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Going It All Alone In Web Entrepreneurship? A Comparison of Single Founders vs. Co-Founders

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ABSTRACT

There is a considerable amount of entrepreneurial activity in the information technology (IT) industry, especially in the Web. Many claim that the founders are the single most critical factor in startup success. The entrepreneurial self-efficacy theory and the jack-of-all-trades theory suggest that founders with diverse skills and broad experience will be able to successfully create a business alone. Alternatively, social capital theory suggests that founders who have high social capital and who engage in social networking will be able to go alone. Others, however, claim that team building is crucial for startup success as to bringing complementary skills together.

In this study, we investigate if having a diverse skill set, higher experience, or more social connections is indeed a determinant of single founders, while co-founders have more specialized (yet complementary) skills. Our results are derived from analysis of 91 Web startups and their 183 (co-) founders. Contradicting existing theory, we could not find determinants for starting a new business alone. However, we find that co-founders do indeed complement each other's skills.

Our results suggest that existing entrepreneurial theory needs to be expanded and revised to accommodate for the contradictions found and that future research is required in this area.

Categories and Subject Descriptors

K.1 [Computing Milieux]: The Computer Industry – *statistics, suppliers*; K.7.0 [The Computing Profession]: General; K.6.1 [Management of Computing and Information Systems]: Project and People Management – *staffing*.

General Terms

Management, Performance, Economics, Human Factors

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Keywords

Web entrepreneurship, startups, founders, co-founders, founding teams, social networks, entrepreneurial self-efficacy theory, jack-of-all-trades theory, team diversity, human capital, social capital

1. INTRODUCTION

“IT is the magic ingredient that inspires and most often enables contemporary entrepreneurial endeavors” [21]. Despite the considerable amount of entrepreneurial activity in the IT industry, little is known about actual founders and founding teams in this context [48]. We would like to contribute to a better understanding of what we call *Web entrepreneurship* – startups that make intensive use of the Internet and web technologies.

Since Schumpeter's [55] days, entrepreneurship has been a fruitful research field, resulting in typologies of entrepreneurs (e.g., [65, 69]), as well as theories on factors leading to entrepreneurship, including the entrepreneurial self-efficacy theory [15] and the jack-of-all-trades theory [41]. However, to our knowledge, those theories have only been applied to single entrepreneurs so far and not to teams of entrepreneurs or co-founders. Theory suggests that diversity [35] and heterogeneity of skills within (founder) teams can be beneficial [12, 36, 45].

Our research is guided by the following question: What differentiates single founders from co-founders? In other words, why do some people found alone and others in teams? We aim to show that, as theory would imply, single founders have more relevant entrepreneurial skills, have more experience, and are better connected than co-founders. On the other hand, we aim to provide evidence that team formation is driven by the need to gain access to complementary resources, resources that can compensate for individual skill deficits. Finally, we want to investigate whether single or co-founders are more successful.

The paper is organized as follows. In the next section, we provide a literature review and develop a theoretical framework for our study. Then, we discuss our research method and data. Following that, we present our empirical findings. Finally, we discuss these findings against the existing entrepreneurial theory as well as implications for research and practice. We conclude with a summary and provide a research outlook.

2. LITERATURE REVIEW AND THEORETICAL BACKGROUND

In this section, we provide some theoretical background about our research context, and develop hypotheses based on a review of the existing literature.

2.1 Web Entrepreneurship

Entrepreneurship has been studied intensively since Schumpeter [55] laid the grounds for this research field in the early 20th century. Web entrepreneurship falls into this larger stream of research. Information Technology (IT) has become increasingly important in this field: “*Our steadfast belief is that IT is the magic ingredient that inspires and most often enables contemporary entrepreneurial endeavors*” [21]. Compared to IT startups in general, Web startups are new ventures that do not only use IT to support their business processes, moreover they are using the Internet and associated technologies – often coined as ‘Web 2.0’ [52] – to create and implement new business ideas. Different other terms have been used in the past, including “*e-entrepreneurship*” [40], “*pure dot.com firms*” [56], and “*Internet businesses*” [46]. Despite the considerable amount of entrepreneurial activity in the IT industry, especially in the Web, little is known about actual founders and founding teams in this context [48].

2.2 Entrepreneurs (Single Founders)

Looking at the person of the entrepreneur, several frameworks have been suggested to understand the factors (i.e. the characteristics of a person) leading to entrepreneurship. Especially the (entrepreneurial) self-efficacy theory and the jack-of-all-trades theory have been brought forward to explain disposition to entrepreneurship. In addition to those human capital factors, social networking and social capital have been used to explain entrepreneurial success.

