
Creativity, connections and innovation: a study of linkages in the Montréal Region

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Abstract. The importance of creativity as a driving force in regional economic growth and prosperity has been previously documented; however, the mechanisms of this relationship are less well understood. Earlier research suggests, but does not demonstrate, that high levels of density and creative-class employment create conditions under which innovations generated by the interactions between individuals are more likely to occur. The authors examine the specific interactions among the creative, technical, business, and design communities of the Montréal region. It is demonstrated that such connections are possible and can have a positive impact on the innovative and total business activity across the region. A set of mechanisms through which creativity helps to achieve regional growth and prosperity benefits is demonstrated through specific examples.

Background

The importance of creativity as a driving force in regional economic growth and prosperity has been previously documented by one of us (Florida, 2002a; 2002b; 2002c). However, the mechanisms of this relationship not well understood. Knudsen et al (2003) have shown that innovative activity within a region is positively associated with population density and creative-class workforce, both jointly and separately. The explanation put forth suggests, but does not confirm, that high levels of density and creative-class employment create conditions under which innovations generated by the interactions between individuals are more likely to occur. In this paper we present evidence of these innovation-generating interactions.

Theories of regional economic growth have stressed the importance of the role played by technological spillovers (for example, see Arrow, 1962; Glaeser et al, 1992; Jacobs, 1969; Marshall, 1890; Porter, 1998; Romer, 1986). The interactions created by the combination of density with size and diversity within cities accelerate and magnify this spillover process (Duranton and Puga, 2000; Glaeser et al, 1992; Jacobs, 1969; Knudsen et al, 2003). Recent research has demonstrated the importance of human capital in regional innovation (Lucas, 1988; Zucker et al, 1998). In ‘creative-capital theory’, one of us (Florida, 2002b) has claimed that it is the density not only of human capital, but of those whose occupations have a creative component, that is primarily responsible for innovation and, subsequently, growth. Although density and diversity are known to have a positive impact on regional innovation, these earlier findings rely on unseen and undocumented interactions for the generation of spillovers.

The standard approach to understanding the positive impact from spillovers is to investigate knowledge spillovers between firms in an industry (Arrow, 1962; Romer, 1986). Marshall (1890) applies this thinking to cities, and posits that industry and city growth are positively impacted by the knowledge spillovers generated by high

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concentrations of an industry in a city. Porter (1990) adds that local competition within the concentrated industry cluster drives more rapid generation and adoption of innovations. Unlike Porter's and Marshall's approaches, Jacobs (1969) posits that it is knowledge transfers across industries, and even sectors, which are the most important source of innovation. In this case diversity and proximity, rather than specialization and concentration, drive innovation and growth. In a comparison of these three models—Marshall–Arrow–Romer, Porter, and Jacobs—Glaeser et al (1992) found that “inter-industry knowledge spillovers are less important for growth than spillovers across industries, particularly in the case of fairly mature cities” (page 1151). Duranton and Puga (2000, page 553) found that “the link between innovation and density seems fairly robust”.

Existing literature has demonstrated the links between knowledge-producing inputs, outputs, and knowledge spillovers (Jaffe, 1986) and it has been noted that a significant fraction of spillovers affecting a firm's innovative activity come from other firms. According to Feldman (2000), demonstrating that knowledge can spill across firms at all, especially across firms in close technological proximity, means that there is a credible possibility that geographic proximity can also mediate these spillovers. Thus, recent literature has added a geographic element in an attempt to measure “the geographic impact of knowledge spillovers on innovation” (Feldman, 2000, page 374). Audretsch and Feldman (1996) present key findings in this line of research. They found that, even after controlling for the concentration of production, innovation is still concentrated close to the source of the new knowledge. This suggests that these spillovers have a geographic limitation. Glaeser provides intuition for this effect when he notes that “The [externality] kind of [nonmarket] interaction even more strongly depends on spatial proximity. In many cases, these effortless transmissions of ideas and values depend on sight or hearing... Obviously, the ability to see or hear depreciates sharply with space” (2000, page 103). The important insight from this train of research is that the geographic proximity of knowledge-producing inputs influences the knowledge flows that are responsible for innovation. But, little empirical attention has been paid to the mechanisms that produce the spillovers. We next describe literature that concerns these mechanisms.

Zucker et al (1998) discussed how intellectual human capital is a means by which geographically mediated spillovers are realized. They demonstrated empirically that the localization of intellectual human capital (embodied in ‘star’ biotechnology scientists) is predictive of the localization of new biotech start-up firms. Feldman claimed that “This work demonstrates that localized intellectual capital is key in the development of the bio-tech industry and that knowledge generates externalities that tend to be geographically bounded within the region where the scientists reside” (2000, pages 380–381). Thus, whereas the first strain of literature suggested that geographic proximity is important in that it promotes the spillovers necessary for innovation, this research suggests that it is the skills and knowledge embodied in individuals which are the mechanisms by which these spillovers actually occur.

This is taken one step further when we look at the work of Lucas (1988, page 38), who reasons that it is the interactions between individuals with high human capital that facilitates spillovers and the growth of knowledge. He continues by saying that these interactions are so important that people are willing to pay extremely high land rents in order to be close to other people, and thus to benefit in terms of learned knowledge and increased productivity.

Thus, the knowledge transmission and learning that precedes innovation is geographically bounded if, given the often tacit nature of the knowledge responsible for innovation, the knowledge-producing sources must be proximate to enable the

spillovers to occur. The mechanism enabling these spillovers is the intellectual human capital and knowledge embodied in individuals and, according to Lucas, specifically, the interactions amongst these individuals. Whereas earlier work was focused on the importance of spillovers between firms as the important driver of regional growth, more recent findings have shown the importance of the connections between individuals and have suggested that the diversity of those connections is a more important factor. The encounters that create these individual connections are more likely to occur in a region with higher density.

