Makers and entrepreneurial opportunities

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DISSERTATION

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Preface

The last 3.5 years have been a journey with ups and downs, with highs and lows. What may sound corny is actually quite true and tells the story of a personal adventure with many people along the way, which in the end allowed a personal development and growth for which I am grateful. Therefore, I would like to use the following sections of this preface to express my gratitude to these people.

First of all, I would like to thank my supervisor Jörn Block, who gave me the opportunity to pursue this dissertation as an external PhD student and supported me intensively throughout the entire process. Without his valuable advice and guidance, this research project would not have been possible in this depth. Furthermore, he has enabled me to grow personally as a researcher and as an individual through the ongoing challenges of this project. I am grateful for all that I have learned over the years and hope that our collaboration will continue in future research projects.

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In this section, I would like to thank my friends who have always been a source of motivation, inspiration, and support during the past 3.5 years. In particular, I would like to thank Sina, Alex, Daniel, Louis, Simon, and Ferdinand for the precious time, conversations, and shared activities that have always provided me with a great balance. I would also like to thank Joseph and Alex for the deep friendship that has united us since our time together in California, and I appreciate your native language support. A special thank you also goes to my close friend Berry, who has always pushed me forward and given me opportunities I could never have imagined.

Finally, I would like to express my deepest gratitude to my beloved girlfriend Lina. Thank you for your support, your understanding, and your unique and inspiring perspective on many things that make me a better and happier person. Of course, that includes Angela, Burkhard, Tika and the rest of the extended family. Most of all, I am extremely grateful to my family for the endless support they give me at every stage of my life. Thank you, Karin and Jörg, for being such incredibly strong, persevering, and caring parents, and thank you, Alexander, for being such a great, inspiring, and motivating brother. This thesis is dedicated to you

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Abbreviations

3D	Three dimensional
B2B	Business to Business
B2C	Business to Customer
CA	Conjoint Analysis
CBC	Choice Based Conjoint Analysis
CEO	Chief Executive Officer
CNC	Computerized Numerical Control
CTO	Chief Technology Officer
CVA	Conjoint Value Analysis
DARPA	Defense Advanced Research Projects Agency
DIT	Do-it-together
DIWO	Do-it-with-others
DIY	Do-it-yourself
EU	European Union
FabLab	Fabrication Laboratory
HLM	Hierarchical Linear Modelling
HP	Horsepower
IMLS	Institute for Museum and Library Services
IPR	Intellectual Property Rights
K-12	Kindergarten to 12^{th} grade
M&A	Mergers and Acquisition
MIT	Massachusetts Institute of Technology
NDA	Non-disclosure agreement

NSF	National Science Foundation
OLS	Ordinary Least Squares
OS	Open Source
R&D	Research and Development
RBC	Rating-based Conjoint Analysis
RQ	Research Question
SCT	Self-Categorization Theory
SDT	Self-Determinational Theory
SIT	Social Identity Theory
STEM	Science, Technology, Engineering and Math
VC	Venture Capital
VOW	Verband offener Werkstätten

Zusammenfassung

In den letzten Jahren hat die Einrichtung neuer Makerspaces, in Deutschland, erheblich zugenommen. Das zugrundeliegende Phänomen der Maker-Bewegung (engl.: Maker Movement) ist eine kulturelle und technologische Bewegung, die sich auf die Herstellung physischer und digitaler Produkte unter Verwendung von Open-Source-Prinzipien, kollaborativer Produktion und individueller Ermächtigung konzentriert. Aufgrund ihres Potenzials, den Innovations- und Produktionsprozess zu demokratisieren, Einzelpersonen und Gemeinschaften zu mehr Selbstständigkeit zu befähigen und Innovatoren in die Lage zu versetzen, Probleme auf lokaler Ebene zu lösen, hat die Maker-Bewegung in den letzten Jahren stark an Aufmerksamkeit gewonnen.

Trotz zahlreicher Indikatoren ist nur wenig über das Phänomen und die einzelnen Mitglieder bekannt, insbesondere in Deutschland. Erste Untersuchungen deuten darauf hin, dass die Maker-Bewegung großes Potenzial für Innovationen und das Unternehmertum birgt. Allerdings gibt es immer noch eine Lücke im Verständnis darüber, wie MakerInnen unternehmerische Gelegenheiten entdecken, bewerten und nutzen. Darüber hinaus ist es immer noch umstritten – sowohl unter politischen Entscheidungsträgern als auch in der Maker-Community selbst – welchen Einfluss die Maker-Bewegung auf Innovation und Unternehmertum in der Zukunft hat und haben kann.

Durch die Beantwortung offener Forschungsfragen zielt diese Dissertation darauf ab, ein besseres Verständnis der heterogenen Individuen, die in die Maker-Bewegung involviert sind, einschließlich ihrer Charakteristika, Motivationen und Identitäten zu schaffen. Darüber hinaus wird in dieser Dissertation die Bedeutung der verschiedenen Eigenschaften der MakerInnen bei der Bewertung von unternehmerischen Möglichkeiten analysiert, um einen Beitrag zur Verknüpfung zwischen der Maker-Bewegung und dem Unternehmertum zu leisten.

Nachdem Kapitel 1 die Motivation und den Aufbau der Dissertation beschreibt, bilden Kapitel 2 und Kapitel 3 das theoretische Fundament dieser Arbeit. In diesen Kapiteln wird der aktuelle Stand der Wissenschaft zum Maker Movement und unternehmerischen Gelegenheiten herausgearbeitet. Kapitel 4 untersucht qualitativ, welche Attribute für MakerInnen wichtig sind, wenn sie unternehmerische Gelegenheiten bewerten und beleuchtet die Motivation von Individuen, als Maker oder Makerin aktiv zu sein. Damit bildet Kapitel 5 die Grundlage für den Aufbau der Studie und die Beschreibung der Methodik. In diesem wird die Analyse-Methode des Conjoint Experiments und des verwendeten Fragebogen beschrieben. Weiterhin wird erörtert, welche Stichprobe im Rahmen der Studie untersucht wurde und anhand welcher Kriterien die Auswahl innerhalb der Stichprobe getroffen wurde.

Als erstes Ergebnis-Kapitel liefert Kapitel 6 deskriptive Ergebnisse zu den MakerInnen, den Individuen im Rahmen des Maker Movement. Dabei werden demographische Faktoren erfasst, die Erfahrung der TeilnehmerInnen im Rahmen des Maker Movement untersucht, individuelle Motivation näher betrachtet und die unternehmerischen Erfahrungen und Ambitionen der TeilnehmerInnen beleuchtet. Kapitel 7 untersucht die Bewertung unternehmerischer Gelegenheiten durch MakerInnen, um zu verstehen, aus welchen Gründen Menschen innerhalb des Maker Movement es als attraktive Möglichkeit erachten, unternehmerisch aktiv zu werden. Dabei wird im Rahmen eines Conjoint-Szenarios die Wichtigkeit von fünf Attributen – Attraktivität des Marktes, Schutz von geistigem Eigentum, sozialer Impact, Technische Herausforderung und Team-PartnerInnen – untersucht. Weiterhin wird beleuchtet, ob individuelle Charakteristika der MakerInnen Auswirkungen auf die Bewertung der unternehmerischen Gelegenheiten haben. Kapitel 8 betrachtet die Identität von MakerInnen im Detail und zeigt auf, dass sich innerhalb des Maker Movement drei verschiedene Identitäten identifizieren lassen. Diese weisen verschiedene Motivationen und Ansichten auf und zeigen, dass unternehmerische Gelegenheiten unterschiedlich bewertet werden. Kapitel 9 fokussiert einen speziellen Teil der Studie und untersucht die Charakteristika und Bewertung von unternehmerischen Gelegenheiten bei MakerInnen in Makerspaces an Universitäten und Hochschulen im Speziellen.

