones that lack “a clear and readily identifiable path to a solution.”¹⁵

Psychologists have found that the creative function required for novel and appropriate ideation requires multiple cognitive processes to operate in harmony. Originality often requires divergent thought processes, which involve significantly intuitive cognitive function, while appropriateness often requires convergent evaluation, a more analytic thought process.¹⁶ Most people are more inclined to either divergent or convergent thought, and most people have difficulty alternating between the two cognitive processes.¹⁷ The difficulty of combining divergent and convergent thought processes into a unified achievement is one aspect that renders creativity a difficult challenge.¹⁸

Divergent ideation itself can involve either or both of two different types of creative thought: problem-finding and problem-solving. The former refers to identifying a new problem that no one has recognized before, the latter to solving an already identified problem.¹⁹ Post-it notes, for example, were invented when someone recognized that combining a weak adhesive and paper could produce a useful product, years after each element had been invented independently.²⁰ This is an example of problem-finding. Thomas Edison’s invention of the light bulb, on the other hand, is an example of problem-solving. The incandescent light bulb had been invented prior to Edison’s achievements, but inventors the world over were involved in a search for a filament that would burn longer so as to produce a more useful

14 *Id.*

15 *Id.* This element has intriguing implications for the nonobviousness requirement in patent law. “A heuristic versus algometric definition indicates that ‘the manner in which an invention is achieved’ (contrary to the dictate of section 103(a)) does implicate its creativity. Rote trial-and-error work would not be considered creative. . . . [Although research also indicates that] the prevalence of ‘rote’ trial-and-error work is likely highly overstated.” Mandel, *supra* note 4, at 335 n.219.

16 JOHN S. DACEY & KATHLEEN H. LENNON, UNDERSTANDING CREATIVITY 204–05, 214 (1998).

17 Dennis R. Brophy, *Understanding, Measuring, and Enhancing Individual Creative Problem-Solving Efforts*, 11 CREATIVITY RES. J. 123, 126–27 (1998). That being said, studies indicate that individuals can be trained to engage in both types of thought processes to a greater degree. *Id.* at 136–37.

18 *Id.* at 126–27.

19 See Sawyer, *supra* note 8, at 473–74.

20 STEPHEN VAN DULKEN, INVENTING THE 20TH CENTURY 180–81 (2000). Ironically, the adhesive used in Post-it notes was invented by an inventor trying to formulate a strong, not weak, adhesive. *Id.*

product.²¹ Edison's primary invention was the discovery that several species of bamboo provided a far superior filament to anything that had previously been identified.²²

Problem-finding and problem-solving each can involve different styles of creative thought processes. Where problem-finding often involves more abstract thought processes, problem-solving can entail more analytical cognitive function.²³ Studies indicate that experts and lay-persons routinely view problem-finding as particularly creative innovation.²⁴ Unfortunately, most people are better at problem-solving than at problem-finding, and few individuals are highly proficient in both qualities.²⁵ Again, it is the difficulty of combining different thought processes that can render creativity difficult to achieve.

Exceptional artists and scientists are usually those who, among other qualities, are able to integrate divergent and convergent thought processes.²⁶ Though most people tend to think of successful artists as primarily or exclusively divergent thinkers, in practice, artists generally must work within an established set of parameters and resource limits.²⁷ Research indicates, for example, that people tend to appreciate artistic creativity most when it presents something new, but not too different from pre-existing work.²⁸ In a similar vein, Edgar Allan Poe's description of how he wrote *The Raven*, one of the most famous poems of all time, sounds more in convergent than divergent thought: "It was my design to render it manifest that no one point in its composition is referable either to accident or intuition—that the work proceeded, step by step, to its completion with the precision and rigid consequence of a mathematical problem."²⁹ Artistic achievement, of course, also requires divergent creativity, but in combination with convergent thought, not exclusively.³⁰ A detailed study

21 Gregory Mandel, *Thomas Edison's Patent Application for the Incandescent Light Bulb*, in 2 MILESTONE DOCUMENTS IN AMERICAN HISTORY 978, 979–83 (Paul Finkelman ed., 2008).

22 *Id.*

23 Sawyer, *supra* note 8, at 473–74.

24 *Id.* (stating that problem-finding often produces the "most radical breakthroughs").

25 Brophy, *supra* note 17, at 128.

26 *Id.* at 130.

27 *Id.*

28 Jeanne C. Fromer, *The Role of Creativity in Trademark Law*, 86 NOTRE DAME L. REV. 1903 (2011).

29 Edgar A. Poe, *The Philosophy of Composition*, 28 GRAHAM'S MAG. 163, 163 (1846), quoted in SIMONTON, *supra* note 8, at 39.

30 Mandel, *supra* note 4, at 331, 342–43 ("[I]nspired artistic . . . achievement usually comes from a harmonious mix of intuitive and analytic creativity.").

of the sketches and history leading to the development of Pablo Picasso's *Guernica*, one of most famous paintings of the twentieth century, found a striking mix of convergent and divergent thinking that went into its production.³¹

Conversely, although most people tend to view scientific creativity as involving routinized, convergent thought processes, the reality is also more mixed. Psychologists who study creativity, as well as scientists themselves, recognize scientific creativity as similar to artistic.³² Nobel Laureate Max Planck believed that creative scientists "must have a vivid intuitive imagination, for new ideas are not generated by deduction, but by an artistically creative imagination."³³ Albert Einstein echoed this sentiment, noting that "imagination is more important than knowledge" for new scientific discovery.³⁴ Similarly, a study of the mental processes of sixty-four eminent scientists found that they often perceive their inventive thought processes to function in manners usually attributed to artistic creativity.³⁵

That being said, technological achievement also requires convergent thought. One researcher observed scientists at work in molecular biology and immunology laboratories in the United States and other countries in order to study scientific thought processes as they occurred.³⁶ These observations revealed that the scientific process, at least in these laboratories, involved a complex combination of analytic and exploratory thought processes. While about half of the results obtained in the labs during the periods observed (ranging from three months to one year) were the logically expected result of more linear, step-by-step experiments and analysis, the other half were unexpected, as reported by the scientists themselves.³⁷ These studies indicate that

31 Robert W. Weisberg, *On Structure in the Creative Process: A Quantitative Case-Study of the Creation of Picasso's Guernica*, 22 *EMPIRICAL STUD. ARTS* 23 (2004).

32 Although most psychologists who study creativity would agree with this statement, this understanding is not universal. Nobel Laureate Herbert Simon contends that scientific discovery follows more rigid, logical principles, and, in an effort to make his case, designed computers to "discover" various scientific formulas, such as Planck's formula for blackbody radiation or Kepler's third law of planetary motion. This work, as a model of actual scientific creativity, has been criticized for oversimplifying the problems, hindsight in defining the problems, and hindsight in ordering the operations. SIMONTON, *supra* note 8, at 50-55.

33 *Id.* at 29.

