9 Personality Traits of Successful Free Innovators

Recall from the national surveys summarized in chapter 2 that from 1.5 percent to 6.1 percent of individuals in six countries develop new or modified products for their own use. This is in some ways an impressive figure, representing tens of millions of free innovators in just those six countries. But another way to look at it is that 94–98 percent of individuals in those countries are *not* free innovators, or perhaps try to innovate but fail. Two questions then arise: Are there differences between individuals who successfully carry out innovation projects in the household sector and those who do not? And, if there are differences, can we do anything to increase the amount of successful free innovation?

In this chapter, I draw upon a study by Stock, von Hippel, and Gillert (2016) to identify personality traits significantly associated with successful free innovation in the household sector. Based on these findings, my colleagues and I suggest two possible ways to increase the amount of successful free innovation.

Design of the Study

Given the documented importance of free innovation, it clearly will be valuable to learn more about the characteristics of free innovators. Stock, von Hippel, and Gillert (2016) began this work by a conducting a study of free user innovators' personality traits that are related to innovation success among a sample of 546 German consumers. Our study focused on three successive innovation process stages: (1) having an idea for an innovation for personal use; (2) building a prototype for personal use; and (3) diffusing the innovation either by free, peer-to-peer transfer or to a producer firm. To be able to compare success and failure at each stage, we grouped participants according to how far each had progressed in the innovation process. As can be seen in figure 9.1, progressively fewer consumers successfully

completed each successive stage. This allowed my colleagues and me to conduct a "success-failure" comparison at each stage. That is, starting at the left in figure 9.1, we were able to compare the personality traits of those not having an idea (stage 0) with those who did have a product innovation idea (stage 1). Next, we could compare the personality traits of those who did not prototype their idea with those who succeeded in creating a prototype for personal use (stage 2). Finally, we could compare the personality traits of those who did not diffuse their prototyped innovation to the traits of those who successfully did so (stage 3).

The design of our study approximates the real-world situation faced by individual household sector innovators (consumers) in an interesting way. Personality traits are stable, and so those traits an individual has that are associated with success in early stages are necessarily carried into later stages, where those same traits may be less helpful or may even be a hindrance. Conversely, if a trait that enhances individuals' chances of success at, say, stage 3 is negatively associated with success at phase 1, those possessing that trait are unlikely to reach stage 3.

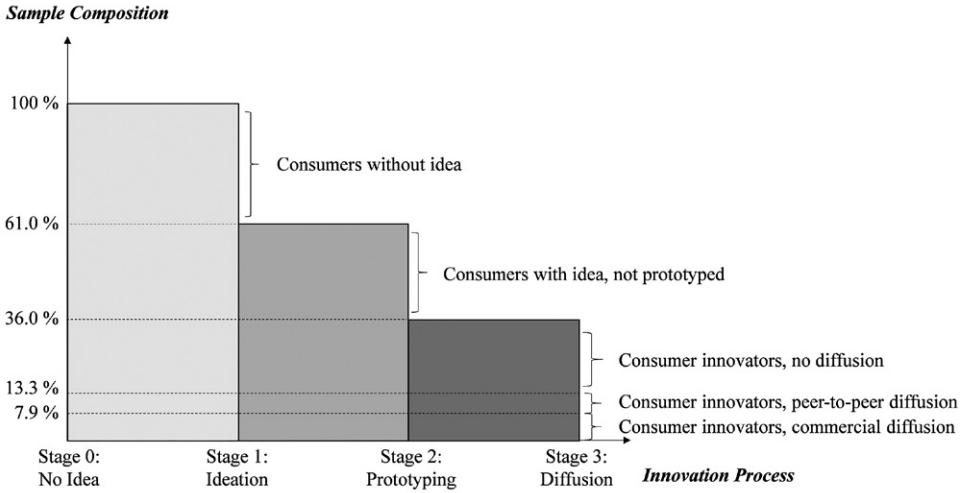

Figure 9.1
Data analysis strategy: comparison of individuals accomplishing vs. not accomplishing successive stages in the innovation development and diffusion process. Source: Stock, von Hippel, and Gillert 2016, figure 1.