Damit liefert diese Dissertation zusätzlich einen Beitrag für die Literatur im Forschungsfeld Academic Entrepreneurship, einer speziellen Literatur-Strömung, die Unternehmertum im Rahmen von Bildungsinstitutionen erforscht.

Die Ergebnisse im Rahmen dieser Dissertation weiten die Forschung im Bereich des Maker Movement weiter aus und bieten zahlreiche verschiedene Implikationen für die Praxis. Diese Arbeit liefert erste quantitative Daten zu MakerInnen in Makerspaces in Deutschland, ihren Charakteristika und Motivationen. Insbesondere wird die Beziehung des Maker Movements zum Unternehmertum erstmals eingehend beleuchtet. Ergänzt wird dies durch die Darstellung verschiedener Identitätsprofile bezüglich der involvierten Individuen. Dies ermöglicht Verantwortlichen mit Bezug zum Thema ein besseres Verständnis für die Bewegung, Persönlichkeiten und Werte zu entwickeln und in Initiativen und Formaten zu berücksichtigen.

Weiterhin unterstützten die Erkenntnisse Verantwortliche in Politik, Administration und Wirtschaft dabei die Relevanz und Nutzung von Makerspaces im Rahmen von Bildungs-, Innovations- und Entrepreneurship-Initiativen besser zu verstehen und zu fördern.

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1 Introduction

1.1 Motivation

The past decade has seen a significant increase in the establishment of new makerspaces. The underlying phenomenon of the Maker Movement is a cultural and technological movement that focuses on creating physical and digital products using open source principles, collaborative production, and individual empowerment. Because of its potential to democratize the process of innovation and production, it empowers individuals and communities to become more self-sufficient and enable innovators to solve problems locally, the Maker Movement has gained significant attention in recent years. Just recently, the Covid-19 pandemic was a painful reminder of how dependent the global community has become on complex supply chains and micro-distributed processes. There has been a dramatic decline in the ability to produce goods and services locally and regionally. In addition, there is widespread concern that the once innovative power of countries, like Germany, is in decline and that the prosperity and solidarity of society are increasingly being eroded.

Makerspaces provide a physical place for local communities to meet and get involved with tools and technologies. They provide an environment for learning, working together and innovation. Users include people from all walks of life, with many having technical backgrounds. Driven by diverse motivations and goals, makers come together in makerspaces to tackle things themselves. During the first current phase of the Covid-19 pandemic in early 2020, makerspaces provided protective equipment (e.g., face shields) when supply chains and the government couldn't, by making it themselves locally (called "Maker vs. Virus"). For a short period of time, it was apparent what innovative power these communities could create when barriers to accessing knowledge, materials and production facilities are dissolved. As part of the ‘We vs. Virus’ hackathon initiated by the German government, research institutes, companies and private individuals, including many makers, collaborated to rapidly develop solutions for a current problem.

Not only since then have policy-makers seen great promise in the Maker Movement but in 2014, President Obama introduced a campaign for the United States to be and become ‘A Nation of Makers’. Obama emphasized the importance of education and the expansion of resources for maker entrepreneurs as well as the development of advanced manufacturing in the United States. (The White House 2016) In Europe, the European commission fosters the Maker Movement as part of a campaign linked to “spreading the culture of Digital Manufacturing and Industry 4.0, which are keys to make the European economy flourish again” (EU Policy Lab 2016). In 2015, a strategy regarding "mass makerspaces" was presented in China. It was intended to promote self-making and self-entrepreneurship to boost the democratization and acceleration of innovation, technology and scientific achievements. (Lindtner 2015) In addition, to its potential for economic development, the maker mindset meets the current zeitgeist and is mentioned frequently as a promising tool within the field of education as it stresses a hands-on mentality and encourages learning-by-doing. Consequently, the number of makerspaces in local communities and educational institutions (e.g. universities) grew rapidly.

To date, only little research has quantitatively investigated the growth of the Maker Movement makerspaces (Halbinger 2018; Cuntz & Peuckert 2023). Although the Maker Movement is a recent phenomenon, the lack of sufficient data complicates the analysis of growing impact from this field. Regarding the number of makerspaces and involved makers, measurement problems complicate growth studies. Furthermore, there is a great heterogeneity of makerspaces, related concepts e.g. FabLab’s and the individuals involved which has hardly been studied in detail so far. Considering a possible positive relationship between the Maker Movement and entrepreneurship, there are only sporadic indications (Browder et al. 2019a; Cuntz & Peuckert 2023). Initial studies also suggest tensions between the open source ideology prevalent in the Maker Movement and venture creation with a commercial orientation (Hausberg & Spaeth 2020).

Prior research shows that intrinsic motivations play a decisive role in the engagement of makers in makerspaces (Mauroner 2017). For instance, they are motivated by a desire to solve problems, improve upon existing designs, or simply bring something new and innovative into the world.

Makers are often driven by a sense of curiosity and a desire to learn and understand how things work. Enjoying the process of making itself, makers are driven by a desire to make a positive impact on the world, whether through the creation of practical solutions to real-world problems or by simply bringing joy and inspiration to others through their creations. The demographic characteristics of makers are diverse and varied, reflecting the wide range of interests and motivations that drive individuals to engage in making. However, first evidence suggests that a majority of makers are male, technically-oriented and well educated. As a result of the increasingly diverse landscape of makerspaces, there is a progressively diverse picture of the individuals involved. To date, there is a research gap regarding the characteristics of makers.

Prior research shows that makers discover entrepreneurial opportunities while working on their projects, sometimes even rather accidentally (Halbinger 2018). However, many of them decide to engage in entrepreneurship and start a small business. In addition, growth entrepreneurs use makerspaces to produce prototypes or produce small badges of their first product ideas. For instance, the founders of Square, Jack Dorsey and Jim McKelvey manufactured their first prototype in a makerspace in California. Several publications emphasize the promising opportunities for entrepreneurship that the Maker Movement holds (van Holm 2015; Aldrich 2014). To date, however, there is a knowledge gap about how makers discover, evaluate and exploit entrepreneurial opportunities. Furthermore, it is still controversial what impact the Maker Movement really has on innovation and entrepreneurship and may have in the future, including differing views from outside (e.g. policy-makers) and inside (e.g. the maker community) regarding the role and expectations for the Maker Movement (Ferretti & van Lente 2022).

The multi-faceted nature of this emerging phenomenon and the related research opportunities inspired me to contribute to a better understanding of makers and makerspaces. Therefore, this dissertation addresses the characteristics of makers in German makerspaces and explores more closely how they interact with entrepreneurial opportunities.

1.2 Objectives and research questions

The literature on the Maker Movement is relatively new and limited. This dissertation provides exploratory insights into the Maker Movement and the individuals involved. This is essential in order to derive practical implications, understand the entrepreneurial potential of the movement, and promote it in a targeted manner. I then pose the following research questions regarding the characteristics of makers.