34 *Id.*

35 *Id.* at 32.

36 Kevin Dunbar, *How Scientists Build Models: In Vivo Science as a Window on the Scientific Mind*, in *MODEL-BASED REASONING IN SCIENTIFIC DISCOVERY* 85, 85-86 (Lorenzo Magnani et al. eds., 1999).

37 *Id.* at 90.

the scientific process depends on a heavy mix of both convergent and divergent thought processes.³⁸ Consistent with this study, creativity researchers recognize the important role of analytic creativity to scientific and technological endeavors, just as well as the intuitive.³⁹

The mix between problem-finding and problem-solving, and between divergent and convergent thought processes, will vary from innovation to innovation, and will be significantly dependent on the context. Some innovation will result from laborious, time-consuming, and sometimes more rote, trial-and-error work, while other innovation will result from a less-planned moment of insight. Patent law, however, applies a uniform nonobviousness standard to all type of invention, no matter how achieved, and thus effectively treats these different types of innovation and thought-processes identically.⁴⁰ It is quite possible, however, that different processes of innovation could be promoted more efficiently in different manners and with different rewards.⁴¹

Although there will always be exceptions, producing creative output, whether in the arts or sciences, usually requires both divergent and convergent thought, and both problem-finding and problem-solving. Not every step needs to be performed creatively in order to produce a creative result. There can be a creative solution to a known problem, for example. However, at least one of the elements must represent a creative achievement in order for the end result to provide a creative advance. Critically, these cognitive steps do not all have to be completed by the same individual or team. Rather, a collaborative effort, with different individuals and groups assigned to different portions of a task, perhaps in accord with those tasks at which they excel, may provide the most efficient and most promising means to achieve a creative breakthrough.⁴² The following section examines how motivation plays a role in creative efforts, followed by a section on how such collaborative efforts can occur.

II. MOTIVATION AND CREATIVITY

One of the most significant findings from psychology of creativity research is that intrinsically motivated work is more likely to produce

38 *Id.* at 90–91.

39 AMABILE, *supra* note 7, at 87–90; SIMONTON, *supra* note 8, at 62.

40 35 U.S.C. § 103(a) (2006).

41 FED. TRADE COMM'N, TO PROMOTE INNOVATION 12–15 (2003), *available at* <http://www.ftc.gov/os/2003/10/innovationrpt.pdf>.

42 *See* Brophy, *supra* note 17, at 137 (proposing a problem-person matching method as the best means for solving problems).

more creative output than extrinsically motivated work.⁴³ This robust finding sounds a note of caution across intellectual property law—law’s ability to promote creativity not only may be limited, but could even be detrimental, to the extent it turns an artist’s or inventor’s internally motivated activity into one conducted for the copyright or patent prize.⁴⁴

Intrinsic motivation is motivation that arises from an individual’s inherent interest, involvement, or challenge found in a given task or project.⁴⁵ Extrinsic motivation is motivation that comes from external goals, such as financial or other rewards, or from past or expected evaluation.⁴⁶ Tying these results into the differences in cognitive thought processes, divergent thinkers tend to be more intrinsically motivated to solve problems creatively, while convergent thinkers tend to be more extrinsically motivated.⁴⁷

The differences between intrinsic and extrinsic motivation are believed to translate directly into the cognitive processes that individuals use to tackle a project, producing the differential in creative achievement. Extrinsically motivated individuals tend to focus on the potential reward or another external motivator rather than on the actual project and consequently are less engaged in the pertinent task.⁴⁸ As a result, externally motivated individuals are more likely to rely on well-known, algorithmic methods for solving a problem.⁴⁹ Intrinsically motivated individuals, however, maintain much greater interest in and enjoyment of the challenge itself.⁵⁰ This leads internally motivated individuals to explore a project more, and makes it more likely that they will come up with a creative solution or product.⁵¹

43 AMABILE, *supra* note 7, at 6–17, 112–24; Lawrence, *supra* note 11, at 3–4.

44 AMABILE, *supra* note 7, at 107–24; Diane Leenheer Zimmerman, *Copyrights as Incentives: Did We Just Imagine That?*, 12 THEORETICAL INQUIRIES IN LAW 29, 49–54 (2011); *see also* DAN ARIELY, *THE UPSIDE OF IRRATIONALITY* 17–52 (2010) (discussing various experimental studies indicating that increasing monetary incentives for tasks can reduce the quality of performance of the task).

45 Lawrence, *supra* note 11, at 3–4.

46 Brophy, *supra* note 17, at 132; Lawrence, *supra* note 11, at 3–4.

47 Brophy, *supra* note 17, at 132.

48 AMABILE, *supra* note 7, at 122; Lawrence, *supra* note 11, at 6.

49 AMABILE, *supra* note 7, at 122.

50 *Id.*; Richard M. Ryan & Edward L. Deci, *Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being*, 55 AM. PSYCHOLOGIST 68, 69 (2000).

51 AMABILE, *supra* note 7, at 122. Although this discussion describes the current leading psychological understanding, there are competing theories. *See* Maarten Vansteenkiste et al., *Intrinsic Versus Extrinsic Goal Contents in Self-Determination Theory*:

Pure extrinsic or intrinsic motivation are not the only types of motivation possible, but represent two extremes that frame a continuum. At one end lies “external regulation,” which refers to behavior that is fully produced or prompted by extrinsic demands and pressures.⁵² Slightly less externalized is “introjected regulation,” a situation where an individual engages in an activity in order to comply with internal pressure, but that internal pressure arises out of a sense of externally related obligation.⁵³ Motivation based on a need for self-esteem or to avoid guilt or shame are examples of introjected regulation.⁵⁴ Such motivation arises internally, but as a result of an external pressure. “Identified regulation,” on the other hand, refers to motivation that is more autonomous and lies further towards the intrinsic side of the continuum.⁵⁵ Identified regulation involves activities that an individual chooses to engage in “because the individual identifies with the importance [or] value [of] the activity,”⁵⁶ although the individual may not see the activity itself as wholly self-expressive or even pleasant in and of itself.⁵⁷ For instance, a person might engage in an athletic activity because he or she believes it contributes to his or her growth or development, even though the individual does not particularly enjoy the activity.⁵⁸ The most internalized form of external motivation is “integrated regulation,” which refers to behavior that an individual engages in because of a desired outcome, although not as a result of interest in the activity solely for its own sake.⁵⁹ Keeping with the athletic theme, training for a marathon that one is internally motivated to compete in could be an activity that results from integrated regulation.⁶⁰

Another Look at the Quality of Academic Motivation, 41 *EDUC. PSYCHOLOGIST* 19, 25 (2006) (discussing how the difference between intrinsic and extrinsic motivation could also produce different outcomes due to differences in the amount of motivation an individual feels or the type of individual who is motivated). Recent experimental studies indicate that the explanation in the text is likely the most accurate description. *Id.* at 25–27.