A working hypothesis arising from this literature is that the geographic proximity of individuals possessing human capital, skills, expertise, or creative capabilities enables their interactions, and these interactions facilitate the spillovers necessary for innovation. In a working paper, Autant-Bernard and Messard (2001) partially test this theory with the aid of a French data and find a positive connection between density of human capital and regional innovation. Knudsen et al (2003) recently considered the effect of the density of creative capital, as opposed to human capital, and also found a positive relationship with innovation measured as regional patents. Innovation and growth are not singularly institutionally or firm focused.

Thus far, we have discussed in detail how geography, human capital and creativity, and interactions relate to spillovers and learning, but we have not described specifically how these various factors (spillovers included) relate to innovation.

In *The Economy of Cities*, Jacobs (1969, page 57) defines innovation as the process by which new work is added to old divisions of labor, thus creating new products, processes, or ideas, and thus also new divisions of labor. Feldman adds that “innovation is the novel application of economically valuable knowledge” (2000, page 373). In other words, innovation is a process of creating new, profitable products and ideas by incorporating observations or insights taken from elsewhere into the work one had previously been doing (Desrochers, 2001, page 378).

Building on this definition, innovations occur when individuals with high degrees of existing knowledge make novel and creative combinations of this knowledge with new insights observed or learned through spillovers (Desrochers, 2001). Individuals require a high degree of existing expertise to engage in innovation for a number of reasons. First, an extensive and sophisticated knowledge of the current work will provide insights into how to create new combinations when new observations arise through spillovers. Clearly, if one has only a superficial knowledge of the initial, current, work it will be less obvious how to make interesting departures from that work or important additions to it. Cohen and Levinthal (1994, page 227) note how this phenomenon exists at the firm level, referring to a firm’s ability to leverage its installed base of expertise to sift through and take advantage of the signals it receives from the outside as the firm’s ‘absorptive capacity’. Additionally, Desrochers suggests that “...innovation ultimately depends to some degree on one person’s knowledge and skills” (2001, page 370); and Lee (2001) has empirically documented the positive effects of high human capital workers on innovation. Thus, the ideas necessary for innovation are embodied in individuals with the creativity, know-how, and skills to engage in technological advance.

In dense cities, scientists and engineers, artists, writers, and people from all walks of life are forced together and ‘rub shoulders’. For the scientists and engineers, being near people of similar capabilities and expertise increases their own productivity through spillovers: together they come up with ideas that they would not otherwise have generated. Additionally, the general creative milieu of a place with a prominent presence of artists, musicians, and other creative people increases overall creativity and innovation by providing stimulus and inspiration for those who actually produce innovations (Florida, 2002c). The idea here is that all creative people—artists, writers,

scientists and engineers, etc—work best in an environment that promotes and rewards creativity. The presence of this creative milieu also acts as a regional attraction for scientists and engineers. The roles of density and diversity in all of this are to compact all of these people into a space where they collide and, hence, where these important interactions and spillovers can occur.

Our goal in this paper is to document some specific spillovers, and even ‘spillacrosses’ to show the positive effects of these connections and to demonstrate that it is the diverse creative milieu that can give rise to innovation and, through that, regional growth and prosperity.

Montréal background

The study was conducted through a series of focus groups and interviews with individuals from the business, education, arts, and government sectors of the Montréal region. The Montréal region is defined by Statistics Canada (2004) as the Montréal Census Metropolitan Area, and includes the entire Montréal metropolitan area.

The Montréal region is ideally suited for this study for a number of reasons. First, among the twenty-five most populous metropolitan areas in the USA and Canada, the Montréal region ranks third in average population density (behind the Boston and New York Consolidated Metropolitan Statistical Areas). Among that same group of regions, the Montréal region has the second greatest percentage of its workforce in the ‘super-creative core’, defined to be those with occupations in the following fields: computers, mathematics, architecture, engineering, life sciences, physical sciences, social sciences, education, training, library, arts, design entertainment, and media (Florida, 2002a, page 328). This combination of density and diversity increases the probability of significant findings. The authors’ relationship with Culture Montréal created an opportunity for unparalleled access across all sectors of the Montréal economy. (Culture Montréal is an independent nonprofit organization that promotes culture as an essential element of Montreal’s development, and helped to fund this study.) With its worldwide renown for the arts, and international festivals ranging from jazz to fireworks, Montréal exudes creativity, and is an environment in which technology, design, and the arts can all interact.

Montréal’s location places it equidistant between Europe and the West Coast, with easy access to all the major population centers both in the USA and in Canada. As one interviewee put it:

“In the morning I can talk to London and after lunch, LA . . . In the same six hours, I can fly to either Paris or Los Angeles.”

In addition, as the only major metropolitan area in the USA and Canada that is predominately bilingual, and somewhat multilingual, the Montréal region offers a unique setting in which to investigate the innovative impact both of language and of cultural connections. The region is also the most diverse in Canada in terms of number of industries, which means that there are greater opportunities for interesting connections to arise (Beckstead and Brown, 2003).

Table 1 shows a comparison of the workforce among the creative, service, working, and farming/agricultural classes, as defined by Florida (2002a), for the Montréal region, the province of Québec, Canada, and the United States. (Among the farming/agricultural workers, only those who are working in that sector for a company are included: the self-employed are not reported in any of the four classes.) In addition to a breakdown of the workforce, the percentage of total wages earned by each class is also presented. The Montréal region has a larger percentage of creative and service workers, with fewer working class, which includes manual manufacturing and construction workers, than the province as a whole or either country.

Table 1. Montréal, Québec, Canada: workforce breakdown.