2.2.1 Entrepreneurial Self-Efficacy

Self-efficacy refers to the ability of a person to independently solve problems, complete tasks, and reach his/her goals [7]. In the entrepreneurial context, self-efficacy refers to self-reported “*confidence in having the relevant skills for running one’s own business*” [19]. Chen et al. [15] specified a measurement construct of entrepreneurial self-efficacy (ESE) as being comprised of self-efficacy in five managerial functions: innovation, marketing, management, risk-taking, and financial control. Besides those generic skills, entrepreneurs in the Web context need to have some domain-specific abilities. For instance, computer efficacy includes additional dimensions (such as technologies and design skills) that are relevant specifically in the IT context [16]. We have adapted computer efficacy to the specific context of Web entrepreneurs in this study.

We suggest that single entrepreneurs and co-founders can be differentiated based on their degree of entrepreneurial self-efficacy, i.e., the number of specific entrepreneurial skills. In the case of single founders, all or most of these traits need to be present in one person:

HYPOTHESIS 1: Single entrepreneurs have a higher degree of entrepreneurial self-efficacy (more entrepreneurial skills) than co-founders

2.2.2 The Jack-of-All-Trades Theory

The ‘jack-of-all-trades’ view of entrepreneurship suggests a balance of skills, breadth of education, and number of roles served

in prior job positions as predictors of entrepreneurial success [41, 42, 68].

For the case of single founders, we expect that they can be differentiated from co-founders based on a higher education and greater work experience:

HYPOTHESIS 2: Single founders have a higher education and greater work experience than co-founders

2.2.3 Social Networking and Social Capital

The concept of social capital has become increasingly popular and has found broad acceptance and application beyond its origins in the social sciences [2], including the field of information systems research [71]. Social capital is “*the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit*” [49]. Networks are not only very relevant for individuals but are also an important resource for the firm [30].

Oliver Bussmann, Chief Information Officer of SAP, has recently stated that “*you’re putting your executive career at risk if you’re not social*” [28]. This “socialness” refers to the use of social networking to expand executives’ viewpoints and knowledge. Access to knowledge is the most important resource for companies [32, 51], especially in the networked economy [57].

Entrepreneurship is inherently a network activity [23]. There have been many studies addressing the importance of personal and business networks in the success and/or survival of startups [11, 12, 61, 67]. This is especially true in earlier stages of startups [9, 24, 39]. There are three essential processes in the early stages of startups, where networks play a crucial role: “*discovery of opportunities, securing resources, and obtaining legitimacy*” [24]. Furthermore, access to diverse information and resources has been shown to have a positive effect on entrepreneurial success [11].

Online social networks support the maintenance of existing connections as well as the formation of new social ties [25]. In this sense, online social networks, such as LinkedIn, facilitate access to information and resources. Thus, social networking is crucial for the generation of social capital. Recent research showed a positive relationship between an entrepreneur’s LinkedIn network size and entrepreneurial survival [60]. Founding teams are able to compensate for disadvantaged network constellations of co-founders, i.e. their lack of social capital, which single founders cannot. Thus, for single founders, social networking plays an even more pivotal role.

HYPOTHESIS 3: Single entrepreneurs are more engaged in social networking and have more social capital than co-founders

2.3 Entrepreneurial Teams and Diversity

In recent years, research has paid increasing attention to entrepreneurial teams [17, 34], recognizing that many new startups are not founded by lone entrepreneurial heroes [54, 63]. Cooney [17] defines entrepreneurial teams as “*two or more individuals who have a significant financial interest and participate actively in the development of the enterprise*”. In our research context, most of the team members described their position as ‘co-founder’, which is very different from a regular employee who gets paid for the job only.

Different factors may lead to team entrepreneurship, including personal reasons [29] and diversity considerations [45]. Research on team diversity and team outcomes is very comprehensive, and a recent meta-analytic review confirmed the positive impact of task-related diversity on team performance [36]. However, diversity (and its synonyms like heterogeneity) is an ambiguous concept as there are three distinctive types: separation, variety, and disparity (see [35] for a detailed discussion). In this research context, we are referring to diversity as variety, which can be summarized as “*composition of differences in kind, source, or category of relevant knowledge or experience among unit members*” [35]. Research showed that diversity of skills among a team of entrepreneurs can decrease uncertainty risks in the innovation process [45]. Such heterogeneity in teams may relate to both knowledge and viewpoints. Diversity of skills may help the co-founder team to identify opportunities between otherwise unconnected fields and hence lead to something new as the essential for innovative startups [12]. The heterogeneity of the top management team of startups has been found positively related to capital accumulation during an initial public offering (IPO) [72] and growth [59]. However, to avoid enduring conflict and increase constructive conflict, inner cohesion in teams is essential [26].