Descriptive statistics (Chapter 6)

RQ1: *What are the demographic characteristics of makers?*

RQ2: *Which entrepreneurial activities and interests are present among makers in makerspaces?*

RQ3: *What are the main motives for makers to be active in makerspaces?*

Prior research uses different terms to refer to the intersection of makers and entrepreneurship, including maker entrepreneurship, maker entrepreneurs and accidental entrepreneurs (Mauroner 2017; Troxler & Wolf 2017; Greenberg et al. 2020; Bergman & McMullen 2020). While there are sporadic empirical research studies on the topic of Maker Movement in the strategy and management literature (Dhebar 2016; Davis 2016; Kohler 2015; Kortmann & Piller 2015; Furnari 2014), literature regarding the relationship of the Maker Movement itself and its relationship to entrepreneurship is underdeveloped (Aldrich 2014; Halbinger 2018; Hamalainen & Karjalainen 2017; van Holm 2015; Mortara & Parisot 2016). While this fruitful connection is indicated in several studies, the relationship and mechanisms how the Maker Movement might foster entrepreneurship are poorly researched and thus not sufficient for policy makers and other stakeholders who want to consider and utilize the Maker Movement's potential as a catalyst for economic growth (Holman 2015; Zakoth & Mauroner 2020). There is a critical need to understand whether makers are interested in entrepreneurship in the first place, when and how they become interested, and how they evaluate entrepreneurial opportunities when discovering them. Following this, I pose the following research questions:

Conjoint analysis (Chapter 7)

RQ4: *Which attributes matter to the makers when they evaluate the attractiveness of entrepreneurial opportunities?*

RQ5: *How do individual characteristics and motivations affect the evaluation of entrepreneurial opportunities?*

Research indicates a high degree of heterogeneity among the individuals involved in the Maker Movement. Based on paradigms from the entrepreneurship literature regarding founder identities (Fauchart & Gruber 2011), I propose that there are different identities with different personal traits among the makers as well. In order to test these assumptions, the following research questions are developed:

Maker identities (Chapter 8)

RQ6: *Which maker identities can be derived from the different motivations and characteristics of makers?*

RQ7: *How do the different maker identities affect the evaluation of entrepreneurial opportunities?*

Literature on the Maker Movement has focused heavily on its implications for education. K-12 schools have been the primary focus of these publications, while higher education has been explored rarely. Therefore, the following research questions were defined with an emphasis on university-based makerspaces:

Academic makers in university-based makerspaces (Chapter 9)

RQ8: *What are the characteristics, entrepreneurial interests and motives of academic makers in university-based makerspaces?*

RQ9: *Which attributes matter to the academic makers when they evaluate the attractiveness of entrepreneurial opportunities?*

1.3 Dissertation structure

The dissertation is structured into seven chapters (see Figure 1).

In the first chapter I outline the motivation to address this research field, describe the objectives and proposed research questions and present the structure of the dissertation.

Following this, chapters 2 and 3 establish the theoretical basis for the empirical part of the thesis. Thereby, chapter 2 addresses the Maker Movement and describes the central concepts of the phenomena. In addition, previous research linking makers and entrepreneurship will be discussed. Moreover, the physical meeting points of the makers, makerspaces, are described in more detail and differentiated on the basis of their characteristics.

Chapter 3 concludes the theoretical foundation by reviewing the literature on entrepreneurial opportunities and explaining the relevant concepts in the context of this thesis.

Chapter 4 builds on the theoretical concepts of the Maker Movement and provides the first empirical components of the thesis. Qualitative semi-structured interviews with makers and Maker Movement experts are used to investigate the entrepreneurial activities and motivations of makers in depth. These findings combined with secondary data from literature serve as the foundation for choosing the decision criteria for the metric conjoint experiment.

Chapter 5 covers all facets of (metric) conjoint analysis from planning to execution, as well as the theoretical pillars of this methodology. First, the structure of the conjoint analysis with the most important elements and the functionality of the methodology are outlined. Furthermore, similar research in this field will be presented and their most important findings will be described. Second, based on these insights, the design and realization of the quantitative study is described using an established procedure. This includes all facets of the metric conjoint experiment as well as the standardized post-questionnaire.

Chapter 6 provides the descriptive results of 307 makers from the conjoint analysis and the follow-up questionnaire. In addition to the descriptive data analysis, the research questions regarding the characteristics, motivations and entrepreneurial activities of the makers are answered. As the first results section, this chapter provides valuable insights into a phenomenon that has been little researched empirically to date.

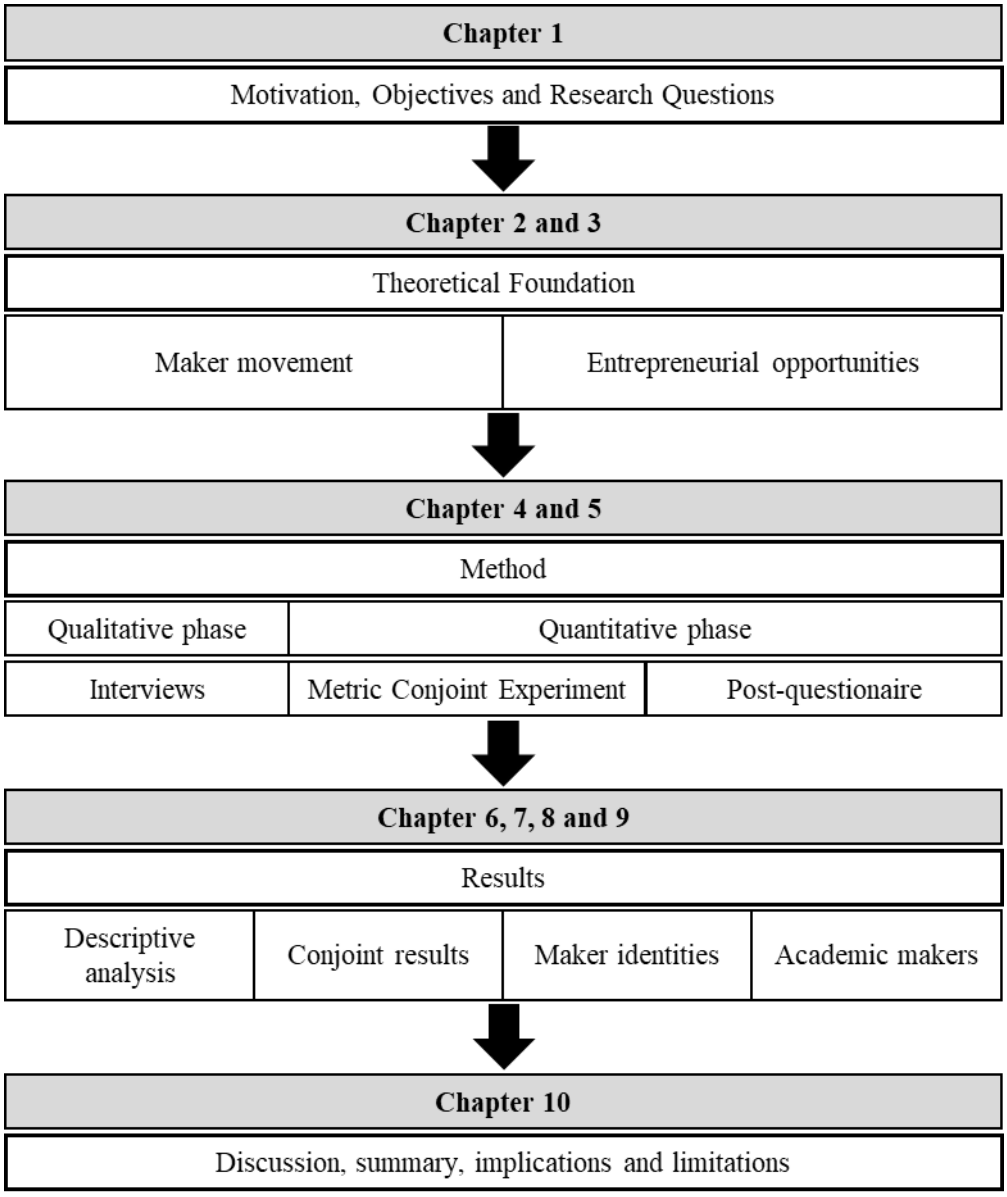
Chapter 7 presents the results of the metric conjoint experiment, the regression models and control variables. Thereby, the relative importance of makers' decision criteria is central. Moreover, interactions regarding attributes are explored.