	Sector			
	creative	service	working	farming
<i>Montréal</i>				
Total number	450 200	771 900	377 900	3 300
Percentage of workforce	28.8	49.4	21.6	0.2
Percentage of total wages	40.6	36.9	22.3	0.2
<i>Québec</i>				
Total number	1 008 198	1 686 223	863 430	86 535
Percentage of workforce	27.7	46.3	23.7	2.4
Percentage of total wages	41.2	35.3	21.8	1.7
<i>Canada</i>				
Total number	4 361 905	7 161 625	3 518 560	534 480
Percentage of workforce	28.0	46.0	22.6	3.4
Percentage of total wages	42.1	34.1	21.4	2.3
<i>United States</i>				
Total number	32 313 140	47 334 940	24 344 420	235 790
Percentage of workforce	31.0	45.4	23.4	0.2
Percentage of total wages	49.6	30.3	20.0	0.1

Theory, methodology, and hypotheses

As the literature review shows, density and diversity work together to create spillovers within a city or region. However, whereas traditional economic approaches have centered on the interaction between firms, more recent results point to the role played by individuals—specifically, high human capital or creative individuals—interacting with each other in generating innovations and spillovers across a region. Knudsen et al found that “density and creativity [specifically the creative class] separately and jointly affect innovation in metropolitan areas” (2003, page 1). The ‘creative class’ includes a significant level of diversity within itself, ranging from mathematicians to sculptors to engineers to artists to educators to designers to doctors. Density, on its own, only increases the likelihood of chance encounters among these diverse individuals which lead to connections that create innovations and spillovers. The question is: do these diverse individual connections exist and, if yes, do they generate innovations and new combinations? More specifically, what kinds of potentially beneficial connections are most likely to be formed? And, can we find evidence of these ‘unexpected’ connections that are only possible in the context of such diversity?

Given that the Montréal region is the area for this study, the search for previously undocumented connections can be pursued in two ways. The first is to look for ‘unexpected’ connections that might arise in Montréal but could also, just as easily, arise in any other major metropolitan area. The second is to look for connections that are likely to be unique to the Montréal region. Finding either will provide evidence of the value of such connections. Whereas the first type may indicate benefits that can accrue to any region, the second type are likely only to be applicable to Montréal.

The scope of the study was as follows. Our area of interest was specifically limited to the creative class. Although this is still fairly broad in nature, it is restricted to those individuals who create value through and are compensated for their thinking. The primary area of interest is the ‘super-creative core’ (Florida, 2002a) whose members are not all individually generating innovation but who, as a group, are the source of most innovation. The item of interest is the connections that may create innovations and spillovers. These connections exist among individuals, do not necessarily create

equal benefits to those involved, but should be, in some way, beneficial to all parties. In particular, it is the ‘unexpected’ and previously undocumented connections that are of the most interest, specifically, connections that are only possible under conditions of diversity. Interfirm technological spillovers are well understood and documented (see Arrow, 1962; Jacobs, 1969; Marshall, 1890; Romer, 1986; Saxenian, 1994). In this study we look for previously ignored interactions to develop a fuller understanding of the mechanisms by which innovations can be generated.

The process used to identify potential connections within the Montréal region started with focus groups. Groups of up to ten individuals from across the business, education, arts, and government sectors of Montréal were led through a parallel-thinking technique (DeBono, 1985) focused on a specific area of the Montréal creative economy. The number of participants by sector and topic area is shown in table 2. The information from these focus groups was captured, codified, and categorized. This approach allowed the categories to emerge from the data collected, without imposing the expectations of the researchers. The results of the focus groups were then synthesized to develop a theoretical perspective which could be used to investigate those connections that created innovation and spillovers within the Montréal region more fully. This perspective was used to develop a survey instrument which was used to complete a series of open-ended interviews.

Table 2. Focus-group participants by sector.

	Number of groups	Sector			
		business	education	arts	government
Montréal overview	1	4	1	5	0
Technology	2	6	5	5	4
Talent	2	4	5	5	3
Tolerance and diversity	2	4	6	4	5
Territory assets	2	6	4	6	4

Theoretical framework

From the existing research, we can draw the following conclusions (or, at least, stylized ‘facts’). First, the geographic proximity of individuals possessing human capital, skills, expertise, or creative capabilities enables their interactions, and these interactions facilitate the spillovers necessary for innovation. Second, innovation occurs when a person possessing creativity combines his or her existing expertise with observations learned through spillovers. These creative spillovers are in part believed to arise because of frequent face-to-face interactions and communication between individuals. These interactions are more frequent with increased population density. Third, for scientists and engineers, being near people of similar capabilities and expertise increases their own productivity through spillovers: together they come up with ideas which they would not otherwise have generated. Additionally, the general creative milieu of a place with a prominent presence of artists, musicians, and other creative people increases overall creativity and innovation by providing stimulus and inspiration for those who actually produce innovations.

Together, earlier research, our own work, and the findings from the focus groups suggested three new areas where connections creating spillovers leading to innovation might be found. The first is the connection between technology (traditional or high-tech business) and the artistic, creative, community: it is not only the impact of technology on the arts, but also the potential impact that the arts may have on technology which should be investigated. The second area is a direct result of the bilingual nature of Montréal: the prevalence of the French *and* English languages, and the ability of a

significant portion of the population to speak both, create a unique opportunity for linguistically related innovation, for example, multilanguage software or automatic-translation services. The third and final area where connections could be found relates to Montréal's geographic and cultural position. Montréal is among the closest (by air) major North American cities to Europe and affords ready access to the major US population centers in the northeast. This physical proximity should enable multinational connections across which ideas and innovations could flow.

Interview survey and protocols

Based on the potential connections identified above, a structured-interview instrument was developed. The instrument itself was in five sections:

- (1) basic information about the interview and interviewee segment or sector;
- (2) demographic information;
- (3) specific, sector-based questions (only one subsection per interview):
 - (a) for creative companies (arts and design),
 - (b) for the general business community,
 - (c) for others (nonprofits, government, academic);
- (4) interviewee perceptions of the Montréal region;
- (5) firm information (collected where appropriate).