Summarizing, we hypothesize that the creation of entrepreneurial teams is driven by diversity considerations in the sense that co-founders complement each other in a variety of skills. More specifically, we hypothesize that co-founders complement each other in the skills underlying entrepreneurial self-efficacy (see discussion on ESE above); these are the skills that are required to become an entrepreneur.

HYPOTHESIS 4: Co-founders in entrepreneurial teams are selected complementing each other’s ESE skills to increase the overall diversity (variety).

2.4 Startup Performance and Funding

“*The most compelling research finding about new venture teams to date is that team founded ventures appear to achieve better performance than individually founded ventures*” [14]. As noted before, heterogeneity of the top management team of startups is positively related to IPO proceeds [72] and growth [59]. Stam and Schutjens [62] have also shown that team startups tend to have significantly higher startup capital than solo startups.

Performance and success of startups is not generally defined, especially in their early phases. For instance, actual revenues (if any at all) do not fully represent a startup’s value. Typical successes for tech companies, especially web startups, are exits in the form of Initial Public Offerings (IPOs) or being acquired by an established company. The IPO rate or acquisition rate of portfolios is often a measurement for the success of venture capitalists (VCs) [1]. VCs are the primary source of selection for startups that have not yet exited [8]. Hence, funding received through these “*confirms the quality of the company and decreases the uncertainty about its potential success. [...] The credibility associated with a funding event – emanating from the information available to the VC firm as well as its reputation – gives a strong signal about the quality of the startup*” [20]. This is in line with other studies that measure the potential success of a startup as a function of external funding [8, 12, 20].

In line with existing theory, we would expect that founder teams would be able to raise more external funding than single founders.

HYPOTHESIS 5: Founding teams (co-founders) are able to raise more external funding than single entrepreneurs

3. DATA AND RESEARCH METHOD

We have used a quantitative empirical approach to test our hypotheses against a data set of Web startups, their founders, and the characteristics of the founders.

3.1 Data Sources

We used a data set of 91 Web startups, 183 (co-) founders and their personal characteristics. The data set was compiled specifically for this study by utilizing two main data sources: the web database CrunchBase [18] and the professional networking site LinkedIn [44].

CrunchBase is a free public database, which is part of TechCrunch, a network of technology-oriented blogs and other web properties recently bought by AOL [5]. As of March 30, 2013, the database listed 118,774 companies, 154,011 people, and 34,168 funding rounds [18]. CrunchBase has a focus on startups and entrepreneurial companies [31]. The CrunchBase data are collected using a crowdsourcing [37, 38] approach: everyone is invited to contribute knowledge. CrunchBase has a large user community supported by a professional team from TechCrunch. The information can be accessed directly by means of an open application programming interface. We used a Java-based parsing program to download a complete dump for further processing on a local database.

LinkedIn is the world’s largest professional online network with more than 200 million members in over 200 countries [50]. We believe the personal information presented on LinkedIn to be reasonably correct for the purpose of our study. This is in line with recent studies that found information available through online social networks to be quite accurate [6, 33]. Since the LinkedIn User Agreement prohibits any use of automated methods like software and scripts to access their data [43], we manually visited all founder profiles and extracted the relevant information for our attributes.

3.2 Sampling Strategy and Data Set

Our sampling strategy has been as follows. First, we selected only startups that were US-based to reduce the impact of other factors outside of the interest of this study (such as national culture). Second, we selected only startups that received seed funding in the year 2011 to make the data set coherent in terms of time (avoiding impact from, for example, the financial crisis) as well as stage of development. Finally, we selected only Web startups (category ‘Consumer Web’ on CrunchBase) to ensure homogeneity and comparability in our sample. Applying this selection strategy resulted in a first set of 103 companies. After removing 12 entries, because either the respective company was not active any more (e.g., website was taken offline) or the funding information could not be confirmed by alternative sources (e.g., self-declared only), we resulted with a set of 91 startups. Next, we identified the respective founder(s) of each startup using information from CrunchBase, LinkedIn, AngelList [4], press releases, and ‘About Us’ pages. This resulted in 183 individuals. For each one of them, we manually searched for the corresponding LinkedIn profile, where we could match 171 founders (93%). All findings on the individual level will be based on this set of 171 founders with LinkedIn profiles (only the

analysis on the number of founders per startup is based on the 183 founders), if not stated otherwise.