52 See Marcus Selart et al., *Effects of Reward on Self-Regulation, Intrinsic Motivation and Creativity*, 52 *SCANDINAVIAN J. EDUC. RES.* 439, 440 (2008); Vansteenkiste, *supra* note 51, at 21.

53 Selart et al., *supra* note 52, at 440–41; Vansteenkiste, *supra* note 51, at 21.

54 Selart et al., *supra* note 52, at 440–41; Vansteenkiste, *supra* note 51, at 21.

55 Selart et al., *supra* note 52, at 440–41.

56 *Id.*

57 *Id.*; Vansteenkiste, *supra* note 51, at 21.

58 Robert S. Weinberg & Daniel Gould, *Foundations of Sport and Exercise Psychology* 140 (4th ed. 2007).

59 Selart et al., *supra* note 52, at 441.

60 WEINBERG & GOULD, *supra* note 58, at 139.

At the opposite end of the motivation spectrum from external regulation is true intrinsic motivation, activities that an individual engages in because he or she identifies with the activity as an expression of his or her own self and which is fully self-determined activity.⁶¹ Intrinsic motivation can arise from a knowledge-based desire for learning or exploring something new, an accomplishment-oriented goal of creating something new or mastering new skills, or a stimulation-based desire to experience pleasant feelings, such as fun, excitement, or aesthetic pleasure.⁶²

As motivation moves from the extrinsic toward the intrinsic side of the motivation spectrum, individuals' work product tends to become more creative.⁶³ This specification helps explain the high level of creativity and consequent recent attention that is being paid to user innovation. User innovation refers to innovation produced by technology users as opposed to individuals whose profession it is to develop technology.⁶⁴ User innovation occurs when users modify products they have purchased in an effort to provide a more enjoyable user experience.⁶⁵ These modifications can produce significant advances. Examples of user innovation range from programming an iPod or cell phone, to cyclists who invented the mountain bike due to an interest in off-road biking, to surgeons who modify and improve surgical equipment for their own use.⁶⁶ User innovation, by definition, is often largely intrinsically motivated, and therefore may be expected to produce particularly creative results in certain circumstances.

The challenge for intellectual property law is how to turn the external reality of a patent or copyright prize into an opportunity that is internalized by the inventor or artist. So long as a patent or copyright is perceived solely as an extrinsic motivator, it may be expected

61 Selart et al., *supra* note 52, at 439.

62 WEINBERG & GOULD, *supra* note 58, at 139.

63 AMABILE, *supra* note 7, at 122; Selart et al., *supra* note 52, at 439. Creativity is not necessarily a proxy for productivity, and depending on the nature of the task at hand, extrinsic motivation may be more valuable than intrinsic. Studies suggest that intrinsic motivation is more important for work that an individual considers interesting, but that where a task is considered boring or less interesting, extrinsic motivation becomes the more effective motivational power. Robert J. Vallerand et al., *Reflections on Self-Determination Theory*, 49 CANADIAN PSYCHOL. 257, 259 (2008). This does not, however, mean that extrinsic motivation produces greater creativity in such situations.

64 Katherine J. Strandburg, *Evolving Innovation Paradigms and the Global Intellectual Property Regime*, 41 CONN. L. REV. 861, 872 (2009) (providing examples of user innovation).

65 *Id.* at 872–75.

66 *Id.* at 872.

to produce only algorithmic efforts by inventors and artists. To the extent the drive for a patent or copyright can be internalized, it is much more likely to lead to achievements that are more creative.

Studies have found that certain types of external opportunities can produce intrinsic motivation. One significant example for intellectual property law is that a reward for a creative or novel accomplishment can increase intrinsic motivation and creativity.⁶⁷ Mere expected rewards, however, are extrinsic motivators and have a detrimental effect on creativity.⁶⁸ Commissioned work, for example, is often less creative, due to external regulation and constraint that the creator feels.⁶⁹ The award must be perceived as being not for an output product per se, but only for a particularly creative result.

As this discussion indicates, the line that separates the positive from negative effects of external motivation can be subtle. Rewards that are contingent on task performance or that produce concern about competition, expected negative evaluations, rewards, or constraint on how work is done all have been found to detract from creativity.⁷⁰ These activities each reduce the autonomy and sense of competence of the potential creator and produce extrinsic motivation.⁷¹ Conversely, reward and recognition for creative ideas, clearly defined project goals, and frequent constructive feedback can each enhance creativity.⁷² Though the elements that lead to extrinsic versus intrinsic motivation are similar, the difference is that extrinsic motivation that confirms the creator's competence and autonomy without instituting control, or that offers rewards if the individual does exciting work, can enhance internal motivation.⁷³ Extrinsic influences that are seen as controlling or likely to result in negative effects, however, counteract internal motivation, and can reduce creativity.⁷⁴ Recent studies indicate that a sense of autonomy by itself can

67 See, e.g., *AMABILE*, *supra* note 7, at 117 (referencing a study finding "that the highest levels of creativity were produced by subjects who received a reward as a kind of bonus"); Selart et al., *supra* note 52, at 440 ("[E]xtrinsically motivated behaviours that are initially externally prompted can become increasingly internalised and result in greater self-regulation.").

68 Selart et al., *supra* note 52, at 443.

69 *AMABILE*, *supra* note 7, at 117. Clearly, this finding raises concerns regarding the creativity of works produced under the work-for-hire doctrine. 17 U.S.C. § 201(b) (2006).

70 *AMABILE*, *supra* note 7, at 117; Ryan & Deci, *supra* note 50, at 70; Selart et al., *supra* note 52, at 452.

71 Ryan & Deci, *supra* note 50, at 70.

72 *AMABILE*, *supra* note 7, at 117.

73 *Id.* at 118.

74 *Id.*; Ryan & Deci, *supra* note 50, at 70.

have an independent positive effect on learning and effort, and thus that intrinsic motivation and autonomy may synergistically promote creative accomplishment.⁷⁵

Also pertinent to intellectual property law, whether an activity is engaged in from an internally or externally motivated perspective can depend on how the activity is perceived by the individual engaging in it.⁷⁶ Framing the same activity as having intrinsic versus extrinsic goals tends to cause individuals to engage in the activity from a more internally motivated versus externally motivated perspective, respectively, and produces greater performance outcomes in the intrinsic case.⁷⁷ Consequently, how individuals understand intellectual property law may have a significant effect on how the law influences creativity. To the extent intellectual property law is perceived as creating competition, constraint, or providing rewards for task (not creative) performance, the law may produce extrinsically motivated efforts that are less creative. To the extent, however, that intellectual property law is perceived as providing potential creators with a wide degree of autonomy and a reward for creative achievement, the law can produce intrinsic motivation that enhances creativity.