The majority of the interview consisted of open-ended questions concerning the impact and value of various connections, as perceived by the interviewee. In addition, quantitative information was also collected on the value of various types of connections, the interviewee, his or her firm, and his or her perceptions of the Montréal region. Each interview generally lasted one and a half hours. The interviews were recorded, with the interviewee's permission, but each interviewer also took extensive notes on the interview form itself. Two visual aids were shown to each interviewee. The first was the seven-point Likert scale that was used for most of the quantitative questions, and the second was a list of ten cities which was used to rank the Montréal region for the 'perceptions' section.

Over 85% of the interviews were conducted in person, with the remaining interviews conducted by telephone. All telephone interviews fell into the 'other' category and were used only for quantitative information. Three interviewers, all well versed both in the background to and in the purpose of the study and proper interviewing and data collection techniques, completed all the interviews. All interviews were conducted in English. However, a representative from Culture Montréal was present: he introduced the research methods and goals (in French), and was available for translation assistance, which was rarely needed. After the introduction, he remained as a silent observer and only spoke when asked for translation assistance by the interviewee.

Care was taken in selecting potential interviewees from across the creative milieu of Montréal. The goal was to interview at least fifteen people from the artistic and design community and fifteen people from the business community. Five not-for-profit arts and design organizations and fourteen non-design businesses along with ten for-profit design firms that overlapped both categories resulted in fifteen arts and design and twenty-four business-community interviews. Five interviews from the government and academic sectors were used primarily for additional perspectives and to provide quantitative information. All interviews were arranged by a representative of Culture Montréal. Culture Montréal was incredibly persistent and was able successfully to arrange interviews with over 90% of the people initially targeted and contacted. All interviews were conducted in June and July of 2004 and were held at the interviewee's location or an alternative location in Montréal.

Results

Thirty-four interviews were completed. Most were with representatives from individual for-profit firms, which ranged from purely creative-based or arts-based business to design and software development to technology companies. Table 3 shows the breakdown of interviews by economic sector and primary function or segment of the firms. On average, the interviewees had been living in Montréal for 15½ years (range 2–35 years).

Table 3. Numbers of interviews from firms by type (economic sector) and primary function.

Economic sector	Primary function				
	creative/arts	business/technology	design	other	total
For-profit firm	3	11	8	0	22
Academic	0	2	1	2	5
Government/civic	0	0	0	3	3
Arts/cultural	2	1	1	0	4
Total	5	14	10	5	34

Interviewees were asked to rank the Montréal region among a list of ten similarly sized US and Canadian cities separately for performance and standing in technology, talent, tolerance and diversity, and territory assets or quality of place. They were also asked to give their overall impression of or feeling about the Montréal region in each of those same four areas. The ‘high-level creative economy’ perceptions of the interviewees did not differ greatly from more objectively defined and collected measures.

On the basis of the hypotheses presented above, interviewees were asked their opinion of the impact of various connections. The specific connections inquired about varied according to the interviewee’s sector and segment. Specifically, interviewees were asked about the impact of connections between:

- (1) the arts and technological innovation,
- (2) the arts and the design community,
- (3) the arts and the general business community,
- (4) the design and business communities,
- (5) Montréal and Europe,
- (6) Montréal and the United States,
- (7) the French and English languages.

Table 4 presents a summary of these results. Generally, interviewees felt that the impact of these various connections on their organizations was ‘somewhat positive’ to

Table 4. Impact ranking of selected connections.

Connection	<i>N</i>	Average score ^a (1–7)	Range
<i>Asked by sector/segment</i>			
Art–technology	10	6.1	5.5–7
Art–design	11	5.6	4–7
Art–business	23	5.6	4–7
Design–business	18	5.4	4–7
<i>Asked of all interviewees</i>			
Europe–North America	29	5.6	2–7
Montréal–USA	29	5.6	3–7
Language connections	29	5.6	2–7

^aLikert scale: 1—extremely negative, 7—extremely positive.

'very positive'. The highest average impact was between the arts and technological innovation, and the lowest, though still above 'somewhat positive', was between the design and business communities. In general, these results are in line with the hypotheses: in addition to the typical (firm-to-firm) spillovers, additional value is perceived to be generated by further reaching 'spillacross' facilitated by a diverse creative milieu. Although the sample is not very large, most interestingly, the greatest average impact was perceived to come from connections between art and technological innovation. This was seen from the perspective both of the high-tech innovator and of the independent artist: it was *not* the case that one set of interviewees (say, the artists) thought this connection was valuable whereas the other (say, high-tech companies) did not see any significant impact from this connection.

In addition to the previously discussed survey-based, semiquantitative data, a great deal of information on specific connections and both positive and negative examples of organizational impacts were collected via open-ended questions. After all the interviews had been completed, a review by the three people conducting interviews, including the primary author of this paper, was held to discuss the results, refine hypotheses, and cull specific positive and negative examples for inclusion in this paper. The general expectation of value being generated from nontraditional, unexpected connections, especially among the connections between the arts, design, technology, and business communities, was confirmed. However, the results of the interviews also revealed that the geographic and language connections, although generally judged to have positive impacts, did not properly capture all the nuances of the situation in the Montréal region. In reviewing the comments made both about the geographic and about the language connections, it became apparent that these more specific connections were, in fact, being understood to represent a much more general set of cultural connections. Numerous interview participants pointed out that, although linguistic and geographic connections may play a role, the broader cultural connections, with both Europe and the USA, are more important. As one interviewee put it:

"Montréal has a culture that is both European and American. We have the laid-back attitude of the French and the Italians along with the organization of the English and Germans that works so well with the US."