Chapter 8 describes the development of three different maker identities, their characteristics, underlying motivations and impact with regard to opportunity evaluation.

Chapter 9 offers a more sophisticated refinement of the results by focusing particularly on the sub-sample of university-based makerspaces and extracting results for the intensively frequented academic entrepreneurship domain.

Chapter 10 concludes the thesis with a summary, along with a contextualization of relevant theoretical and literary currents, implications for practice, limitations, as well as directions for future research.

Figure 1: Dissertation structure



Source: Own illustration

2 Maker Movement

In this chapter I will provide an overview of the Maker Movement. After a brief introduction regarding the status quo, I will describe the central underlying concepts and dimensions that characterize the Maker Movement. Following this, I will take a closer look at the external factors that have led to these new developments. Bridging to the second major theme of this thesis, I will then discuss the Maker Movement's relationship to entrepreneurship, review the initial research on maker motivation and give a brief overview of the related literature.

2.1 Overview and definition

The Maker Movement is a growing global phenomenon consisting of individuals utilizing technology to collaborate in creating tangible, material artifacts (Anderson 2012; Browder et al. 2017). Furthermore, the movement reflects increasing interested in craft modes of production, the value of working with one's hands (Crawford 2009) and stresses innovative applications of technologies, such as 3D-printing, and fosters invention and prototyping (Mauroner 2017; Pütz 2021). Access to these resources has become possible for larger groups of people in recent years due to lowered barriers, the sharing of technology tools in social spaces and the encouraged emerging amount of collaborations on physical projects. At this point it is often referred to the democratization of invention and innovation that made this movement possible in the first place. (Blikstein 2014; Hippel 2005) With regard to the success of the internet, the democratization of the digital space has opened up many opportunities for makers and hackers and as a result spurred entrepreneurship and economic growth. (Anderson 2012) Recent research highlights, that the promising possibilities of transferring this movement into the physical space, might create opportunities beyond imagination and could be a starting point for the 'next industrial revolution'. (Browder et al. 2019a)

The Maker Movement can be dictated within the framework of current research interests on socio-economic changes. Thereby, blurring boundaries exist to other developments and research streams such as the Do-it-yourself (DIY)-culture (Browder et al. 2019a), sharing economy (Hamari et al. 2016; Schor 2016; Kortmann & Piller 2015) crowdfunding (Drover et al. 2017; Mollick 2014), open innovation

(Chesbrough 2006; West & Bogers 2014), low-cost experimentation (Kerr et al. 2014) and user-entrepreneurship (Shah & Tripsas 2007).

Research investigating the Maker Movement increased over the last decade (Browder et al. 2019a; Sterzenbach 2019; Lou & Peek 2016). (For a bibliographic review see Sharma (2021).) Several means related to the Maker Movement have been researched by scholars, such as the impact of the Maker Movement on education (Halverson & Sheridan 2014; Martin 2015), the potential of the Maker Movement to drive innovation, economic development and entrepreneurship (Browder et al. 2019a; van Holm 2015). Moreover, the social and cultural aspect of the Maker Movement, the Maker Movements role in urban development (Wolf-Powers et al. 2017), the role of makerspaces within the Maker Movement (Halbinger 2018; Sheridan et al. 2014) and the ethical implications of the Maker Movement (Marotta 2022) have been studied. In addition, prior research investigated the individuals involved in the Maker Movement, including gender and diversity (Eckhardt et al. 2021), motivations, entrepreneurial activities and educational background (Hausberg & Spaeth 2020; Kwon & Lee 2017). Moreover, scholars shed light on the intersection of the Maker Movement and sustainability (Millard et al. 2018) and its integration into traditional industries as well as certain industry branches (Rieken et al. 2020; Zakoth et al. 2023). Recently, researchers gained interest regarding the role of the Maker Movement in the fight against the Covid-19 pandemic (Browder et al. 2022b; Corsini et al. 2020).

Policy makers all over the world believe that initiatives that encourage making will lead to increasing innovation and improved economic growth (Browder et al. 2017; BMBF 2018; van Holm 2015). As a result, makerspaces have quickly become essential parts for universities, large enterprises and communities looking to foster innovation and entrepreneurship (Bergman & McMullen 2020). In the United States, the Defense Advanced Research Projects Agency (DARPA) and other funding agencies such as the National Science Foundation (NSF) and the Institute for Museum and Library Services (IMLS) provide grant funding to initiatives within the Maker Movement. (Martin 2015) Thereby, a particular focus is placed on the interconnection between making and education. In 2014, former President Barack Obama introduced a campaign for the United States to become ‘A Nation of Makers’.

Obama emphasized the importance of education and the expansion of resources for maker entrepreneurs as well as the development of advanced manufacturing in the United States. (The White House 2016) In Europe, the European commission fosters the Maker Movement. Thereby the EU emphasized that the European continent is home to the highest number of makerspaces in the world. The support of the Maker Movement is especially linked to “spreading the culture of Digital Manufacturing and Industry 4.0, which are keys to make the European economy flourish again” (EU Policy Lab 2016). The focus on promoting economic growth, manufacturing and education is similar to that in the USA. This strategy is complemented by the dynamics of the individual member states, which must be considered. (Bachter & Mendez 2016; Howard et al. 2014) In this way, transnational projects are given special support, as the EU-funded DIGINOVA project, an association of 20 European countries, illustrates. (Rosa et al. 2017) As part of the EU, the German government has implemented a number of policies to support the Maker Movement as well. In particular, this includes embedding the Maker Movement as an element of the national high-tech strategy (BMBF 2018). In addition, the government promotes the use of digital fabrication tools and technologies in educational institutions like schools and universities, through programs such as makerspaces, FabLab’s and maker education (BMBF 2022; Ministry of Economics, Labor and Tourism Baden-Württemberg 2022). In 2015, a strategy regarding "mass makerspaces" was presented by the Chinese government. It is intended to promote self-making and self-entrepreneurship to boost the democratization and acceleration of innovation, technology and scientific achievements. Thus, economic growth is to be specifically promoted through entrepreneurs, financing and innovation hubs. (Lindtner 2015) Alongside the major economic areas, it is becoming apparent that there is also a rapidly growing interest in the Maker Movement in emerging economies (Levie et al. 2014). Entrepreneurship-rates in emerging economies are higher compared to further developed countries leading to a higher number of necessity-entrepreneurs (Reynolds 2001). The opportunity for democratized access to production and reduced entry barriers have attracted the attention of policy makers and social entrepreneurs, who are interested in workforce education and human capacity development on a large societal scale. (Linna 2013; Ponelis & Holmner 2015) Thus, for larger parts of the population, there might be opportunities to become