Intriguingly, these results indicate that patent law's nonobviousness requirement may enhance creative efforts, while copyright's originality requirement could detract from them. In order to acquire a patent, an invention must not merely be novel in relation to the prior technology, but must measure a nonobvious advance over existing technology.⁷⁸ The nonobviousness requirement thus mandates a certain level of creative achievement in order to secure a patent, making a patent a reward for a particularly creative achievement.⁷⁹ To the extent that a potential inventor understands this, the inventor is likely to perceive a patent as a reward only for a creative accomplishment, and thus the patent system may enhance intrinsic motivation in this regard.

75 Vansteenkiste et al., *supra* note 51, at 24–25.

76 *Id.* at 25.

77 *Id.*

78 35 U.S.C. § 103(a) (2006).

79 Understanding the relationship between motivation and creativity also adds an additional concern to recent (though now abating) concerns over too low a nonobviousness requirement. See Gregory Mandel, *The Nonobvious Problem: How the Indeterminate Non-Obvious Standard Produces Excessive Patent Grants*, 42 U.C. DAVIS L. REV. 57, 90 & n.144 (2008) (collecting sources). To the extent inventors perceive a very low nonobviousness requirement, a patent will no longer be perceived as a reward for creative accomplishment, and thus will present more of an external rather than internal motivator.

The creativity requirement for a copyright, on the other hand, is famously low, requiring only that a work display a minimum amount of creativity.⁸⁰ The Supreme Court has held that the requisite level of creativity “is extremely low; even a slight amount will suffice.”⁸¹ To the extent that potential creators are aware of copyright’s minimalist creativity standard, the copyright reward will be viewed more as simply providing a reward for task performance. The perception of a task performance reward produces only extrinsic motivation, rather than providing the desired internal desire to achieve a creative result, and may lead to a reduction in the creativity of copyright-related efforts.

III. COLLABORATION AND CREATIVITY

A variety of research makes clear that collaboration can be a valuable driver of creative achievement. The utility of collaboration has become increasingly important in recent times as an overriding proportion of valuable inventions are now the result of collaboration, and a significant and growing amount of artistic works are as well.⁸² Collaboration has become both more common and more necessary across numerous technological and artistic fields.⁸³ Congress recognized this in amendments to the Patent Act in the 1980s that were designed to promote team research.⁸⁴ The trend towards collaboration is also evident in patent filings, where the average number of inventors listed per patent has increased by fifty percent from the 1970s to the 2000s.⁸⁵

80 Feist Publ’ns, Inc., v. Rural Tel. Serv. Co., 499 U.S. 340, 345 (1991).

81 *Id.*

82 Rochelle Cooper Dreyfuss, *Collaborative Research: Conflicts on Authorship, Ownership, and Accountability*, 53 VAND. L. REV. 1159, 1162 (2000) (“The creative industries have evolved: collaborative production is replacing individual effort.”); Roberta Rosenthal Kwall, “*Author-Stories: Narrative’s Implications for Moral Rights and Copyright’s Joint Authorship Doctrine*,” 75 S. CAL. L. REV. 1, 63–64 (2001); Lawrence M. Sung, *Collegiality and Collaboration in the Age of Exclusivity*, 3 DEPAUL J. HEALTH CARE L. 411, 417–19 (2000). Portions of this Part are drawn from Mandel, *supra* note 4, at 349–52.

83 INT’L EXPERT GROUP ON BIOTECHNOLOGY, INNOVATION & INTELLECTUAL PROP., TOWARD A NEW ERA OF INTELLECTUAL PROPERTY 42 (2008) (report concluding that current intellectual property system discourages collaboration, retarding biotechnology development); Dreyfuss, *supra* note 82, at 1162–63; Catherine L. Fisk, *Credit Where It’s Due: The Law and Norms of Attribution*, 95 GEO. L.J. 49, 82 (2006); Hargadon & Bechky, *supra* note 3, at 484; Jessica Silbey, *The Mythical Beginnings of Intellectual Property*, 15 GEO. MASON L. REV. 319, 338–39 (2008).

84 130 CONG. REC. 28069, 28071 (1984), as reprinted in 1984 U.S.C.C.A.N. 5827, 5833.

85 Dennis Crouch, *The Changing Nature Inventing: Collaborative Inventing*, PATENTLY-O BLOG (July 9, 2009, 9:28 AM), <http://www.patentlyo.com/patent/2009/07/the-changing-nature-inventing-collaborative-inventing.html> (reporting an average

The extraordinarily advanced achievements and specialization that have occurred in contemporary society mean that individuals often do not have the intellectual capacity to make further advances on their own without collaboration.⁸⁶ The entire field of nanotechnology, for example, involves advanced aspects of physics, chemistry, and biology such that multidisciplinary collaboration is essential for most work.⁸⁷ Collaboration is also increasing in the arts, for instance to produce more complex works or works that will appeal to individuals across a wide range of cultures.⁸⁸

A variety of psychological and sociological research demonstrates the importance of collaboration to promoting creativity in both the arts and the sciences. Creativity almost always involves the combination of prior ideas and work, and such combination is routinely accelerated by collaboration.⁸⁹ Psychology studies find that the problem-solving capabilities of a group often exceed the problem-solving capabilities of an individual.⁹⁰ With respect to creativity in the arts and sciences in particular, experiments reveal that individuals exposed to strongly unrelated images generate more creative artistic outputs than those not so exposed, as judged by independent raters.⁹¹ Research also finds that more creative scientists, as judged by reputation level and productivity, tend to have a greater ability to draw from a broader array of resources when solving problems.⁹² Similarly, scientists whom peers identify as the most creative are more likely to have had exposure to information from different scientific disciplines.⁹³ The most significant intellectual revolutions in Western history, including the Renaissance and the Scientific and Industrial Revolutions, may be significantly attributable to conceptual cross-pollination across different

of 1.6 inventors listed per patent in 1970s and 2.5 inventors listed per patent in 2000s).

86 Dreyfuss, *supra* note 82, at 1162, 1216.

87 Gregory Mandel, *Nanotechnology Governance*, 59 ALA. L. REV. 1323, 1328–31 (2008); see Dreyfuss, *supra* note 82, at 1162 (making similar point for biotechnology).

88 Dreyfuss, *supra* note 82, at 1162; see also Michael J. Madison, *A Pattern-Oriented Approach to Fair Use*, 45 WM. & MARY L. REV. 1525, 1686 (2004) (discussing the value of making “connections between previously unconnected phenomena”).

89 See generally KEITH SAWYER, *GROUP GENIUS* (2007) (discussing the creative power of collaboration).

90 E.g., EDWIN HUTCHINS, *COGNITION IN THE WILD* (1995); Patricia Heller et al., *Teaching Problem Solving Through Cooperative Grouping*, 60 AM. J. PHYSICS 627, 635 (1992).

91 SIMONTON, *supra* note 8, at 46.

92 Sarnoff A. Mednick, *The Associative Basis of the Creative Process*, 69 PSYCHOL. REV. 220, 223 (1962).

93 AMABILE, *supra* note 7, at 87.

fields.⁹⁴ Collaboration greatly increases the likelihood of scientists and authors encountering widely different phenomena, experiences, and resources.