The type of data gathered is summarized in Table 1 below. Most of the attributes could be derived directly from the LinkedIn profiles or the CrunchBase website. For the entrepreneurial self-efficacy and computer efficacy attributes we used research team triangulation (see [22]). Chen et al. [15] provide some suggestions to assess the different self-efficacies. For instance, risk-taking is described as “*take calculated risks, make decisions under uncertainty and risk, take responsibility for ideas and decisions,*

work under pressure and conflict” [15]. We selected the corresponding attributes based on the descriptions of prior jobs and educational background, e.g., if there was prior founding experience we drew the conclusion that the person must be “risk-taking”. While the original entrepreneurial self-efficacy construct was self-reported and self-evaluated by the survey participants [15], we believe that our objective approach based on natural data delivers at least equally good results. Entrepreneurial self-efficacy refers to one’s perceived confidence in performing domain-specific tasks, thus, describing the ability to fulfill this task in a job description should be a sufficiently good proxy.

Table 1: Overview of data and attributes

Startups	<i>Company attributes</i>	Name Number of founders Amount seed funding received in 2011
Founders	<i>Demographic data</i>	Name Gender Ethnicity Location (i.e. U.S. state)
	<i>Education and work experience</i>	Highest degree earned Total years of education Total years of work experience Number of prior work positions Prior consulting experience (dichotomous) Prior founding experience (dichotomous) Prior employee experience (dichotomous) Prior experience as venture capitalist (dichotomous) Startup sole position at time of founding Founder still active in startup (as of June 2012)
	<i>Entrepreneurial self-efficacy (ESE) attributes</i>	Innovation skills (dichotomous) Marketing skills (dichotomous) Management skills (dichotomous) Risk-taking skills (dichotomous) Financial control skills (dichotomous)
	<i>Computer efficacy attributes (adapted to Web context)</i>	General IT skills (dichotomous) Design skills (dichotomous) Web technology skills (dichotomous)
	<i>Social networking attributes</i>	LinkedIn profile Number of LinkedIn connections

3.3 Statistical Methods

First, we conducted a descriptive statistical analysis of the data to identify the major characteristics of the data set. Second, we performed Pearson’s Chi-2 tests to compare the entrepreneurial self-efficacy attributes of single entrepreneurs with co-founders. Third, we applied Chi-2 tests in combination with two-sample *t*-tests to differentiate founders on their education and work experience. Fourth, we used two-sample *t*-tests to compare the average number (mean) of LinkedIn connections. Fifth, we used one-way ANOVA (analysis of variance) to differentiate between the number of founders in a startup and the coverage of skills on the company level. Sixth, we analyzed the relationship between number of founders and the amount of funding received. As the explanatory variable is nominal and the explained variable continuous, we calculated Spearman’s rank correlation coefficient (ρ) and Kendall’s Tau-b to test for correlations. We used the software IBM SPSS 21 for all statistical analyses.

4. FINDINGS

In this section we summarize our findings. First, we present some descriptive statistics about the founders and startups in our data sample. Next, we present the findings in light of our hypotheses.

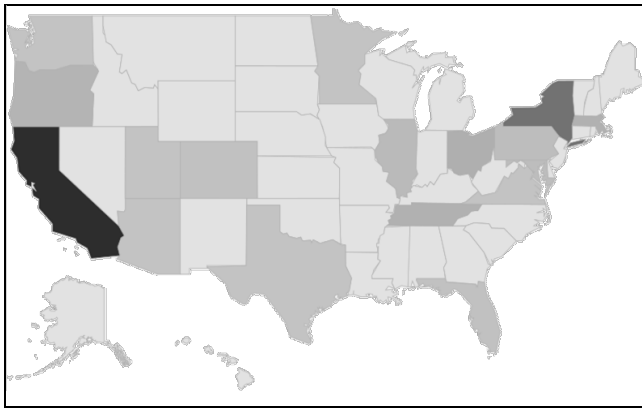
4.1 Descriptive Statistics

Most of the startups in our sample are founded by two co-founders (45.05%). Single entrepreneurs account for (28.57%), as shown in Table 2 below.

Table 2: Number of founders per startup

(Co-) Founders	Startups	Percentage
1	26	28.57%
2	41	45.05%
3	21	23.08%
4	3	3.30%
Total	91	100.00%

The majority of founders declared the United States as their place of residence (which is unsurprising as we looked only at US startups). Less than 10% live outside, primarily in Europe and India. For the US residents, we found a similar geographic distribution in our sample compared to earlier examinations [53]. As shown in Figure 1 below, the dominant states for Web startups are California (39%) and New York State (22%).

**Figure 1: Geographic distribution of US-based founders**

Our sample had a majority of male, white founders, as shown in Table 3 below. Overall, the gender ratio is very unequal (except for the Asian sub group, where it is balanced). The distribution in terms of ethnicity is not representative of the US overall population [66].