Study Methods

As was mentioned above, the study sample of Stock, von Hippel, and Gillert consisted of German householders. To ensure that we would have enough subjects for analysis at in all three innovation process stages, my colleagues and I recruited participants in two different ways. First, we used "snowball sampling" (Goodman 1961). In this method, individuals who have a rare characteristic—in our study, engagement in innovation development—are asked to identify others they may know who have the same characteristic (Welch 1975). (The utility of snowballing stems from the observation that people with rare characteristics tend to know or be aware of people similar to themselves.) In the second method, our goal was to increase the number of individuals in the sample who were likely to have successfully completed all three stages in the innovation process. We therefore deliberately sought out individuals who either had posted a description of an innovation they had developed on the Internet or had been featured on a German TV program devoted to individual inventors.

The net result was a sample containing both free innovators and entrepreneurial household sector innovators hoping to commercialize their innovations. In total, the sample we recruited for the study consisted of 546 individuals in the German household sector, 443 of them identified via the first method and 103 via the second. The two subsamples of respondents were similar in their demographic characteristics and were combined for analysis. Data were collected from respondents by means of an online questionnaire.

Personality Traits

Personality "traits" are aspects of individuals' personalities known to be highly stable over time, situations, and social roles. Today, studies of personality traits typically use what is called the five-factor model of personality (also known as the Big Five model) consisting of five underlying traits in personality that display minimal overlap. The Big Five model's variables have been proven to encapsulate many more detailed personality variables well, and to be quite stable (Costa and McCrae

1988, 1992, 1995; Goldberg 1993; McCrae and John 1992; McCrae and Costa 1997).

Big Five analyses describe individuals' personalities by the extent to which they display each of five traits in their lives (Barrick and Mount 1991):

- Openness to experience "characterizes someone who is intellectually curious and tends to seek new experiences and explore novel ideas" (Zhao and Seibert 2006, 261; Barrick and Mount 1991). Individuals high on the trait of openness can be described as creative, innovative, imaginative, reflective, and untraditional. In contrast, individuals low on openness prefer the plain, straightforward, and obvious over the complex, ambiguous, and subtle (McCrae and Costa 1987).
- Extraversion "describes the extent to which people are assertive, dominant, energetic, active, talkative, and enthusiastic" (Zhao and Seibert 2006, 260; LePine and Van Dyne 2001; Lucas, Diener, Grob, Suh, and Shao 2000). Those with low levels of extraversion (i.e., introverts) prefer nonsocial situations and are quieter, more reserved, and more independent than those with higher levels (Zhao and Seibert 2006, 260).
- Conscientiousness "indicates an individual's degree of organization, persistence, hard work, and motivation in the pursuit of goal accomplishment" (Zhao and Seibert 2006, 261). Individuals with high scores on conscientiousness have a preference for planned rather than spontaneous behavior (Barrick, Mount, and Judge 2001).
- Agreeableness describes an individual's interpersonal orientation. Agreeable individuals are modest, trusting, forgiving, altruistic, and caring. They tend to conform to social conventions and to engage in cooperative, high-quality interpersonal interactions (Barrick and Mount 1991; Zhao and Seibert 2006). Someone at the very low end of the dimension can be characterized as self-centered, suspicious, and hostile (Feist 1998).
- Neuroticism "represents the tendency to exhibit poor emotional adjustment and experience negative affects, such as anxiety, insecurity, and hostility" (Judge, Bono, Ilies, and Gerhardt 2002, 767; also see LePine and Van Dyne 2001). The opposite of neuroticism is emotional stability.

Study Findings

All the findings of our study are summarized in table 9.1. In the top half of the table, the significances of four "control variables" are presented. In the bottom half, significant relationships between Big Five personality factors and likelihood of success at each innovation process stage are shown.

Findings regarding control variables

In order to see the effects of personality traits clearly, one has to "control for" the effects of other variables known to have a strong relationship to innovation process success; hence the term control variables. (By including control variables explicitly in our study model, we addressed what is called omitted-variable bias. This would result from the absence of an independent variable correlated with both the dependent variable and one or more included independent variables.)