Studies of invention indicate that extraordinary innovation usually arises from integrating teachings from disparate fields, an outcome much more likely in collaborative research.⁹⁵ Research similarly reveals that paradigm shifts in scientific understanding are often achieved by scientists who are trained in an original field and then migrate to a new one.⁹⁶ Related findings have been made in the arts, where representational shifts often result from an artist trained or working in one creative tradition encountering works or techniques from another.⁹⁷

Psychologists identify a number of cognitive processes that can produce creative results. “Associative richness” is one of the primary processes, referring to the capacity to connect different ideas in unusual ways.⁹⁸ Output products tend to be judged as more creative when the connected concepts are more widely varied.⁹⁹ As Einstein explained, “combinatory play seems to be the essential feature in productive thought.”¹⁰⁰ Professor Julie Cohen makes a similar point in studying the impact of culture on creativity: “A critical ingredient [in creativity] is the ‘play’ that the networks of culture afford, including . . . the extent to which they enable serendipitous access to cultural resources and facilitate unexpected juxtapositions of those resources.”¹⁰¹ The opportunity for associatively rich connections increases with greater collaboration.

Collective creativity is not just the sum of the individual creativity of group members, but also the product of teamwork and collaboration. Successful collaboration involves individuals building on each others’ ideas in a synergistic manner that enhances individual creative

94 See generally Sean O’Connor, *The Central Role of Law as a Meta Method in Creativity and Entrepreneurship*, in *LAW, CREATIVITY & ENTREPRENEURSHIP* (Shubha Ghosh & Robin Malloy eds., 2011) (theorizing that the methods of innovation are the true locus of human progress as opposed to intellectual property law’s focus on the artifacts).

95 Sawyer, *supra* note 8, at 480–81.

96 SIMONTON, *supra* note 8, at 123–25.

97 Julie E. Cohen, *Creativity and Culture in Copyright Theory*, 40 U.C. DAVIS L. REV. 1151, 1190 (2007) (collecting examples).

98 SIMONTON, *supra* note 8, at 28; see also Sawyer, *supra* note 8, at 465–67 (discussing “conceptual combination” as a type of creativity that can lead to innovation).

99 SIMONTON, *supra* note 8, at 28; Sawyer, *supra* note 8, at 465–67.

100 SIMONTON, *supra* note 8, at 29.

101 Cohen, *supra* note 97, at 1190; see also DACEY & LENNON, *supra* note 16, at 88–93 (discussing the role of culture in creativity).

activity.¹⁰² E.M. Forster famously wrote in the epigraph to the novel *Howard's End* that the most important thing is to “[o]nly connect.”¹⁰³ Though Forster was referring to emotional relationships, the same can be said of creative endeavors. The potential for access to, comparison of, and connection among differing information will increase as collaboration increases.¹⁰⁴ Collaboration, in short, promotes creativity, and intellectual property law should therefore promote collaboration.

Surprisingly, intellectual property law often does just the opposite. Joint author and joint inventor law are the primary areas of intellectual property law that govern collaboration. These joint creator doctrines pertain to whether an individual (such as a collaborator, assistant, or supervisor) has contributed enough to an endeavor to be entitled to the status of joint inventor or joint author, and consequently entitled to concomitant patent or copyright rights in the underlying intellectual property. Briefly, joint author law provides that individuals can only be joint authors if each intended to produce a joint work, each intended to be a joint author, and each made an independently copyrightable contribution to the work.¹⁰⁵ Patent law is more lenient in this regard: a person is a joint inventor if he or she makes a not insignificant contribution to the conception of an invention, regardless of intent, regardless of whether it was an independently patentable contribution, and even if he or she only contributed to a subset of the patent claims.¹⁰⁶

102 SAWYER, *supra* note 89, at 7 (“[T]he whole is greater than the sum of its parts.”); Clara Xiaoling Chen et al., *The Effects of Intergroup and Intragroup Tournament Pay on Group Creativity* 21–23 (Feb. 12, 2010) (unpublished working paper) (on file with the *Notre Dame Law Review*).

103 E.M. FORSTER, *HOWARD'S END* epigraph (Penguin Classics 2000) (1910).

104 See generally SAWYER, *supra* note 89 (discussing the creative power of collaboration).

105 See, e.g., *Aalmuhammed v. Lee*, 202 F.3d 1227, 1233 (9th Cir. 2000); *Erickson v. Trinity Theatre, Inc.*, 13 F.3d 1061, 1071 (7th Cir. 1994); *Childress v. Taylor*, 945 F.2d 500, 504 (2d Cir. 1991).

106 35 U.S.C. § 116 (2006); *Ethicon, Inc. v. U.S. Surgical Corp.*, 135 F.3d 1456, 1460 (Fed. Cir. 1998); *Pannu v. Iolab Corp.*, 155 F.3d 1344, 1351 (Fed. Cir. 1998). Not only is intent not required for joint inventorship, but even affirmative intent by one joint inventor not to apply for a joint patent cannot defeat the joint inventor rights of both inventors. The Patent Act provides, “If a joint inventor refuses to join in an application for patent . . . the application may be made by the other inventor on behalf of himself and the omitted inventor.” 35 U.S.C. § 116.

The reasons for the disparities between joint author and joint inventor law may be due, in part, to no more than common stereotypical biases about differences in the creative processes of scientists and authors. Mandel, *supra* note 4, at 285.

Strikingly, joint author and joint inventor law can actually dissuade collaboration. The requirement of intent to be a joint author, and the requirement that an individual provide an independently copyrightable contribution, each protect the primary developer of a copyrightable work at the potential expense of a secondary contributor. The law thus effectively displays a bias against collaborative authorship, a bias which some commentators have identified as explicitly revealed in certain judicial decisions.¹⁰⁷ The bias for primary authors will cause some potential secondary contributors to be wary of providing assistance on a project out of concern that they will not receive appropriate reward for their effort. The bias will consequently reduce collaborative efforts and the production of collaborative works.¹⁰⁸

Similar concerns exist for joint inventor law. By ignoring intent, and providing for joint inventorship rights in a full patent based only on a contribution to a single patent claim, joint inventor law effectively protects the rights of a minor contributor at the potential expense of the primary inventor. Joint inventor law's bias for protecting the rights of secondary contributors will lead some primary researchers to be wary of involving potential secondary assistants in their work, out of fear of losing a disproportionate share of their patent rights.¹⁰⁹ Like joint author law, this bias will tend to reduce collaborative efforts and the production of collaborative inventions.