Table 3: Founders by sex and ethnicity

	Sample			
Ethnicity	Female	Male	Total	US overall
White	7.60%	71.35%	78.95%	80.98% “White”
Arabic	0.00%	1.17%	1.17%	
Indian	1.75%	8.19%	9.94%	4.65% “Asian”
Other Asian	4.68%	4.68%	9.36%	
Black	0.00%	0.58%	0.58%	13.14%
Total	14.04%	85.96%	100.00%	98.76%

Almost half of the founders in our sample have a Bachelor’s degree as their highest degree before they start their own business, as shown in Table 4 below. The entry ‘No information’ represents the group of founders that did not have any information on education in their LinkedIn profiles. ‘Other education’ relates to founders that started with a first degree but did not finish yet, or they took some other classes that did not result in a degree.

Table 4: Highest degree earned

Highest degree	Founders	Percentage
No information	15	8.77%
Other education	18	10.53%
College	7	4.09%
Bachelor	84	49.12%
Master (incl. MBA)	42	24.56%
PhD	5	2.92%
Total	171	100.00%

4.2 Single Founders vs. Co-Founders

In this section we are comparing the single founders against the co-founders to find evidence for our above-mentioned hypotheses.

4.2.1 Entrepreneurial Self-Efficacy

We performed a series of Chi-2 tests to test the dependence between being a single vs. co-founder and the 8 dimensions included in our entrepreneurial self-efficacy construct. The results are given in Table 5 below. We did not find a significant differentiator between single founders and co-founders in any of the ESE dimensions. In addition, we tested for the total number of ESE dimensions covered by an individual and compared single founders and co-founders. The average of the number of ESE dimensions is almost identical between the two groups: 3.27 for single founders and 3.20 for co-founders. Again, the difference was not significant.

Table 5: Number of founders vs. ESE

ESE-Dimension	Single founders		Co-founders	Pearson Chi-2 S.
Marketing skills	31.82%	<	36.73%	0.654
Innovation skills	36.36%	>	32.65%	0.739
Mgmt. skills	63.64%	<	70.07%	0.542
Risk-taking skills	40.91%	<	50.34%	0.409
Financial skills	54.55%	>	44.22%	0.364
Design skills	9.09%	<	9.52%	0.948
General IT skills	50.00%	>	45.58%	0.698
Web tech. skills	40.91%	>	31.29%	0.369
Count ESEs (maximum 8)	Avg.3.27	>	Avg. 3.20	0.892
Individuals	22¹		147	-

¹ Excl. two single founders due to incomplete LinkedIn profiles

In addition, we tested for differences across the complete 2x8 matrix, as well as single founders against teams of two founders only. In both cases the results were either not significant or contradictory. This can also be seen in Table 5 when looking at the direction of the difference.

Overall, there is no clear indication that single founders have more ESE skills as hypothesized. These results are in contradiction to the above mentioned entrepreneurial self-efficacy theory (see discussion).

Hence, we can reject Hypothesis 1:

HYPOTHESIS 1: Rejected. No support that single entrepreneurs have a higher degree of entrepreneurial self-efficacy (more entrepreneurial skills) than co-founders

4.2.2 Jack-of-All-Trades

We analyzed the groups of single founders and co-founders for differences in education and work experience, such as prior consulting experience. The results are summarized in Table 6 below. Again, we applied Chi-2 tests to test for statistical significance between any pair of variables. There was no significant differentiator between single founders and co-founders. We can only see an indication ($p=0.063$) that single founders rather had prior experience as a venture capitalist (VC) than co-founders.

Table 7).

In order to statistically validate the indicated difference in network size between single founders and co-founders we again applied a t -test. However, the difference in the average number of LinkedIn connections was not statistically significant ($p=0.504$). Thus, we cannot show that single entrepreneurs are more engaged in social networking and we need to reject our hypothesis.

There are no significant differences between single founders and co-founders. Thus, we can reject hypothesis 2:

HYPOTHESIS 2: Rejected. No support that single entrepreneurs have a higher education and greater work experience than co-founders

4.2.3 Social Networking

As we can see in Table 7 below, single founders have 852.2 LinkedIn connections on average, compared to 703.5 for co-founders. For both types of entrepreneurs, this is considerably higher than the 387.7 connections per user in a recent survey [10], and 94.9 connections on LinkedIn across all users [58]. Because the LinkedIn profiles do not reveal the exact number of connections > 500 we have estimated those values based on some reasonable assumptions (see comments below

HYPOTHESIS 3: Rejected. There is no significant difference in social networking between single founders and co-founders.