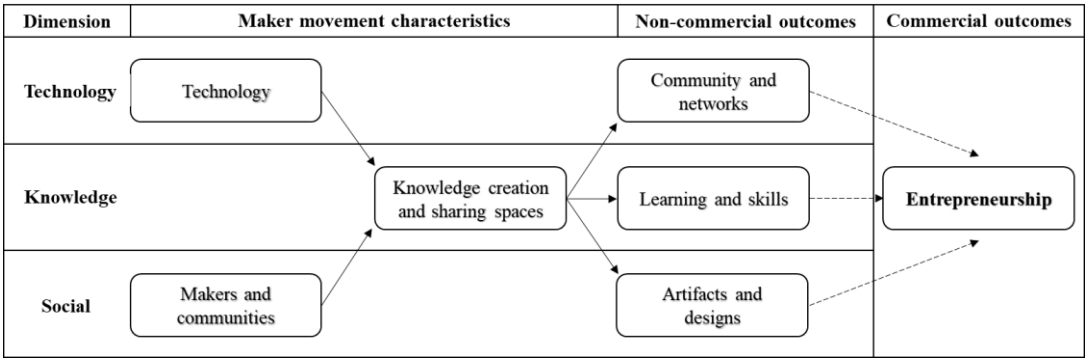
part of the global economy beyond being merely consumers at the bottom of the pyramid. (Prahalad 2012) In contrast to these opportunities, challenges remain in distributing access to these opportunities equally and comprehensively. Overall, the Maker Movement offers far-reaching opportunities for pioneering technology entrepreneurs in these markets to tackle the challenges of their societies in an entrepreneurial way. (Koh et al. 2016; Pan 2014; Linna 2013)

Understanding the underlying dimensions, key elements and enabling factors of the Maker Movement is essential, when discussing the relevance for society, economic growth, entrepreneurship and innovation as well as its contributions to research.

2.2 Three key dimensions of the Maker Movement

The conceptual framework of the Maker Movement can be described using three key dimensions. In addition, there are a number of external enabling factors enabling and shaping the movement. The interconnection of these components provides a better understanding of the underlying relationships and mechanisms. The three (resource) dimensions of the Maker Movement are (1) technology, (2) social aspects e.g. the community, as well as (3) virtual and physical (maker) spaces where knowledge creation and the actual process of "making" takes place. Figure 2 shows a conceptual model of the Maker Movement phenomenon and its relation to entrepreneurship developed by Browder et al. (2019a). Since the model has proven to be very relevant and valuable during this project, it will be revisited several times within this dissertation.

Figure 2: Conceptual model of the Maker Movement and entrepreneurship



Source: Own illustration based on Browder et al. (2019)

2.2.1 Technology and the democratization of innovation

Technology is a central element of the Maker Movement (Browder et al. 2019a; Aldrich & Browder 2020; Halbinger 2018). Both, technology and the associated tools are central to enabling maker projects to actually be realized. There is a great heterogeneity in terms of the tools available and the associated design and production capabilities, such as associated software and licensing options. There are no specifications as to what equipment a makerspace must possess in order to be defined as a makerspace. However, some standard inventories are visible when reviewing makerspace interiors around the globe. First, 3D printers have become a symbol of makerspace equipment and represent a new wave of DIY and open source like no other tool. Second, makerspaces usually provide digital facilities like laser cutters, CNC machines, micro-controller kits (e.g. Arduino and Raspberry Pi) and programming tools (Anderson 2012; Hatch 2014; Maietta & Aliverti 2015). In addition, makerspaces usually provide hardware tools for wood, metal, textile and plastic treatment. Beside some elements, which have established themselves as a standard and occur in a number of spaces, there is also specialized and exotic equipment, e.g. from the biotechnology sector (Schmieder & Andrew-Wani 2014; Kera 2014).

The available tools and technologies are usually related to the orientation and focus of the makerspace and its community (e.g. textiles, electronics, wood). In some cases, the equipment may change over time as challenges and projects shift and the makerspaces develop. Moreover, sponsorships from companies like Autodesk, from the design software sector, RaspberryPi or Arduino, a micro-controller company, illustrate that the movement is also interesting for manufacturers operating in this market. (Browder et al. 2019a) The ability to combine digital and physical tools in a way that enables a complete value creation process from design to finished product in collaboration with people everywhere on the whole planet, offers enormous opportunities for the Maker Movement (Merfeld 2014).

Table 1 contains a list of various devices and tools that can be found in makerspaces. At this point, the frequency and completeness of the available devices cannot be specified more precisely within this research project. The objective of this table is to give an initial overview of the variety and form of the devices and tools used.

Table 1: Tools used in makerspaces

Category	Tools & Technologies
Hybrid	3D-printers • Fused Deposition Modelling (FDM) – most popular • Stereolithography (SLA) • Selective Laser Sintering (SLS) • Direct Metal Laser Sintering (DMLS) • Materials: Plastic, resins, metal (powder), nylon Lasercutter CNC milling machines Cutting plotters
Analogue and physical	Wood • Milling machines • Saws • Grinding machines • Drilling machines • Planing machines • Woodturning machines • etc. Metal • Milling machines • Lathes • Welding machines • Angle grinder • Beding machines • Edging bench • Sand blasting machine • Drilling • etc. Electronics • Soldering stations • Crimping pliers • Circuit board holder • Magnifiers • Hardware (Arduino, RaspberryPi, etc.) • Assembly automation • Measuring devices (Multimeter, etc.) • Fine pliers, tweezers • Laboratory power supplies • Reflow-oven • etc. Textile • Sewing machines • Embroidery machines • Knitting machines • Screen printing • Flocking machine • etc. Plastics processing • Thermoformer • Foil processing • etc.

	Various tools • Tools (screwdriver, etc.) • Pottery • Compressed air • Photo equipment • Melting furnace • Hot-glue guns • Vacuum press • Casting materials (resins, silicone, etc.) • etc. Community area • Coworking-area • Kitchen • Beamer, printer, books • etc.
Digital only	• Server • Virtual machines • Design and construction software • Website and documentation tools • Open source software and platforms • Community oriented software (discord, mailing lists, etc.) • Wi-Fi and routers (popular: Freifunk – own Wi-Fi)

Source: Own illustration

2.2.2 Makerspaces and maker faires

Makerspaces represent the second key dimension. Figure 2 illustrates that makerspaces are the (usually) physical locations where the social dimension and the technological dimension intersect and enable the Maker Movement to create something new and innovative (Carbonell et al. 2019; Browder et al. 2019b). The sharing of productive and design-related assets among makers implicates that individuals and groups often intersect with hardware and software tools around shared spaces. The social technology literature describes such spaces as communities of practice, focused on the acquisition of existing knowledge by practicing next to each other (Garud & Karnoe 2003). However, shared spaces within the framework of the Maker Movement reach out far beyond this description. They function as sources of innovative knowledge (Nonaka & Toyama 2015; Wu & Ma 2022) and create new loci of innovation (Matsui et al. 2022), not only within firms but also independent of organizations through collective experimentation and learning (Furnari 2014; Hargadon & Becky 2006). Cavalcanti (2013) characterizes makerspaces as places with different ranges of tools and project opportunities that enable creative ideas, local and municipality development, prototypes, complex projects and sometimes commercial business ideas by providing easy-to-use

machines and technologies. Usually the capacities and possibilities available at such spaces, cannot be found by hobbyists and professionals in their own places, which leads to an attracting effect on these groups.