Certainly, joint creator laws do not dissuade all collaboration—lots of collaboration occurs. Some potential collaborators are entirely unaware of joint creator law, and potentially unaffected. Others are aware of joint creator laws and able to contract around them. In certain situations, other intellectual property law doctrine resolves these or similar issues. The work-for-hire doctrine, for example, resolves certain of these problems in copyright law by granting a copyright to the entity that paid to have a work created, rather than the actual creator.¹¹⁰ Patent law has no work-for-hire doctrine, but research

107 Professor Roberta Kwall identifies this bias in the Ninth Circuit's leading joint authorship case, *Aalmuhammed*, 202 F.3d at 1232. Kwall, *supra* note 82, at 60 (contending that the opinion "reveals[] the court is fixated on a definition of 'authorship' which embodies a single creative entity").

108 The bias will also reduce distribution of a work. Two authors who can independently exploit a work will tend to produce greater distribution of the work than a solo author.

109 This does not necessarily mean that the 1984 Patent Act Amendments negatively impacted joint inventor law, only that additional problems still exist. *See* Sung, *supra* note 82, at 439.

110 17 U.S.C. § 201(b) (2006). A work is classified as a work-for-hire if it is "prepared by an employee within the scope of his or her employment." 17 U.S.C. § 101.

organizations often solve these and other problems by contracting in advance for rights to employee inventions as a condition of employment.¹¹¹

For parties between the extremes of full ignorance of joint creator laws and privately negotiated agreement, however, joint creator law matters at the margin. This group will include those who have an awareness of joint creator laws, but for whom the transaction costs of delineating rights *ex ante* are too great—either financially or because they do not want to be bothered with legal agreements or lawyers.¹¹² This group will also include those who are not directly aware of joint creator laws, but who operate within a social culture of heightened concern about being treated fairly if one contributes to an endeavor.¹¹³ Contributors often do not adequately consider their intellectual property rights beforehand, or even if they do, rarely pay enough attention to clearly define their respective rights by contract.¹¹⁴ Even when potential collaborators develop a private agreement delineating intellectual property rights, the contract may turn out to be insufficiently comprehensive or unclear in the hindsight of a dispute.¹¹⁵ The recent rise in joint creator litigation makes evident the difficulties and costs of private solutions.¹¹⁶

The challenge of achieving sufficient and comprehensive private agreements is a particular problem for intellectual property endeavors because the goal of such agreements is often to develop something uncertain and unknown. These problems not only lead to disputes concerning rights but also a lack of clarity as to how certain creative output may be exploited or further developed. Such uncertainty can

Certain types of works, including motion pictures, are classified as works for hire if the parties agree in writing. *See id.*

111 Catherine L. Fisk, *Removing the 'Fuel of Interest' from the 'Fire of Genius': Law and the Employee-Inventor, 1830–1930*, 65 U. CHI. L. REV. 1127, 1130–31 (1998). Patent law does have a common law shop right doctrine that grants employers a non-exclusive license in any invention made through use of the employers' resources. *See id.*

112 *See* Dreyfuss, *supra* note 82, at 1172 (“[M]any scientists and artists have cultural aversions to lawyers and legal matters.”).

113 Sung, *supra* note 82, at 435–38 (discussing how law of joint inventorship has led to anxiety among researchers about exchanging information).

114 Dreyfuss, *supra* note 82, at 1165.

115 *See id.* at 1169–82 (discussing a number of examples where private agreements failed, either because they were not properly entered or because they were not sufficiently comprehensive).

116 Sean B. Seymore, Note, *My Patent, Your Patent, or Our Patent? Inventorship Disputes Within Academic Research Groups*, 16 ALB. L.J. SCI. & TECH. 125, 150 (2006); Sung, *supra* note 81, at 435; *see* *Ethicon v. U.S. Surgical Corp.*, 135 F.3d 1456, 1460 (Fed. Cir. 1998) (litigation concerning joint inventors).

lead to the underutilization of a valuable creation.¹¹⁷ A prime example concerns the dispute over rights related to the identification of the AIDS virus. Two prominent scientists at the National Cancer Institute and Pasteur Institute exchanged virus samples, a common form of collaboration in their field.¹¹⁸ Their work led to the discovery of the AIDS virus, creating the possibility for highly profitable research into diagnostic tests and vaccines for AIDS.¹¹⁹ Resulting disputes over patent and attribution rights, however, drained precious scientific resources into litigation and delayed critical research in these areas.¹²⁰

All of these effects also impact the common culture around collaborative research, such that even those who may be personally unaware of joint creator laws now operate in an atmosphere shaped by the doctrine. The effect of a general culture of concern around collaborative work is documented in reports that reveal the negative impact of apprehension around joint creator rights on scientific researchers and authors.¹²¹

The deleterious effect of joint creator law on collaboration is likely to have the greatest negative impact on small firms, start-up entities, and certain university-based creators. Large firms are generally more sophisticated in handling intellectual property rights and will often have sufficient in-house expertise to attempt to avoid most problematic effects of joint creator law. Small firms, start-ups, and university creators who act more independently, however, often will lack this expertise and are more likely to fall victim to the disincentive effects of joint creator law. This effect is particularly problematic for innovation, because research indicates that smaller and start-up entities are more likely to develop more dramatic innovation than larger, more established firms.¹²²

The negative effects of current joint creator laws are impossible to quantify, but both the evidence discussed above and the recent rise

117 Dreyfuss, *supra* note 82, at 1165, 1176–77; Sung, *supra* note 82, at 435–38.

118 Dreyfuss, *supra* note 82, at 1173.

119 *Id.* Their discovery of the AIDS virus may have occurred as the result of inadvertent cross-contamination of the samples. *Id.*

120 *Id.*

121 See, e.g., J.S.G. Boggs, *Who Owns This?*, 68 CHI-KENT L. REV. 889 (1993) (discussing issues of joint creator interaction and rights); Kenneth D. Sibley, *Collaborative Research*, in *THE LAW AND STRATEGY OF BIOTECHNOLOGY PATENTS* 137, 138 (Kenneth D. Sibley ed., 1994) (noting that issue of inventorship is a “constant source of confusion” for collaborative team work); see also Sung, *supra* note 82, at 435–38 (discussing how the law of joint inventorship has led to anxiety among researchers about exchanging information).

122 André van Stel et al., *The Effect of Entrepreneurial Activity on National Economic Growth*, 24 SMALL BUS. ECON. 311, 313 (2005).

in joint creator litigation demonstrate that the problems are real. Much collaboration still takes place in both science and the arts, but we do not know how much more collaboration would occur, or how much more valuable such collaboration would be, under a superior intellectual property regime.