And a software-development executive put it as follows:

"We develop products that we can sell in both the USA and Europe because we understand them both."

Having analysed the results of the interviews, some revision of our original hypotheses was necessary. Although connections between art and technology are generating innovations and value for the region, the more detailed geographic and linguistic connections needed to be recast more broadly in terms of cultural connections in order to understand more fully the mechanism through which value is being created for the Montréal region.

We now give specific examples that demonstrate the ways in which these previously uninvestigated connections have generated spillovers and spillacrosses for the resident firms and individuals of the Montréal region. These examples focus on two areas: the value-generating connections between the arts and business or technology, and the value-generating cultural connections which stem from the unique cultural position the Montréal region occupies. Although these last are certainly unique to Montréal, the connections between the arts and business or technology are of the type that could generate value for any region.

The examples selected are only some of those identified during the interviews; we have tried to select a diverse sample from among the connections identified.

As the interviews also made apparent, these connections did not necessarily always generate positive outcomes; negative aspects identified are also included.

Art – culture ↔ technology connections, confirming examples

Of the thirty-four interviews completed, twenty two were with individuals from for-profit firms. The firm size ranged from three to over 6000, with an average of 555 and a median firm size of eighty-three employees. Among these twenty-two firms, on average, respondents estimated that a remarkable 49% of their employees had an “[outside] part-time job, hobby or passion related to arts, design, or culture”. Although creative and design firms were included in the sample, so too were the major aerospace technology manufacturing companies in the Montréal region (Bombardier, and Pratt and Whitney), along with consulting, information technology development, architecture, and design companies, as well as some from other industries.

Many interviewees mentioned how the artistic and cultural environment of the Montréal region helps to attract technical talent. Thus Bombardier has hundreds of young technical employees who live in the city because of the nightlife and affordability, and interviewees from other companies cited the same energetic atmosphere of Montréal. Reaching outside the firm to establish connections is an important option for employees, as was recognized by Discreet, an entertainment technology software developer. Discreet cultivates a bottom-up engineering-development environment through academic internships, and uses the ‘soft’ cultural aspects of the Montréal region’s clubs and art scene to get potential employees ‘stuck’ in the region. In this way, the entire creative milieu helps attract and retain these highly sought-after employees.

Equally important as having a region with the creative milieu that allows employees such pursuits is the ability of a firm to tap into its own employees’ creative energies. Occasionally, a firm will lose an employee when his or her ‘outside’ job becomes successful enough that the ‘day’ job is no longer needed. Rather than being perceived as a problem by the firm, several firms mentioned that they use success stories like these as a recruiting tool to help attract new talent. One local marketing company goes so far as to give its own employees grants of up to \$50 000 to develop and pursue their own creative or artistic opportunities after hours. The company produces the events and items, but the individuals profit from them. The company says that 50% of its staff are artists, and sees this as a way to not only retain its creative staff but also to provide them with an opportunity to learn something new which can be applicable to their work.

Such art – technology – business synergy occurs not just within companies but also between them, and between companies and outside individuals too. The interviews yielded countless examples of companies (small and large, but mainly smaller) using outside, independent, design firms and independent workers of all types: “Innovation uses a lot of subcontractors”, said one interviewee. For instance, the game designer A2M, hires local artists, both visual and musical, to help develop its software. This “adds creative depth” to a company, in the words of another interviewee. It also creates a market for independent design that allows people to pursue their passions, and occasionally get paid for them; in Montréal, “artists work for themselves first, then for a company”.

Specific examples of connectivity between the art, technology, and business worlds were too numerous for all of them to be mentioned here, but a representative sample will help to paint a picture of the Montréal region’s interdisciplinary connections.

Select Montréalers have long excelled in filmmaking-related fields. In the 1980s, the National Film Board (NFB) of Canada provided funding for a short film, *The Hunger*, made completely with CGI (computer-generated imagery). Production of this film prompted the development of rudimentary software to create computer-generated ‘realistic’ three-dimensional characters. This software then became the basis for Soft-Image, which took the basic ‘engineering-based interface’ (all numbers) and developed an ‘artist-based interface’. The first major commercial use of SoftImage software was in the film *Jurassic Park*. In the meantime, CRIM, a research center for computer technology, partnered the NFB to develop a search engine for audiovisual materials.

Kino is a loose organization of independent filmmakers who craft and show short films, which works with a local provider of digital imagery equipment. The business owner loans equipment to the filmmakers, who then provide feedback on the equipment—its strengths and its limitations. Kino also provides an opportunity for individuals to learn the skills needed by professional production companies in film and television. Individuals are able to build their portfolio and skills, which positions them to apply those skills in employment. Kino enables and supports the training of new imagery technology and techniques that are later applied for commercial use.

Ex Centris develops technology for digital film delivery. Their DigiScreen product is designed to provide a high definition, digital movie-theater experience at an affordable price. Traditionally this conversion has been very expensive, and even digital movies need to be distributed via actual film prints. Digital projection supports nearly instantaneous distribution on demand, reduces distribution costs, and dramatically changes the access that independent filmmakers have to movie theaters. In a similar vein, D-Box is now working on a high-speed, robotic chair for a home-theater research project with Gary Mace, the LA-based music composer, to advance the concept and richness of the surround-sound experience in theaters.

Completing the film production, distribution, and promotion loop is another Montréal start up, Pixman (see <http://www.pixman.com>), which describes itself as technology for “nomadic advertising”. First used to promote the Montréal Independent Film Festival, Pixman has since shown up in cities around the world for uses ranging from fashion shows to promotion of Nintendo’s latest video games. The Pixman concept started as art—almost performance art—and has since been developed for commercial use.