The effects of the first two control variables in table 9.1 have been studied and found important in the national surveys of consumer innovation described in chapter 2 (von Hippel, Ogawa, and de Jong 2011; de Jong 2013; de Jong, von Hippel, Gault, Kuusisto, and Raasch 2015; and Kim 2015). In line with the findings of those studies, on the first row of the table we see that male gender is significantly associated with both successful idea generation and prototyping. Gender may also be statistically associated with successful diffusion. However, because most of the individuals who had succeeded at the earlier phases and so were entering the third and final diffusion stage were male, there was not enough variation in the sample entering stage 3 to assess the significance of that control variable in the diffusion stage.

In the second row of table 9.1, we next see that technical background is significantly associated with successful idea generation. As was the case with gender, technical background is so strongly associated with successfully passing stage 1 that most of the individuals who move on to further stages have technical backgrounds. For this reason, the importance of technical background to success at stages 2 and 3 cannot be analyzed. However, we do know from other research that technical background is also very important to stage 2 prototype development (Lüthje, Herstatt, and von Hippel 2005).

Table 9.1
Effect of personality on the likelihood to successfully pass through stages of the household sector innovation and diffusion process.

	Ideation (stage 1)	Prototyping (stage 2)	Peer-to-peer diffusion (stage 3a)	Commercial diffusion (stage 3b)
Control variables				
Gender (male)	.39 (.11)***	.62 (.14)***	–.21 (.27)	.44 (.26)
Technical background	.34 (.11)**	–.05 (.13)	.29 (.21)	–.27 (.19)
Inspiring social environment	.49 (.12)***	.14 (.15)	.50 (.28)	–.02 (.21)
Frequency of unmet needs	.62 (.12)***	.61 (.15)***	–.10 (.25)	.30 (.21)
Big Five personality traits				
Openness to experience	.35 (.11)**	.08 (.14)	.21 (.24)	–.09 (.20)
Extraversion	.12 (.11)	–.51 (.16)**	–.28 (.27)	.12 (.22)
Conscientiousness	–.13 (.11)	.31 (.15)*	–.64 (.28)*	.57 (.28)*
Agreeableness	.03 (.11)	–.06 (.14)	–.40 (.25)	–.28 (.24)
Neuroticism	–.07 (.11)	–.13 (.15)	–.35 (.32)	.42 (.22)
Constants	.59 (.10)***	.13 (.13)	–1.89 (.30)***	–1.53 (.29)***
Model Fit				
Wald test statistic (degrees of freedom)			96.36 (9)***	

Source: Stock, von Hippel, and Gillert 2016, table 3. $n = 547$. Analysis method: sequential logit regression. Coefficients reported in log-odds units; robust standard errors in parentheses; degrees of freedom = 9. *$p < .05$, **$p < .01$, ***$p < .001$.

The control variable "inspiring social environment" was included because the social environment within which innovation takes place has been found to be important to innovation likelihood and success. An inspiring environment involves strong social ties (Perry-Smith 2006) and also supportive attitudes toward innovation (Amabile, Conti, Coon, Lazenby, and Herron 1996; Scott and Bruce 1994). For example, a supportive family would say to an ill family member attempting to innovate, "How wonderful that you are being creative in that way, how can we help?," as opposed to, "Why are you doing something so foolish? You should just follow your doctor's orders!" As can be seen from the third row of the table, this variable is significantly correlated with successful idea generation.

The fourth control variable, "frequency of unmet needs," refers to the degree to which a respondent felt that he or she had needs not satisfied by products on the market, and so would have a reason to innovate. The association of this variable with innovation likelihood has been documented in numerous studies of innovation by lead users (e.g., Morrison, Roberts, and Midgely 2004; Franke and von Hippel 2003). As can be seen in row four of table 9.1, this control variable was significantly associated with both successful completion of the idea generation phase and completion of the prototype phase too.

Findings regarding personality traits

In the bottom half of table 9.1 we see the personality traits significantly associated with successful completion of each stage in the innovation process. These differ significantly from stage to stage. In the first stage, table 9.1 shows that individuals high on "openness to experience" are significantly more likely to have an idea for an innovation. This makes sense: openness to experience has been consistently shown to positively affect creative behaviors for different groups of employees (Feist 1998; George and Zhou 2001; Rothmann and Coetzer 2003; Sung and Choi 2009; Wolfradt and Pretz 2001).