One potential solution to the disincentive effects of existing joint creator law would be to break away from law's customary all-or-nothing outcome strictures in order to implement doctrine that provides for equitable allocation of rights in joint works and joint inventions based on each author or inventor's contribution. Allocating joint creator rights in proportion to each collaborator's contribution would produce outcomes that are both more equitable and more efficient in promoting collaboration and the production of collaborative works.¹²³

Although it is not the norm, equitable apportionment has a small foothold in international intellectual property law. Japan awards damages in copyright infringement lawsuits to co-authors in proportion to their contribution to a work.¹²⁴ Japanese patent law remains somewhat unclear as to whether it follows the same rule.¹²⁵ British courts have sometimes taken a similar approach, occasionally awarding joint authors unequal shares in a joint work, based upon the scope of each individual's contribution.¹²⁶

Equitable allocation could have many benefits for potential collaborators, actual collaborators, and society at large. These allocation rules could reduce transaction costs *ex ante* by providing a more mutually acceptable status quo, thereby reducing the need for and costs of private negotiation.¹²⁷ Such rules could also reduce transaction and litigation costs *ex post* by filling unrecognized gaps in agreements.¹²⁸ Part of the rise in litigation over joint rights has included numerous cases in which a contract had been negotiated, but turned out to be incomplete after the fact.¹²⁹ Importantly, improving allocation rules not only advances social welfare directly, but can create an environ-

123 Mandel, *supra* note 4, at 290; see Dreyfuss, *supra* note 82, at 1220 (recommending new statutory category of work besides works for hire and joint authorship, termed "collaborative work," that would provide proportional rights).

124 Copyright Act, Act No. 48 of 1970, art. 117 (Japan).

125 Mary LaFrance, *A Comparative Study of United States and Japanese Laws on Collaborative Inventions, and the Impact of Those Laws on Technology Transfers*, 2005 INST. INTEL. PROP. BULL. 86, 90.

126 See, e.g., *Fisher v. Brooker*, [2006] EWHC (Ch) 3239, [98] (Eng.).

127 Dreyfuss, *supra* note 82, at 1166.

128 *Id.*

129 *Id.* at 1169–82.

ment that will optimize incentives for collaboration, as opposed to the current environment of concern about losing one's rights, and such an environment should lead to greater creative accomplishments and more advanced innovation and artistic expression.¹³⁰

IV. LARGE-SCALE COLLABORATIVE CREATIVITY

The psychological and legal issues concerning differing cognitive thought processes, motivation, and collaboration intersect in an area that is crucial to creativity at the forefront of human knowledge: large-scale collaborative creativity. Large-scale collaborative projects can take place within a single entity, across multiple organizations, or among a globally dispersed collection of individuals and groups. As discussed above, advances in the sciences and the arts render large-scale collaboration increasingly important because no single individual may possess the knowledge necessary to identify or solve desired problems. Scientific research to a great extent, and artistic endeavors in many cases, have become significantly large-scale collaborative creativity enterprises.

Understanding creativity in large-scale collaborative projects, and therefore how to enhance creativity in such circumstances, presents a complex challenge for both psychology and the law. Psychological theories of creative motivation generally were developed in the context of individual and small-group environments.¹³¹ In these contexts, the theories of intrinsic motivation discussed above generally suffice. For large-scale collaborative efforts to operate, however, it is necessary that some form of external organization, often involving hierarchy and formal coordination requirements, be in place.¹³² These extrinsic structures and controls are often antithetical to creativity. Exacerbating this challenge, in many large-scale settings, individual creative contributions will usually be interdependent and often may not be differentiable, factors that again raise challenges for how to achieve desirable intrinsic motivation.¹³³

130 Rules of equitable apportionment could be developed judicially, without the need for legislative action. Nothing in the Patent Act or Copyright Acts precludes equitable allocation. Mandel, *supra* note 4, at 355. For a fuller discussion of equitable allocation and of several potential concerns with its implementation, see *id.*

131 Paul S. Adler & Clara Xiaoling Chen, *Beyond Intrinsic Motivation: On the Nature of Individual Motivation in Large-Scale Collaborative Creativity* 3 (Sept. 2009) (unpublished working paper) (on file with the *Notre Dame Law Review*), available at <https://msbfile03.usc.edu/digitalmeasures/padler/intellcont/BEYONDINTRINSICMOTIVATION-1.pdf>.

132 *Id.* at 3–4.

133 *Id.*

The motivational challenge of large-scale collaboration is how to produce intrinsic motivation among contributors while at the same time convincing them to embrace the extrinsic organizational controls and constraints that are necessary to achieve the larger project objectives.¹³⁴ Solving this puzzle is a challenge that psychologists have only recently begun to investigate.

The most extended form of large-scale collaboration may be “open and collaborative peer production,” which refers to efforts undertaken by vast networks of individuals working towards a common goal.¹³⁵ Peer production networks may be widely dispersed geographically and the individuals involved may not even know each other. The software industry, for example, is one field that often requires large-scale collaborative creativity. Much modern software production involves large numbers of code developers working together in some form to produce a single software application.¹³⁶ Whether as part of a large software company or in open and collaborative peer production, success in this context requires both that contributors be individually motivated to complete their particular tasks and externally mindful of how to coordinate their contribution to fit into the overall project.¹³⁷ This type of large-scale collaborative creativity is necessary or useful in diverse fields beyond software, including pharmaceuticals, motion pictures, music, and biotechnology.¹³⁸

The rise of large-scale collaboration increases the potential for different individuals or groups to be responsible for different aspects of a creative task. These responsibilities can be divided in different manners, such as by differentiating among problem-finding and problem-solving tasks, or among divergent and convergent thinking aspects of a project. In a more hierarchical research team organization, for example, a team leader may be more responsible for problem-finding type creativity, identifying the problem that team will work on.¹³⁹ The team leader, however, may engage in relatively less problem-solving, leaving those aspects of the project to individuals

134 *Id.*

135 YOCHAI BENKLER, *THE WEALTH OF NETWORKS* 1–8 (2006); Arti K. Rai, “Open and Collaborative” Research: A New Model for Biomedicine, in *INTELLECTUAL PROPERTY RIGHTS IN FRONTIER INDUSTRIES* 131, 131–34 (Robert W. Hahn ed., 2005).

136 Adler & Chen, *supra* note 131, at 5.

137 *Id.*

138 BENKLER, *supra* note 135, at 59–90 (discussing peer production in software, information, and other contexts); Rai, *supra* note 135, at 140–45 (discussing open and collaborative software, database, and biomedical peer production); Adler & Chen, *supra* note 131, at 4–5.

139 Grit Laudel, *Collaboration, Creativity, and Rewards: Why and How Scientists Collaborate*, 22 *INT’L J. TECH. MGMT.* 762, 765–66 (2001).

who conduct experiments or try to execute and implement conceptual ideas.¹⁴⁰ Successful overall efforts will require the collaborative integration of the problem-finding and problem-solving aspects of the project.¹⁴¹ In similar regards in other collaborative contexts, the divergent and convergent aspects of a project may be divided among different groups of individuals so as to play to each group's cognitive strengths, but the collective effort must be productively integrated in order to produce a successful result.