One of Montréal’s most famous exports is Cirque du Soleil. Cirque serves as one of the best examples of the city’s technology–art interface, defining itself not as a circus company, but as a creative-content provider. In fact, they employ more engineers than performers in the Montréal region. Cirque has one of the largest R&D operations in the region. Consider the millions spent to develop the technology used for “O” at the Bellagio or for “Ka” at the MGM Grand in Las Vegas.

Cirque’s basic R&D is conducted in three areas: biomechanical, rigging, and general. Ideas can come from anyone, anywhere. All development is done in-house; the only production element that Cirque outsources is set construction. The R&D division within Cirque completes about 35% of the development of any new technology and then makes all possible new ideas available to a show’s Creative Director. When the Creative Director decides he or she wants to use a particular item, setup, or technology in a show, it is developed fully. The technology must serve the artist or performer, who is always foremost in any Cirque show.

Through similarly ambitious cross-fertilization, TOHU–Circus City brings together the greatest numbers of material and human resources in the world to create, form, broadcast, and produce circus arts. It also serves as a model for sustainable

development by utilizing green design and reused materials. Based around the second largest landfill in North America, TOHU–Circus City has been established as a showcase for community development and technology transfer.

High-powered art and entertainment industries naturally create other business opportunities around them. Admission, now part of TicketMaster, was a spin-off of Cirque du Soleil and was the first in web-based ticket sales. They invented the e-ticket for show business in 1999 to meet the demand from the success of the regional circus and arts industries. Admission referenced the demand by the arts and cultural community for their services as one of the early drivers of their success (arts and nonprofits were their key customer market).

M2C1 is a design firm involved in a wide range of international projects, including many large-scale public and museum exhibits. Their design strategy is quite different from Cirque's in that they function essentially as a general contractor and outsource nearly all of their work. As a result, they interact with a wide cross section of Montréal's design, industrial, and technology communities. For example, they used a Montréal technology company to assist in the design of the ticketing system for a Singapore museum. Tickets were designed as 'keys' to access specific portions of the museum, depending on what the customer purchased. Through its outsourcing, M2C1 often functions as a bridge between the design and technology sectors in Montréal and connects these sectors to international contacts.

At a similar juncture of art, commerce, and technology is 4-D Art, an organization crucial to Montréal's reputation as an emerging 'MixMedia' (a term preferred to 'multimedia') capital. The integration of art and science is central to this industry: boundaries between the two disciplines disappear, which has the positive side effect of also eroding the boundaries between different individuals. Montréal used to be the modern dance center of the world; now it is the center for this innovative 'MixMedia'.

More traditional creative industries thrive in Montréal, too. Employing over 100 industrial designers, Megabloks has one of the highest concentrations of industrial designers anywhere in the world. It designs and builds toys for Canadian, US, and European markets.

Beyond companies, Montréal is a fertile ground for connective organizations and societies. The Society for Artists and Technology (SAT) provides a forum for companies and individuals from the two fields to come together. It provides a 'play space' in which artists can try new ideas. This space is also used for a variety of commercial purposes, including the production of fashion and television shows. SAT creates connections among artists and technologists not only from Montréal, but also from around the world. The Daniel Langlois Foundation for Art, Science, and Technology fosters the connection between art and science within the context of technology. In particular, The Centre for Research and Documentation documents history, artworks, and practices associated with electronic and digital media arts, and makes this information available to researchers in an innovative manner through data communications.

Montréal, often called the *ville de festivals*, provides a tremendous showcase for a great deal of experimental work, for all kinds of artists. These various festivals also create tremendous opportunities for interactions via temporary density increases and concentrations of people from across all sectors. The artists are not the only ones who win; organizations and the municipality itself benefit from their presence. The recently completed International Quarter, an urban development project featuring public spaces, public and private buildings, and public art, was defined by its use of open space and its 'urban furniture'; one interviewee noted:

"we hired the best talent—designers who are artists."

Clearly, the art–business–technology links in Montréal are strong and vital. One of our subjects summed it up like this:

“Innovation is in Montréal. You must work to find it. It can be hidden, so you have to network and be curious and look outside your own industry.”

A dense, tolerant, vibrant, and interconnected city allows for such a search to take place.

Art – culture ↔ technology connections, moderating examples

Although interviewees from many companies mentioned the help that arts and culture provide in attracting technical and other creative employees, others commented on the difficulty of attracting or retaining the technical talent generated by the region’s four major universities. Part of the problem may lie in the fact that Montréal’s high-tech industries are described as being ‘immature’, making it difficult for those industries to establish a known presence and develop a reputation. As one economic developer put it:

“our numbers are too dependent on a few large technology companies like Bombardier.”

Business support for the arts has been ‘typical’ at best. Big companies tend to support the SOB (symphony, opera, ballet) amenities, in part because many high-level executives serve on their boards. However, of late, there has been a greater reliance on government support,—which is declining. The emerging, nontraditional arts garner little to no support from the business community. Although businesses undoubtedly benefit from the cultural milieu of the Montréal region, they are doing little to support or encourage that environment directly—aside from employing much of the creative talent drawn to Montréal.

As in most underground or independent arts communities, the artists themselves are not always happy with what they find in their fellow practitioners. “Everyone has their own CD, but quality control is an issue”, lamented one musician. It is possible, though, that only a high level of output—and the corresponding failures which that brings—can produce the one or two great works that put Montréal on the map. Practitioners also seem to bristle at the inherent tension between different disciplines:

“[The relationship between art and technology] is a challenge for artists, who don’t care about making things marketable, to impact technologists, who want functional purpose.”

Interconnectivity is not always an easy thing.

Cultural connections—confirming examples

Montréal’s most unique cultural attribute—its bilingual and multicultural nature—also serves it well on the economic front. The region is known as an ideal test market, both for English and for French products, and can also create and export products in both languages. One interviewee called it

“the perfect market. It is both big enough and small enough. It is big enough that if you are successful, you are likely to be successful in other places. It is small enough, that you have a good chance of being successful.”