A distinction is made between virtual and physical spaces (Loertscher 2015; Lock et al. 2020). Although there is a strong research interest in new organizational forms resulting from social and technological changes, there has been little research on the Maker Movement and the associated spaces (Browder et al. 2019a). However, interest has increased tremendously in recent years, resulting in a number of makerspace related publications (Gantert et al. 2022; Rayna & Striukova 2021; Kraus et al. 2022; Soomro et al. 2022; Sharma 2021; Mersand 2021; Loose).

Physical spaces are in the majority and places where the (craft) production of tangible products meets the social dimension and technology dimension. In the 1970s, Karl Hess launched the first open workshop concepts in Germany which exhibited quite a lot of similarities already (Seravalli 2014; Hess 1995). The term makerspace itself was little used until 2005. At that time, the Make Magazine was born.

The term became popular in 2011 when Make Magazine around Dale Dougherty registered the domain '*makerspace.com'*. (Cavalcanti 2013) Also because of this commercial origin of the term maker and makerspace, the movement is sometimes criticized. Individual people from the scene often consciously distance themselves from these terms as they identify with the dimensions incorporated, but do not agree with the commercial branding of the movement. (Hertz 2022) However, the term and the movement have extended way beyond the activities and connections of Make Magazine and the respective brand. The movement has taken on a life of its own.

In recent years there has been strong growth in the number of spaces (Halbinger 2018; Mersand 2021; Gantert et al. 2022; Sharma 2021). In 2016, with a total of over 1400, the growth rate was already fourteen times higher than in 2006 (Lou & Peek 2016; Whiting 2013; Elrod et al. 1992). Indications suggest the assumption that the number continues to grow rapidly (Halbinger 2018; Mersand 2021). However, current, reliable data is not directly available and points out interesting future research avenues.

In addition, scholars and practitioners aim to develop best-practice approaches for makerspaces (Oliver 2016a; Keune & Peppler 2019; Oliver 2016b) via numerous case-studies and other approaches (Zhao & Zou 2021; Sheridan et al. 2014).

Makerspaces feature various operating model models (Cautela et al. 2014; Gantert et al. 2022; Mersand 2021). While a majority is operated on a non-profit basis by non-profit associations or social enterprises, various commercial (business) models exist and emerge to date (Hafven Makerspace 2022; MotionLab Makerspace Berlin 2022; Tatcraft Makerspace Frankfurt 2022; brigk Makerspace Ingolstadt 2022). Some makerspaces emerged from communities that want to share knowledge and work on projects together. A well-known example is the ‘NYC Resistor’ makerspace. Often, makerspaces that are not founded by a community have a challenge in building such an important underlying community. (Wilczynski & Adrezin 2016) In the USA, a separate brand has even been created at this point. Under the name TechShop, a chain opened "America's First Nationwide Open-Access Public Workshop" (Hatch 2018).

While for-profit spaces tend to be larger and tend to have more members due to economic of scale reasons, the median across all categories is about less than 30 people per space. However, many workshops are not designed for all members to work simultaneously. As a rule of thumb, the number of usable workstations is a fraction of the members. However, these number vary substantially (Bergner 2017).

While makerspaces are usually intended to be open to a wide audience, there are also makerspaces that have a specific focus or emphasis, e.g. wood-work, electronics or textiles. More exotic examples include makerspaces that focus on science topics, such as biology (Walsh et al. 2017) or aerospace activities (Snyder et al. 2019).

Research on makerspaces to date is fairly recent and has focused on a number of different areas. However, there is a consensus that it is difficult to define the various concepts that exist, which is why a wide variety of approaches have developed. (Mersand 2021; Bergner 2017; Lange et al. 2016; Stokes et al. 2015) Because although the terms (open) workshop, makerspace, FabLab and hackerspace are often used synonymously (Dougherty & Conrad 2016), there may be existing key differences for some workshops (Cavalcanti 2013; Bockermann et al. 2021).

Thus, in the German-speaking world, there is also the linguistic challenge that open workshops, are also used as a kind of umbrella term for the different concepts and some makerspaces identify themselves as both open workshop and makerspace (Peppler et al. 2015). Therefore, within the next subchapters I will outline the various concepts.

Open workshops

Many facilities can be described as open workshops[1], where the focus for attendees is on hands-on work, new ways of sharing knowledge, and social purpose. Thus, there can also be connections to other (social) concepts such as food sharing (Bytzek 2022) or bike rental stations, which are often integrated in a local urban context. Open workshops can have completely different focuses and facilities. Thus, there are also concepts that focus on the repair of specific objects (Repair Café's), such as bicycles or electronic devices. Furthermore, there are also some workshops in the field of textiles. One common feature of open workshops is the membership in the association of open workshops (VOW). This is possible on a voluntary basis, but is very popular because important funding is provided to the landscape of open workshops through the network and the associated foundation: Anstiftung (gemeinnützige Stiftung (Anstiftung) 2022). In general, open workshops are often run by non-profit associations and usually provide a fairly open access point for people of all backgrounds. Commercial models in this segment are rare or even non-existent. Fees, if applicable, are usually solely used to cover costs and to maintain the operation. Just like hackerspaces, open workshops existed long before the term makerspaces became popular. However, due to the popularity and broad scope of the term makerspace, there is now a lot of overlap between these concepts and terms.

Hackerspaces

With the spread of computers, hackerspaces emerged. Thus, they were focused on analyzing, editing and modifying software (code) and computer-related hardware in most cases. Often, their goal is to find better and cheaper ways for existing and established processes or the repurposing of hardware.

[1] The German term for these is "Offene Werkstätten" (open workshops). The Association of Open Workshops (Verband offener Werkstätten (VOW)) is a dedicated organization for such workshops.

Usually, the participants are characterized by a strong computer science relation. (Mersand 2021; Bockermann et al. 2021; Murillo 2020; Cavalcanti 2013) In recent years, however, various other streams have emerged that specialize in other processes (e.g. bio-hacking). Especially in the Hackerspace communities the open source idea is strongly prevalent (Bockermann et al. 2021). Mixed forms have also formed in the area of hackerspaces. For instance, they can start as purely software-based types, but over the years other machines and tool areas are integrated. At this point, hybrid forms with makerspaces are created and existing.

FabLab's

While hackerspaces are often operated privately in smaller groups and clubs, a more structured form of movement has developed within the context of Fablab's. The abbreviation FabLab refers to a fabrication laboratory (Fabrikationslabor). Unlike the other terms, the term FabLab is defined quite precisely. While there is no legal review of requirements here. However, there are clear ideas and values that are recorded in a so-called charter (MIT FabLab 2022). In addition, there is a common network to which all FabLab's belong. (Mersand 2021) The inventor of the FabLab movement Neil Gershenfeld, created the course "*How to make almost anything*" at the Massachusetts Institute of Technology in 1998 and received extremely positive reactions. As for makerspaces to date, 3D printers and lasers were already being used in this first setting. The first FabLab after MIT was established in 2002 in India and it depicted a smaller replication of MIT's machinery. (Gershenfeld 2007; Mersand 2021). Nowadays, there are more than two thousand facilities worldwide. So far, the number of FabLab's has doubled approximately every 2 years. (Bockermann et al. 2021) The first german FabLab was founded in 2009 at the Rheinisch-Westfaelische Technische Hochschule (RWTH) in Aachen (Jordanova-Duda 2019). However, as these examples already show, FabLabs are often connected to educational institutions, e.g. higher education institutions and universities, and offer production capacities (only) to the students and employees at these institutions (Bockermann et al. 2021).