Drawing on the earlier discussion of motivation and creativity, the success of large-scale collaborative creativity also depends significantly on achieving a form of intrinsic motivation for contributors. In the large-scale collaborative context, this will often require providing an identified regulation form of motivation.¹⁴² Recall that identified regulation lies towards the intrinsic side of the motivation scale and refers to activities that an individual chooses to engage in because the individual identifies with the importance or value of the activity. Although not as ideal as integrated regulation from a creativity motivation perspective, identified regulation describes the situation where an individual identifies with the goal of large-scale collaboration.

This form of identification could occur through multiple psychological pathways. In a more individual context, a high level of interaction in a large-scale project and a high level of interaction with other collaborators could provide the means for identified regulation.¹⁴³ The social context of a large-scale project could also provide the basis for identification. To the extent an individual categorizes himself or herself as a member of a social group engaged in a group project, social identity theory indicates that the individual would also identify importance in the group project.¹⁴⁴ Under either, or both, mechanisms, an individual can identify with group goals in a manner that is expected to produce a more intrinsic form of motivation that is highly valuable from a creativity perspective.¹⁴⁵ Consistent with this analysis, researchers find that the personal satisfaction that peer production participants acquire from their sense of membership in a peer production community is a very important motivator for them.¹⁴⁶

140 *Id.* at 765–66.

141 *Id.* at 777.

142 Adler & Chen, *supra* note 131, at 9.

143 *Id.*

144 *Id.*; Chen et al., *supra* note 102, at 8.

145 Adler & Chen, *supra* note 131, at 9.

146 Eric von Hippel & Georg von Krogh, *Open Source Software and the "Private-Collective" Innovation Model*, 14 *ORG. SCI.* 209, 216 (2003).

These results indicate that the manner of coordination and the perceived relationships among the various contributors will play a significant role in the success of large-scale collaborative efforts. High levels of interaction and interdependence may lead individuals to more closely identify with the group project. Similarly, developing a creative team that views themselves as members of a particular social group can achieve the same result. These teachings may explain the success of certain open and collaborative peer production efforts. To the extent a collection of software designers from around the world perceives themselves to be part of a particular social group, each individual may be intrinsically motivated not only to solve the particular portion of the project that he or she is tasked with, but also to make sure that the individual contribution coordinates successfully with the group effort. Identification with the group can motivate an individual to focus on the collective effort rather than an individual goal.¹⁴⁷ This form of social identification would seem particularly likely in open and collaborative peer production efforts precisely because individuals self-select into the projects and the groups that are working on the projects.¹⁴⁸ It would not be surprising if peer production contributors feel an unusually high level of association with the group and the group's objectives. Peer production efforts may be highly successful because a largely ignored side effect of their organizational design is that it produces a set of collaborators who feel both strong intrinsic motivation with respect to the individual tasks that they choose to tackle and strong identified motivation with regard to collaborative efforts. These effects can combine to produce a fertile environment for creativity in the large-scale collaborative context.

That being said, the teamwork required for large-scale collaboration and the desire for strong social group identification for motivational purposes also pose certain challenges. The necessity of teamwork and desire for social integration can lead in certain circumstances to an excessive focus on convergent thinking.¹⁴⁹ While creativity requires a combination of divergent and convergent thinking to produce something novel and appropriate, collaborative processes tend to lead to a convergence of ideas and can impede thinking "outside the box."¹⁵⁰ This concern has been born out in experimental

147 Adler & Chen, *supra* note 131, at 10.

148 See, e.g., Zimmerman, *supra* note 44, at 36–37 (describing programmers, authors, and artists engaging in peer production efforts that align with their particular interests).

149 Martin Hoegl & K. Praveen Parboteeah, *Creativity in Innovative Projects: How Teamwork Matters*, 24 J. ENG'G & TECH. MGMT. 148, 149 (2007).

150 Chen et al., *supra* note 102, at 6; Hoegl & Parboteeah, *supra* note 149, at 160.

research, revealing that individuals in collaborative endeavors are often afraid to share differing ideas.¹⁵¹ The research indicates that successful collaborative efforts may require periods where individual contributors have time to work on their own, a period more likely to lead to divergent creative thinking, and distinguished periods of collaboration where the group can integrate individuals' work, select preferred options, and decide on future work targets.¹⁵² These results highlight the value in open and collaborative peer production of the time that individual contributors spend working autonomously on their own to develop a contribution to the collaborative project. The model of far-flung contributors working together toward a commonly selected goal may do a surprisingly nuanced job of navigating the fine line between autonomy and control, and between individualism and social connection, necessary for successful collaborative creativity.

Intellectual property law also may work well in the large-scale collaboration motivational context, despite its potential problems as an extrinsic motivator. The prospect of a patent or copyright on the final group output may help to focus individual contributors on a coherent group target, and unify the contributors so that they see themselves more as members of a single group rather than isolated individual contributors. The prospect of an intellectual property reward based on group effort may also increase group cohesiveness, leading to greater collaborative effort.

Experimental research supports this role for intellectual property in large-scale collaborative creativity. In a recent study, psychology researchers sought to understand how a rewards system can optimally incentivize group creativity.¹⁵³ Participants in the study were assigned in small groups to come up with a creative solution to a designated problem.¹⁵⁴ Participants were rewarded based either on the creativity of the group's solution or on the creativity of the individual's input to the group's solution, as judged by independent raters. The reward was also varied between a proportional division based on creativity or a winner-take-all format.¹⁵⁵ The results indicate that intergroup, as opposed to intragroup, rewards led to higher rates of group cohesion and collaboration, and that this led to greater creativity.¹⁵⁶ Intragroup rewards inspired participants to work harder on individual inputs, but these individual efforts did not lead to more creative

151 Hoegl & Parboteeah, *supra* note 149, at 160.

152 *Id.* at 161–62.

153 Chen et al., *supra* note 102, at 1.

154 *Id.* at 3.

155 *Id.* at 3–4.

156 *Id.* at 16–17.

group solutions.¹⁵⁷ In addition, for the participants rewarded based on group creativity, the groups in the winner-take-all format identified with the group objective more than those in the proportional reward format.¹⁵⁸

Thus, group rewards systems can promote group cohesion, collaboration, and group identity, and these in turn can promote group creativity. Ethnographic studies of organizational research methods reach similar results, concluding that rewards based on collective goals and activities that promote collective goals tend to reinforce behavior that promotes collective creativity.¹⁵⁹

Though the intellectual property system may lead to problematic motivational effects at the individual level, it may actually produce valuable motivation at the group level that enhances creativity. By awarding a winner-take-all intellectual property prize to a creative group as a whole, intellectual property law presents a positive model for extrinsic motivation of collaborative creativity. Subject to the critiques of joint author and joint inventor law discussed above, both the patent and copyright systems are designed to achieve desirable types of group rewards from a psychological perspective in the large-scale collaborative creativity context.

157 *Id.* at 4.

158 *Id.* at 18.

159 Hargadon & Bechky, *supra* note 3, at 493.