Another echoed this sentiment, also referring to Montréal as the “perfect laboratory” for trying out new ideas:

“the many different cultures of Montréal help to improve chances of success in other places.”

Within Québec, Montréal works well as an incubator: it is a good place for entrepreneurs of all stripes to get a leg up, because companies can create products and try them out locally. If the product is successful locally—and it helps that the Québécois like to purchase Québec products—a company can expand to (1) the rest of

Canada, (2) the United States, (3) Europe, or (4) any combination of the above. Asia was also cited as an important geographic region in terms of Montréal's global connectivity, both on the business and the academic fronts. The typical linkage between Montréal and the USA is not from Montréal to anywhere in the USA but specifically from Montréal to New York City, which is seen as having a similar urban, cosmopolitan, and international character to Montréal. Ventures which are successful in New York can be assured that their ideas and products have a good chance of succeeding in the rest of the USA.

Having access to multiple languages and cultures also seems to have a positive impact on the region's talent itself. People 'think differently', we were often told, as a result of their bilingualism or multilingualism. A respondent from a consulting firm noted that when he is faced with difficult problems to solve, he intentionally forms strategy groups with multilingual staff. He observed that being multilingual means you understand the world from different perspectives and are more likely to devise creative and innovative solutions: it's "good for the brain to have to learn how to work and think in [multiple languages]". One problem solves with "more creativity when you have to approach problems from both cultures". And a constructive "synergistic tension" is created by the presence of both English and French. These are all different explanations for what makes Montréal's cultural connectivity tick.

The bilingual nature of Montréal also makes it easier to attract international students, who are not as concerned about language issues: its multiple cultures, diverse resident population, and Canadian location all create a worldwide perception of 'neutrality' that can be comforting to foreigners. It also helps that scientists and researchers can directly read research reported in multiple languages: there is no lag time in the acquisition of new information, and they are able to maintain a more worldly view of their discipline than their counterparts who only speak one language.

Geographically, Montréal's connectivity serves several important functions. It is said that from Europe Montréal is not perceived to be part of 'America' (unlike English-speaking Canada): it is recognized as 'North America', of course, but not 'America'—a crucial distinction in this day and age. In the USA, on the other hand, companies like Megabloks are often perceived to be 'American' firms. Megabloks, has enough of an 'American' culture (its sales force works almost exclusively in English) that even retail outlets buying their products think of them as American. In this sense, then, Montréal's connectivity allows it the best of both worlds.

Partly because of this global, urban, and cosmopolitan connectivity, Montréal's creative milieu is appealing to immigrants and artists alike. It "provides a lot of reinforcement for the independent artist", said one interviewee:

"There are a lot of successful artist models. It is more open and there is a good image of creative people. Regional government provides good funding for the experimental arts. They are the future raw material for film, TV and music. Our creative sector provides the R&D for Society."

This generally supportive atmosphere is cited by those who have moved to the city from abroad, too:

"Montréal is much more a mosaic or patchwork than a melting pot. Immigrants come to Montréal and are able to retain their language and culture."

At the same time, immigrants, entrepreneurs, and artists alike are afforded myriad opportunities to connect with the larger social, artistic, economic, and cultural scenes.

Cultural connections—moderating examples

Multiculturalism and bilingualism are not always unmitigated blessings. One software-development company faces both direct and indirect translation costs because its software designers all work in French and its programmers all work in English. The company not only has to maintain software-requirements documentation in both languages; they also have to translate the original documentation from French to English along with any updates that are made. They employ a full-time translator among a staff of fewer than fifty just for this purpose. Another web-development company talked about doing design work in both French and English, depending on who the designers were, but then having to translate everything into English for the programming staff—many of whom are nonnative English speakers.

Among Montréal's four major universities, two teach in English and two in French. It can be difficult to hire non-Francophones who attend the English universities, and if students did not speak French before coming to Montréal, they are not likely to stay in the Montréal region after graduation. Bill 101, designed to help preserve the French language, can also make it difficult to attract permanent foreign workers to the Montréal region—especially those with or planning to have children, who must attend private school if they wish a non-French-only option. It is equally difficult to attract workers from other parts of Canada and the USA. Another difficulty is that Bill 101 requires that a company in Québec maintain a French website, even if the company does business only in the USA.

Although the geographic connection between Montréal and the USA is obvious, the economic connection, especially for independent workers traveling to the USA to work, is much more complicated. Getting into the USA for a specific job can be complicated, and generally requires a great deal of documentation and knowledge of process and procedures. Canadian immigration policies can also be problematic, often making it difficult to bring in foreign workers—especially those with trailing spouses. One company mentioned the need to 'lie' on immigration forms as the only way to get foreign workers with trailing spouses into Canada.

The Montréal region sometimes suffers from being seen as a stopping-off point for Europeans: they come to Montréal first, but use it only as a way to transition to the United States. Often, they are not interested in staying in the Montréal region. On the bright side, the multicultural environment of the Montréal region creates a wonderful way to make the transition from Europe to the USA. But it can also create a culture of transience that does little to get temporary residents invested in Montréal as a place they care about.

The perception of political instability and the uncertain future of Québec is generally seen as a minor but real concern. The 'fusion' and then partial 'defusion' of the City of Montréal was mentioned as a source of political instability across the region. This may not be a cultural issue per se, but it does spring from language and culture issues and it concerns many Montréalers.

According to the University of Montréal (Lisee), entrepreneurship is lower in Montréal than in Canada generally and is significantly lower than in the USA. It is growing, to be certain, but the lower availability of private seed capital (informal high-risk investment money), the lack of highly visible entrepreneurship training programs, and the limited encouragement for women-owned business, combined with a more laid-back European culture, have all contributed to dampening the entrepreneurial environment. In addition, when considering entrepreneurship, "Québec has a confidence and image problem when, in fact, it is as good as the States."