Makerspaces at universities and academic environments

Increasing numbers of schools (Halverson & Peppler 2018; Vossoughi & Bevan 2014) , libraries (Colegrove 2013) and universities are setting up academic

makerspaces in their facilities (Mersand 2021; Heinzel et al. 2020). At this point, a distinctive research streams has emerged, that focuses specifically on the use of makerspaces in (STEM-) learning (Martinez & Stager 2013; Bevan 2017; Sheridan et al. 2014; Benjes-Small et al. 2017; Rouse & Rouse 2022) and the role of makerspaces in libraries (Koh et al. 2019; Moorefield-Lang 2015a; Maceli 2019). Academic makerspaces are usually used for curriculum-based teaching inter-disciplinary programs such as engineering, business, design, architecture and arts. (Birtchnell et al. 2017; Paio et al. 2012; Kroski 2017) Furthermore, makerspaces might be involved in (open-) innovation efforts of universities, e.g. with companies (Zakoth et al. 2019). Moreover, in the course of growing efforts in the field of entrepreneurship in educational institutions, startups are also becoming a target group of these institutions. Examples include the *startuplab@FH* funding program (BMBF 2022), which supports makerspaces and related concepts at universities, or large makerspaces at universities in Bochum, Dortmund and Munich (Ruhr-Universität Bochum 2020; UnternehmerTUM Makerspace GmbH 2022). Makerspaces are therefore often embedded in the startup and entrepreneurship ecosystem of the respective institutions. The target group is usually solely the users from the particular institution. However, access for external visitors may be possible at some makerspaces.

Corporate makerspaces

Corporate makerspaces within enterprises are not represented in this study, but are also growing in numbers and research interest (Boehm 2018; Rieken et al. 2020). Examples of this can be found at Bosch Siemens Hausgeräte, Microsoft, Ford, Renault, Airbus and many other companies (BSH Hausgeräte GmbH 2018; Microsoft Garage 2022; Passebon 2014; Wijayasinha 2021; Kraft 2019). These spaces are usually used for internal innovation purposes and provide a platform for departments or the company's own product development projects, employee involvement possibilities (Huang et al. 2021) , as well as the development of startups (Nägele et al. 2018; Boehm 2018; Rieken et al. 2020) . They can have a closed or a semi-open character. Thus, open approaches try to bring together user feedback (and user innovations and approaches originating from the companies (Boehm 2018; Nägele et al. 2018). In the context of open innovation, various approaches and models have been developed. For instance, the establishment of industry-specific

makerspaces for collaboration projects between companies and makers (Zakoth & Mauroner 2020). Another interesting approach is offered by Bauhaus, a hardware chain store from Germany. The so-called Workers Point allows customers to learn and use the machines that are traditionally sold at Bauhaus in a makerspace with the support of a tool team (Workerspoint.de 2022; RTF1.de 2020). However, this does not seem to be aimed as a commercial operation of a makerspace but rather a new way of attracting and engaging customers.

Virtual makerspaces

Virtual makerspaces provide the infrastructure for processes related to design, communication, feedback and collaboration in the digital sphere. This enables the individuals, firms and organizations involved, to work on (software) projects independently of location and in a distributed manner. Consequently, these networks offer advantages in terms of access and resources e.g. time and cost. (Loertscher 2015; Lock et al. 2020; Lu 2019; Oliver et al. 2017) Examples for virtual spaces are Quirky, for aspiring inventors, Hackaday, a hardware collaboration community (Croidieu & Kim 2018) or InnoCentive, which specializes in corporate entrepreneurship associated with the crowdsourcing of innovative ideas (Chesbrough 2006; Hackaday 2018).

Mobile makerspaces

To date, mobile makerspaces have been considered a rather exotic phenomenon, but they are becoming increasingly popular due to their versatility (Moorefield-Lang 2015b). Especially for the first contact with the movement and first experiences with making-related content e.g. in schools, these location-independent solutions can be useful (Moorefield-Lang 2015b; Iwata et al. 2019) . It also allows makers to work on projects outside of the space, such as those to be built in specific locations within a municipality (Die Urbanisten e.V. 2022).

Maker Faires

Another way where makers physically meet are maker faires, which take place at local, regional and international level (Make Community LLC 2022). These events can be thought of as a kind of exhibition. Projects are showcased, the latest technologies and tools are presented, and various educational and informational booths are installed. Furthermore, they can also be described as a celebration of the

growing DIY movement and occasions where individual makers use the opportunity to show off. Moreover, the offer is considered to be a family event (O'Brien et al. 2016), as there are often many children on site and projects are kids-friendly. In addition, a commercial character is part of the concept. Companies use the opportunity to get in touch with the maker community, for example, to present new tools and products and to establish them in the community. (Meissner et al. 2019; Lindtner et al. 2016) Maker Faire's are a franchise of Make Magazine and therefore part of this brand. Dale Dougherty, who is also the founder of Make Magazine organized the first maker Faire in the San Francisco Bay Area in 2006. (Maker Faire Inc. 2017)

2.2.3 Social dimension and maker community

While some makers main reason to visit makerspaces is the need to use equipment that is otherwise not accessible to them, other makers have entirely different reasons for visiting. To them, it's the sharing, the collaboration and learning (Do-it-with-others (DIWO)/Do-it-together (DIT)), as well as the shared pizza with board games in the evening with other makers that motivates them to go to the makerspace. (Wang et al. 2015; Dougherty & Conrad 2016; Hatch 2018) Several developments in the field of open source and open hardware would not have been possible without this strong community (Benkler 2006). All this happens, both online and offline. Within the virtual space, the community supports each other in crowdsourcing or crowdfunding projects (Bergner 2017). The more important offline channel – the makerspace – functions as a community space. Likewise, individual makers learn from others and work together on projects, supporting each other's ideas and efforts (Dougherty & Conrad 2016). Recent examples of the scale and capabilities of the community include the *Maker vs. Virus* initiative and similar projects in the early stages of the Covid-19 pandemic. (Parth 2020; Creapolis Makerspace 2022; Browder et al. 2022a) In addition, some people enjoy the reputation and feedback in the community for their (complex) projects and ideas (Kwon & Lee 2017; Troxler & Wolf 2017).

For many makers, the feeling of social belonging and involvement has become part of their identity. They enjoy and seek exchange with like-minded people. Mutual values and interests create a strong sense of 'we' within these communities. (Stokes

et al. 2015) But, setting themselves apart from others strengthens this sense of ‘we’ as well. As a result, this can make it daunting and challenging for potential new members to become accepted as part of the community. They may feel discouraged or uncomfortable during this process. Therefore, it is an essential task for makerspaces to promote diversity and openness. (Davies 2017; Clapp et al. 2017) Overall, Wang et al. (2015) distinguishes between a community space and a space of communities. While in the case of the community space, only one community is strongly established, different communities overlap in a space of communities, which tends to imply a greater openness for new perspectives, people and values. Just how diverse and colorful the scene can be, becomes evident at events surrounding the Maker Movement, such as maker faires (see Chapter 2.2.2).