Table 6: Education and work experience

Characteristics	Single founders	Co-founders	Overall	Pearson Chi-2 significance
Consulting experience	18.18%	21.77%	21.3%	0.702
Founding experience	31.82%	42.18%	40.8%	0.357
Employee experience	90.91%	95.24%	94.7%	0.399
Venture capitalist exp.	13.64%	4.08%	5.3%	0.063
				Two-sample t-test significance
Prior job positions	Avg. 3.91	Avg. 4.42	Avg. 4.36	0.444
Years of higher education	Avg. 4.45	Avg. 3.82	Avg. 3.90	0.661
Years of work experience	Avg. 7.82	Avg. 9.21	Avg. 9.03	0.137
Years of education and work combined	Avg. 10.68	Avg. 11.74	Avg. 11.60	0.212
Individuals	22¹	147	169	-
¹ Excl. two single founders due to incomplete LinkedIn profiles				

Table 7: Number of LinkedIn connections

		This data sample				
LinkedIn connections		Single founders	Co-founders	Overall	LinkedIn survey ²	LinkedIn statistics ³
Low	0 - 49	4.2%	3.4%	3.5%	11.5%	
	50 - 99	4.2%	8.2%	7.6%	20.0%	
Medium	100 - 199	8.3%	10.9%	10.5%	20.3%	
	200 - 299	8.3%	11.6%	11.1%	17.0%	
	300 - 399	8.3%	16.3%	15.2%	13.4%	
	400 - 499	8.3%	10.2%	9.9%		
High	500 - 999	58.3%	39.5%	42.1%	12.8%	
	1000 - 2999				3.6%	
	3000 - 9999				1.3%	
Total		100.0%	100.0%	100.0%	100.0%	
Average		852.2 ¹	703.5 ¹	724.4 ¹	387.7 ²	94.9 ³

¹ Assuming the same distribution of values in the “High” bin as for the participants in the user survey. Calculated based on the midpoints of the bins

² Survey among 306 LinkedIn users [10]. Average connections calculated based on the midpoints of the bins

³ Average LinkedIn member's 2nd degree network has 9,000 people [58], equivalent to SQRT(9000) = 94.9 direct connections on average

Table 8: Complementarity of ESE Skills in Founder Teams

(Co-) Founders	Startups	Average Binary Euclidean Distance Between Founders ¹	Average ESE Coverage on Founder Level	Average Increase of ESE Coverage	Average ESE Coverage on Company Level
1	22	-	3.3 out of 8	-	3.3 out of 8
2	36	3.0 out of 8 (37.2%)	3.7 out of 8	1.5	5.2 out of 8
3	19	3.1 out of 8 (38.2%)	2.8 out of 8	2.6	5.4 out of 8
4	3	2.9 out of 8 (36.8%)	2.8 out of 8	3.2	6.0 out of 8
Total	80²	-	-	-	-

¹ Defined as $(B+C)/M$, where
B = number of variables "present" in case i and "absent" from case j
C = number of variables "absent" from case i and "present" in case j
M = number of variables observed for both cases i and j
see [70] for details

² For this analysis we removed 11 startups, because we could only calculate changes in ESE and founder distance if the information on all founders was complete

4.3 Complementarity of ESE Skills in Founder Teams

In this section we are further investigating the team constellations in founding teams. More specifically we are interested in validating whether the founding team formation follows a pattern, i.e. seeking a co-founder with complementary skills. The results are summarized in Table 8 above.

In summary, the results support our hypothesis that founder team formation is driven by the search for complementary team members. The average Binary Euclidean Distance between any two founders in founder teams is about three, meaning that on average co-founders differ in three out of eight ESE dimensions. This is also reflected on the company level. For instance, in startups with two co-founders, on average the founders cover 3.7

ESE dimensions, while on the company level the coverage is at 5.2 dimensions. Thus, in this case co-founding results in an increase of ESE dimension coverage of 1.5 on average. To clarify, the average distance between founders and the average increase of ESE coverage on the company level are not the same, as the following example illustrates. Consider two founders, one with five ESE dimensions and the other with one more complementary skill. By definition, the distance between the two is six; however the increase of ESE coverage on company level is only one. Still, this one more unique skill might be very valuable for the startup.

In the case of two founders the complementarity becomes also obvious when looking at the different job titles that founders have. In most cases there are combinations of Chief Executive Officer (CEO) on the one side and Chief Technology Officer (CTO)/Chief Operating Officer (COO) on the other side.

In order to statistically validate these observations we applied one-way ANOVA (analysis of variance) with four groups based on the number of founders and ESE coverage on company level as dependent variable. Levene's test of homogeneity of variances between groups was not significant ($p=0.561$), thus we can assume equal variances. ANOVA determined that there is a statistically significant difference between groups ($p<0.001$). More specifically, Scheffé's post-hoc test revealed that the single founders are statistically different from all groups of co-founders, but the startups with two, three or four founders do not differ significantly ($\alpha=5\%$). In summary, the increase of ESE coverage going from one to two founders is statistically significant, but the effect from adding more founders is not.