In the second stage, introversion (the negative of "extraversion") and "conscientiousness" are significantly associated with those who successfully create a prototype for personal use. A connection between introversion and "working on technical things in a lab" also fits prior research findings. Thus, in a study by Lounsbury et al. (2012), scientists

were found to have significantly lower levels of extraversion than nonscientists. Similarly, Williamson, Lounsbury, and Han (2013) found that engineers scored lower on extraversion than non-engineers. With respect to conscientiousness, it is reasonable that those working on prototypes would have this trait. To my knowledge, this is a new finding.

In the diffusion phase, my colleagues and I distinguished between peer-to-peer diffusion and commercial diffusion. We did so because we thought that accomplishing each successfully involved very different activities and personality traits. This final phase is clearly important to innovation success and also to the social benefit derived from the free innovations created. However, because the individuals reaching this final phase had already had some personality traits strongly selected for, we really did not have enough variation left in the sample to see much in the way of significant associations between personality traits and successful diffusion. As table 9.1 shows, we did find a correlation at a low level of significance ($p < .05$) between the personality trait of conscientiousness and diffusion success. Individuals who possessed *high* levels of conscientiousness were more likely to succeed in diffusing their innovations commercially. In contrast, those who were *less* conscientious were more likely to succeed in peer-to-peer diffusion. An explanation for this pattern is not clear to me and, given the modest statistical significance of the findings, I will not attempt interpretation.

How Personality Traits Affect the Success of Free Innovation Projects

To understand the practical effects of personality traits on success in innovation, we calculated marginal effects at the means (MEM). This involved calculating the change in probabilities produced by a one-unit change on a seven-point Likert scale in a single personality trait variable, while holding all other trait variables at their mean values. MEM calculations do show that personality traits are important to free innovation project success.

The Big Five traits jointly accounted for 9.6 percent of variance in successful completion of the ideation stage (Nagelkerke 1991), where success was based largely on openness to experience. A MEM

calculation shows that a one-unit increase in openness, with all other predictors held at their mean values, increased the probability of successfully completing the ideation stage by 9.5 percent. At the prototyping stage, the variance solely accounted by the Big Five was 8.0 percent. Being an introvert and being conscientious were both significantly associated with the likelihood of success in prototyping. Here MEM calculations show that a one-unit increase in extraversion decreased the probability of successful prototype completion by 15.1 percent, whereas increasing conscientiousness by one unit increased the probability of successfully completing a prototype by 9.7 percent.

If we next consider the *combination* of traits an individual must possess to successfully traverse the successive stages, the cumulative effect of personality traits on household innovator success becomes clear. As was mentioned earlier, personality traits significantly associated with successful completion of earlier stages are automatically carried into subsequent stages by the individuals who possess them. For example, as can be seen in table 9.1, the personality traits favorable to successfully completing the first two stages were openness, conscientiousness, and introversion. Individuals in our sample who were found to be at the "90 percent favorable value" for these three traits, with the remainder set at mean values, had a 52.9 percent chance of successfully completing both stages. For individuals displaying the combination of traits least associated with success—low openness to experience and low conscientiousness (tenth percentile) but high extraversion (ninetieth percentile)—the probability of successfully completing both stages was only 16.1 percent.

Discussion

We have seen that a number of factors can significantly affect innovators' likelihood of success at completing three basic stages in the process of developing and diffusing an innovation. In the main, the findings are intuitively very reasonable with respect to both the control variables we included in the study and personality traits. For example, it makes sense that individuals who have lots of unserved needs will more be likely to have ideas about how to solve them and thus succeed at the ideation phase of innovation. And it makes sense that if those

unserved needs are strong, an individual will be more motivated to at least attempt to build a prototype, other things being equal. More generally, it makes sense that having the skills, resources, and personality traits appropriate to completing a certain stage of innovation will make successful completion of that stage more likely.

Is there a way to convert these findings into practical ways to increase levels of successful innovation in the household sector? At first glance things do not look too promising, as most of the control variables and the personality variables in table 9.1 are not easy to adjust. Consider that increasing one's level of technical education requires a major personal investment. Further, personality traits are essentially stable in adulthood. And, if one does not have an inspiring home environment, changing that will probably not be easy either.