As these examples demonstrate, the creative milieu of the Montréal region has given rise to numerous beneficial connections, as well as some disadvantages.

These connections, most in previously uninvestigated areas, generate spillacrosses that arise from the creative diversity, density, and tolerance in the Montréal region. Density helps to drive the formation of these connections by enabling more frequent interactions which occasionally give rise to these innovation-generating connections.

Although the value of many of these specific cultural connections applies uniquely to the Montréal region, the more generic art and technology connections will help generate innovation in any region. We therefore conclude this paper with a discussion of the implications of these results as they apply not only to Montréal metropolitan area but to any major metropolitan area in today's creative economy. Potential areas of future research derived from these findings are also outlined.

Discussion

Although the value of industrial diversity in generating innovation for a regional economy has been recognized previously, in this paper we have clearly demonstrated that this notion must be extended to include a more broadly defined creative diversity. Connections at all levels in a rich, creativity-based economy can generate innovation and value across a region. These connections among the broadly defined artistic, design, technology, and business sectors generate the anticipated more closely related spillovers as well as the less expected and more far-reaching spillacrosses. Although the cultural connections presented in this paper are most clearly identified with Montréal, making it difficult to extrapolate those findings to other regions, the art and technology connections present an opportunity for other regions to learn from the specific examples uncovered in the Montréal region.

Implications for all regions

The importance of arts and cultural events as a regional amenity that can help attract talent to a region, and thereby indirectly drive growth, has recently received attention (see Clark, 2004; Florida, 2000). However, the findings presented here demonstrate that the arts can have a more direct impact on a region's ability to generate innovation. However, these connections are not necessarily established along traditional lines of communication and rely more on the density and diversity of the creative milieu than on specific programs or policies designed to facilitate traditional spillovers (for example, industry networks, tech councils or chambers, and other industry-cluster and technology-transfer initiatives). Much of the benefit in the Montréal region is derived not from specific programs and policies, but from a more general support of the arts (in many forms) along with a broad creative environment. Local governments cannot directly establish these connections but can facilitate a dense, creative environment that would promote the development of the types of linkages described here.

Tremendous innovations in film production, and even entire industries, have evolved in the Montréal region, although not necessarily directly, from relatively small grants made by the National Film Board of Canada to independent film directors and producers. This is not meant to imply that every region needs its own 'film board': rather, it demonstrates the much more complicated nature of innovation being generated through these less 'traditional' connections. As one interviewee put it:

"It [the relationship between art and technology] is a challenge for artists, who don't care about making things marketable, to impact technologists, who want functional purpose."

The primary linkage is via designers and other outside contractors, who may be simultaneously pursuing both professional and artistic endeavors. Creating ways for businesses to find and utilize independent designers, and for those independent

designers to make their services known and available to businesses of all types, could help to exploit the diversity and generate new connections.

Further, opportunities for artists and the artistically minded to find each other can help to build and nurture the creative milieu. The Montréal region, like most major cities, already has an artistic 'underground'. The underground was described as a 'viral marketing', word of mouth, very low-cost communications and distribution channel for emerging artists and designers to spread information about openings, performances, and other events. The barriers to entry are low to nonexistent, which provides the 'techie-by-day; artist-by-night' a channel to perform and exhibit. As with most such weak-tie, artistic, even countercultural networks, a region can do things to support and encourage it but cannot be seen to be sponsoring or controlling it. A region's governments can enact policies that will encourage connections between creative-class members, but cannot organize them.

In addition, regions can and should undergo a process similar to the one that was completed for the Montréal region as part of this study. A small investment of time and some carefully selected interviews or even a more global survey, could result in a similar catalog or inventory of art and technology connections across the region. By developing an understanding of the kinds of connections that exist within the region, a more full appreciation of them and the value they create can be developed. Much as is the case with traditional industry clusters (Porter, 1998) or the newer occupational clusters (Stolarick, 2004), developing an understanding of a region's unique creative clusters (industries, occupations, and individuals) could result in the identification of additional opportunities for enhancing regional growth and prosperity.

Future research

Follow-up work could include a more thorough and detailed investigation of the value generated by specific connections, and more detailed explanation of how these connections are established and maintained. Such an investigation would focus more on specific examples as case studies, and examine each in depth. In the current research we have investigated the value of these connections with a great deal of breadth but little depth. By looking at a few specific examples, a deeper understanding would be developed of (1) the conditions leading to the establishment of such a valuable connection, (2) the actual economic value of the connection, and (3) the conditions necessary to maintain the connection.

A specific investigation into the conditions under which such connections can be initially created and maintained would be of value. Density is one important element, because of the potential to create an interaction in the first place. Diversity at some level is also helpful: these connections are only possible with some diversity of economic activity and among individuals. What is the relationship between density levels and the creation of these valuable connections? What about diversity levels? What else is necessary or sufficient to enable these connections?

In this study we have only looked at a very small slice of the much broader Montréal economy. Although specific benefits have been identified, these are insufficient to do more than suggest the value of such connections to the growth and prosperity of the entire region. Although these connections may be among the necessary conditions for regional innovation, they are not sufficient. A more comprehensive survey of the Montréal region, and possibly other cities, would allow for a more general, quantitative, assessment of the types of connections that exist and the value created by each. This survey could be used as an initial data-collection instrument that would capture much more information across the region or regions and could also be used to identify

specific connections and conditions which could be investigated in more detail, via either a follow-up survey or an interview process similar to the one used here.

Finally, the results in this paper are focused solely on the Montréal region. Although it is clear that such connections exist and generate value within the Montréal region, Montréal may be a completely unique case and similar results may not necessarily be found for other cities and regions. This same methodology and analysis could be applied to several cities simultaneously to allow comparison of results and greater determination of the more generalizable findings.

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