Based on above results we showed that co-founders indeed complement each other's skills. Thus, we could confirm our hypothesis:

HYPOTHESIS 5: Confirmed. Co-founders complement each other's ESE skills

4.4 Amount of Funding

On average, single founders received the highest funding of about \$700,000. Startups with more founders received less funding on average. The standard deviation is quite high for all cases, indicating that the data is spread across a large range. This is also supported by the values for minimum funding (\$10,000) and maximum funding (\$4,000,000) in the sample. See Table 9 below for more details.

Table 9: Funding information

(Co-) Founders	Startups	Mean	Std. dev.
1	26	\$699,744	\$943,148
2	41	\$603,220	\$611,476
3	21	\$410,643	\$449,441
4	3	\$466,667	\$485,627
Total	91	\$581,855	\$689,133

At first glance, there seems to be a (negative) correlation between the number of founders and the average amount of funding. However, when testing the correlation, Spearman's rank correlation coefficient (ρ) and Kendall's Tau-b were both not statistically significant. Even after excluding some potential outliers the results did not change. Consequently, our hypothesis needs to be rejected:

HYPOTHESIS 5: Rejected. Founding teams (teams of co-founders) are not able to raise more external funding than single founders

5. DISCUSSION

In this section we first summarize and discuss our research results. Next, we highlight our contributions and address some limitations. Finally, we describe some implications for theory and practice.

First of all, our study shows some interesting **demographics**. For example, we find that for ethnicity in our sample the portion of Asian founders is high (19%) compared to the general population [66]. We can also see that the portion of female founders is very low (14%). This is indicative of the much-criticized gender gap [64] in IT. However, the percentage of women in our sample is

higher than in earlier studies [13]. Black founders are much underrepresented; there was only 1 out of 171 entrepreneurs.

The **geographic distribution** of founders across the US is not very surprising and in line with prior findings [53]. California with the San Francisco Bay Area and New York State with the Greater New York City Area are widely recognized to be the most vibrant hot spots for entrepreneurial activities [63].

From the **general attributes and characteristics** we can gain some interesting insights into the career paths of founders. First, we see that more than 40 percent of founders in our sample have prior founding experience, which could be interpreted as a signal for investors that investing in this startup is less risky. This can be true even when the prior founding experience was a failure [27, 47]. Second, we find that almost all founders have prior work experience, 9 years on average in more than four different positions. This indicates that entrepreneurs usually build upon a solid basis of general work experience, which brings with it additional factors, for example access to resources and social connections. Third, we were surprised to find that around half the founders in our sample do not state their position at this startup as their sole position, which leads to assumptions that there might be some diversification in place on the side of founders to decrease the high risk associated with startups.

Surprisingly, we could not find any significant **determinants for being a single founder**, the hypotheses based on entrepreneurial self-efficacy, the jack-of-all-trades theory, and social networking did not hold against our data. This indicates that there must be other factors that are relevant for the decision to co-found in a team or go it all alone that we could not account for. For instance, Forster and Jansen [29] report that every entrepreneur in their study had the desire to partner, but they could not find the right partner yet. Also, there might be personality traits such as being an individualist vs. team-player that can make the difference. Looking closely at our results we can see an indication that experience and access to resources could actually matter. In the group of the single founders there are relatively more individuals with prior experience as venture capitalist, but the difference is not very significant ($p=0.063$). Still, this might indicate that a venture capitalist might be more inclined to go it alone based on her personal experience and resources at hand. In addition, we could see that single founders have a higher average number of social ties than co-founders, but the difference was not significant. However, it could indicate that single founders might compensate for their lack of co-founders with an extended network of outside resources. This could be one of the factors that influence a founder to go it all alone. If a single founder has enough of the right external resources in her network and the venture is suitable for working with freelancers and other external workers, she could be more inclined to try it without a formal co-founder.

However, we found that co-founders indeed have **complimentary skill sets** and with that could confirm our hypothesis. Thus, at least part of the decision to co-found and the choice for the specific co-founder(s) is based on complementing a founder's own skill set. This is also reflected in the job titles of co-founders. In addition, we can see in our analysis that in startups with three or four co-founders the average coverage of ESE dimensions by each founder is lower than in startups with only two co-founders. This indicates a higher level of specialization and clearer division of responsibilities made possible by the increase of manpower in the team. Notably, we identified some co-founders that were socially connected before starting the new business, i.e., former classmates, brothers, or even a married couple. Hence, existing

social connections and ties could be an additional explanation for co-founding. Overall our findings are in line with prior research that suggests that entrepreneurial teams are either formed for interpersonal or resource-seeking reasons [29].