However, my research colleagues and I think there are two accomplishable approaches that are likely to yield major benefits. First, one can encourage collaboration, so that people can help one another "fill in their personal gaps" in resources, training, or personalities. Second, one can use technical advances now available to free innovators to make innovation development and diffusion tasks both less demanding and less trait-specific.

Encouraging collaboration

Recall that today the dominant pattern in household sector innovation is that all innovation process steps are completed by a single individual. As table 2.6 documents, studies of household sector innovation in the United Kingdom, the United States, and Japan have shown that in those countries about 90 percent of innovations are made by individuals acting alone. In Finland and South Korea, 72 percent of innovations by consumers are made by individuals acting alone, with the remainder being collaborative efforts.

As was discussed earlier, an individual acting alone may be well prepared in terms of personality traits to succeed at one innovation stage but less well prepared for the next stage, where the identical traits are less helpful. When innovation is collaborative, it may be possible to solve this problem: *Collectively* the collaborators may have all the personality traits needed to successfully complete all three stages of innovation. A start-up firm uses this strategy when it puts different types of

people on a team. When a new business venture is created to develop, produce, and market an innovation, it is a common prescription for success to recruit a group of individuals who *collectively* have expertise in all tasks relevant to the project (Akgün, Keskin, and Byrne 2010; Ensley and Hmieleski 2005; Vissers and Dankbaar 2002). The same strategy is often used by the personnel departments of larger firms (Muchinsky and Monahan 1987; Kristof 1996).

Innovations developed collaboratively also diffuse more frequently than do innovations developed by single individuals. The difference can be quite striking, as was noted in chapter 5. Thus, recall that Ogawa and Pongtanalert (2013) found that when individuals belonged to communities with a shared interest in the innovation they developed, the adoption rate by peers was 48.5 percent. When innovators did not belong to such communities, the adoption rate was only 13.3 percent. Other literature supports these patterns. For example, it is clear that innovators participating in communities tend to share information, including information about innovations they have developed, with other members (Morrison, Roberts, and von Hippel 2000; Raasch, Herstatt, and Lock 2008).

In view of the evidence of the benefits associated with collaborative innovation, policymakers and practitioners may wish to explore ways to increase the proportion of collaborative projects in the household sector. Increasing the availability of innovation facilities such as makerspaces is one potentially useful practical step. Such facilities offer access to sophisticated prototyping tools; they also enable potential collaborators to congregate and to discover one another. Also likely to be helpful are online community forums in which people can post their innovation-related interests and find one another at low cost. One excellent example of such a forum is https://patient-innovation.com/, a non-profit website that provides a collection point for information on patient-developed innovations (Patient Innovation 2016). That website is also designed to support online discussion and sharing of innovation-related information by medical patients and people interested in helping them (Habicht, Oliveira, and Shcherbatiuk 2012). More generally, of course, inexpensive Internet access and toolkits for collaborative design, such as those supplied by and for open source

software development communities, can support collaboration at a distance.

Changing the nature of innovation tasks

A second approach, complementary to the first, is to change the nature of innovation tasks to ease the resource and personality attribute constraints required to accomplish them successfully. This approach, enabled by improvements in innovation development tools available to individuals, is becoming increasingly feasible.

Tools derived from creativity research, such as those supporting analogical thinking, are widely available today and can assist innovators in "thinking outside the box." These tools may help individuals (even those in whom openness is not a strong personality trait) to develop innovation-related ideas. Inexpensive CAD programs increasingly enable even novices to create robust designs more easily and quickly than they could in the past. Manual skills associated with prototyping, such as using saws, hammers, and glue, are giving way to computer-aided manufacturing. Computer-driven fabrication tools such as 3D printers make it practicable to produce parts for a prototype at the push of a button. These methods may reduce the importance of introversion and conscientiousness as personality traits associated with successful prototyping.

With respect to innovation diffusion, face-to-face describing or selling may be at least partly replaceable by a diffusion process based heavily on Internet postings. To non-extroverts, such a process may be more congenial than face-to-face diffusion tasks.

In sum, my colleagues and I conclude that several factors, significantly including personality traits, affect the success of household sector innovators. It seems likely that attention to those factors could enable societies to increase the number of innovation projects attempted by householders, and also to increase the fraction of their projects that progress to a successful conclusion.