Lastly, contrary to some previous research we could not find any significant **difference in funding** based on the number of founders in a startup. This indicates that the number of founders or the fact of having co-founders is only one of many factors that play a role in evaluating the potential of a startup and the corresponding investment by a venture capitalist, especially in the early seed stage that our companies were selected on. One of the main differentiators here could be the selection of the underlying business model (see for instance [3, 73]).

Our research makes some **contributions** to research in three areas. First, we add to the IS discipline a better understanding of Web startups, especially their characteristics and founder demographics. Second, we add to the field of entrepreneurship research a new facet and new perspective on the entrepreneurial self-efficacy construct. We show that the underlying required domain-specific skills need not necessarily be present altogether in single founders, but can also be composed by complementary co-founders. Third, we provide support that entrepreneurial team formation is indeed based on resource-seeking behaviors, i.e. the selection of co-founders is driven by the search for complementary resources.

As an empirical study, this research is not without **limitations**. First, our study is based on a sample of 91 startups and 183 founders, only 24 of which are single founders. This sets a natural limitation on the ability to show statistical significance in analyses. The differences between single and co-founders regarding entrepreneurial self-efficacy, experience, and social networking are rather small. Thus, we suggest future work to aim for a bigger sample size especially when it comes to the inclusion of single founders. Second, our data is only a snapshot of the situation. As entrepreneurship is inherently very dynamic, future studies could try a longitudinal approach to show the dynamic development, e.g. founding team formation and evolution over time. Third, we gathered our data from publicly available sources. This constrains the set of available attributes compared to specifically designed surveys. Also, the data might potentially be biased, e.g., due to founders not reporting or exaggerating the importance of prior job positions. We strongly believe that our data is sufficiently correct for the purpose of our research. As outlined above, recent studies found information available through online social networks to be pretty accurate. Fourth, our conceptualization and measurement of the entrepreneurial self-efficacy construct is different from its original use. Still, we argue that objectively observed skills serve as a good proxy for the perceived self-confidence in a specific skill. Finally, some boundary conditions might apply. Our research focus was on US-based Web startups. We believe that the results will also apply to other industries that are characterized as being very knowledge-intensive as well as highly dynamic. Transferring the results to Web startups outside the US should be feasible, if cultural aspects do not play a stronger role in team formation.

Finally, our research has some **implications** for policy makers, theory and practice. First, the observed gender gap and the imbalance between ethnic groups indicates that policy makers should focus on specific initiatives and programs to foster entrepreneurial activities in those segments of the population as well. Also, universities should consider those imbalances when setting up or revising curricula in entrepreneurship. Second, even

though we found support for our hypothesis on team formation we could not find antecedents for becoming a single entrepreneur or not. This could be approached in more detail in subsequent research. Third, for prospective future founders, our research implies that there is no simple rule to follow, when deciding to go it all alone or find one or more co-founders. The factors that play into this decision might be manifold and can only be answered by the founders themselves. This also leads to the implication for investors, not to discriminate startups based on the number of founders or complementarity of skills alone, but to look closer at the intangible connections found either inside the team or in the founders extended networks. Still, practitioners might want to consider our findings on complementarity of skills – and what kind of skills – when looking for co-founders.

6. CONCLUSION

Using a unique data set of 91 web startups and their 183 (co-) founders, we set out to analyze if there are determinants for going it all alone or co-founding. Surprisingly, and contradicting existing theory, we could not find any significant differences between single founders and co-founders based on entrepreneurial self-efficacy, experience, and social networking. However, we could show that entrepreneurial team formation is indeed driven by complementarity of co-founders' skills.

Our results motivate three further research options that need to be explored. First, due to limitations in the data available from the LinkedIn profiles, the hypotheses could be further tested using a traditional survey approach. Second, there could be other factors that determine the decision to go it all alone or co-found. As we mentioned above, private social connections or other life events that formed social bonds between co-founders might influence this decision. These connections could be explored in a further study. Also, we could show that the choice of a co-founder is at least partly based on complementarity in skills. Thus, future studies could take a more balanced approach to explaining the decision to co-found; looking into both private and professional factors. Third, as mentioned in the results, single founders could also be compensating for their lack of co-founders through an extended network of outside resources. We suggest shedding a light on the difference not only in size but also in diversity and usefulness of the social network of single founders compared to co-founders in future studies building on this research.

We see this study as a first step in understanding the research questions at hand. Building on this study, future work could employ bigger sample sizes and surveys to explore one or more of the promising indications we could find in our data.

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