> *“I’ve always thought a little bit of a maker community as a collection of outsiders, people that don't fit in other places, you know. […] starting with geeks, but not limited to them. And therefore, as we get into things like an entrepreneurial or business question, sometimes it's just an interesting path. Of how do these outsiders fit into that world?”*
>
> *[Interview No. 7]*

2.2.4 External enablers of the Maker Movement

Besides the three key dimensions of the Maker Movement, external factors influence the movement and its dimensions. Those factors, shape, drive and enable the Maker Movement and affect the available resources and economic activities alongside this development (Davidsson 2015; Davidsson et al. 2020).

First, digitization causes a shift from analog to digitized design and production processes and differentiates the Maker Movement from artisan and craft movements of the past. (Browder et al. 2019a) This includes the spread of e-commerce and international shipping as well as easier access to international suppliers e.g. in China (Hagel et al. 2013). Thus, the boundaries between product makers and consumers are becoming increasingly blurred. Many makers now sell their products directly to customers on platforms like Etsy. (Chen 2013; Ramsauer & Piller 2014; Browder et al. 2019a) Virtual communication and interaction based on the internet, offer new possibilities and lower the respective barriers for sharing, sourcing, creating and

learning in the context of knowledge and (physical) artifacts e.g. in online repositories (Blohm et al. 2013; Yu et al. 2010; Lindtner et al. 2014). Gershenfeld & Euchner (2015) describe this development as the meeting of the digital and physical world, where each become objects in the other's spaces.

Second, economization expedites the pooling and sharing of resources, such as tools. In this way, the costs are distributed to a larger user base in society. A trend towards "renter-ship" rather than ownership can be observed and is also closely linked to the "sharing-economy". (Munger 2018) This development also benefits from the reduction of entry barriers and access to broad expertise and skills for a larger number of individuals. Thus, decreasing costs for individual technologies (e.g. 3D-printers) as well as increasing quality at equal or lower prices combined with the miniaturization of digital components are drivers of this influencing factor (Yu et al. 2010; Benkler 2006). Schumpeter's (1934)argument that only large hierarchical companies are active in the field of research and development (R&D) is therefore increasingly being challenged (Altmann et al. 2015; Baldwin & Hippel 2011; Lakhani et al. 2013). Furthermore, easy-access crowdfunding sites like Kickstarter provide seed capital for maker projects worldwide.

Third, collaboration influences the interactions of makers as they learn from each other, design projects jointly, contribute to other projects, or participate for example in crowdsourcing projects (Baier et al. 2016). A central development is the facilitated and promoted access and transfer of individual knowledge, such as designs, programs, equipment and production facilities, towards a collective community thought. (Afuah & Tucci 2012; Anderson 2012; Hatch 2014) This is further evident in the widespread use of open source software and hardware tools, public copyright licenses e.g. Creative Commens, common design file standards (e.g. stl-files) and maker faires, where people share their projects. (Li et al. 2019) This displays a contrary development compared to traditional intellectual property concepts as well as a high degree of appreciation and promotion of the values of shared knowledge. (Schor 2016; Greenstein et al. 2013)

Finally, user-innovation describes how communities of users – such as customers, developers, amateurs and professional – take initiative to contribute as innovators (Altmann et al. 2015). This development dissolves the formerly rigid boundaries

between consumers and producers and fosters experimental learning by gaining and utilizing first-hand knowledge (Kolb 2015). Users take on this role themselves by adapting existing products according to their ideas and a demand for personalization, creating a better user-experience for themselves (Hippel 2013), or by creating completely new products through user-entrepreneurship. (Baldwin & Hippel 2011; Kohler 2015; Shah & Tripsas 2007) In many cases, this leads to a visit in a makerspace.

2.3 Entrepreneurship and the Maker Movement

The previous chapter outlined the key dimensions of the Maker Movement and indicated first evidence for commercial and non-commercial outcomes of the Maker Movement. So far, little is known about the transition effects between these two outcomes. Therefore, in this chapter I will examine the entrepreneurial activities and potential of the Maker Movement, exploring the different ways and degrees of entrepreneurial actions in which makers are using new technologies, platforms, and business models to bring their ideas to market. In addition, I will shed light on the connection to related research streams such as user-entrepreneurship and inventors.

2.3.1 Entrepreneurial outcomes of the Maker Movement

Considering the three dimensions of the Maker Movement (see Chapter 2.2), scholars identified several potential entrepreneurial outcomes of the Maker Movement. First, looking at the technological dimension of the Maker Movement, the creation of prototypes holds great potential for entrepreneurial outcomes (Mauroner 2017; Hui & Gerber 2017). For instance, startups can test their early product ideas in order to test product-market fit and product capabilities (Heckel 2022). In addition, artifacts and designs can become direct products for sale at different scale. Second, within the social dimension, makers can find co-founders and entrepreneurial teams for their entrepreneurial activities. (Browder et al. 2019a) In addition, the maker community offers great opportunities for testing potential products and can also be a starting point for finding the first interested customers. Moreover, the maker community offers possibilities for flexible labor and project-related work possibilities (Halbinger 2014). Third, the knowledge dimension enables entrepreneurial outcomes within the learning-related activities of makers. For instance, projects that started as small experiments might evolve into entrepreneurial projects throughout the learning

process. (Halbinger 2018) In addition, makers can increase their skills while working on their projects or instructor-led trainings offered within makerspaces. (Nonaka et al. 2006)

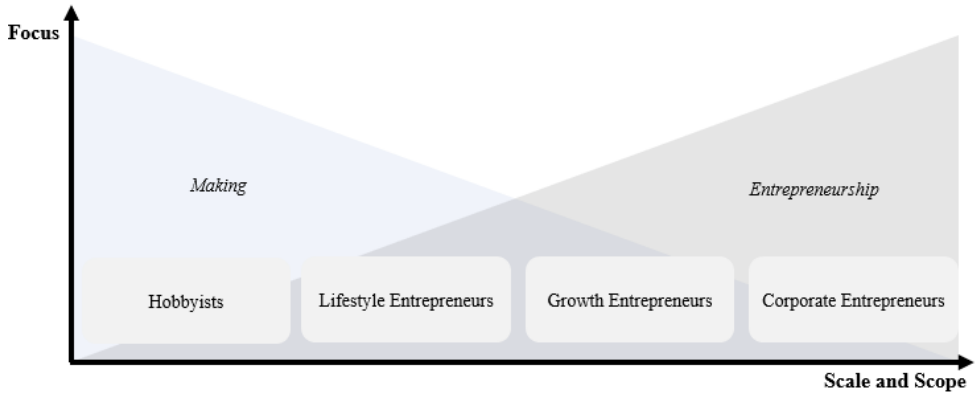
However, despite these first indications for entrepreneurial outcomes of the Maker Movement, little is known about the transition between non-commercial and commercial outcomes of the Maker Movement (Langley et al. 2017). Therefore, researchers call for further investigation of the conditions that enable entrepreneurial outcomes within the Maker Movement (Halbinger 2018; Browder et al. 2019a). In order to follow this request, I will describe the entrepreneurial interest and activities within the next subchapter.

2.3.2 Makers' and their entrepreneurial activities and potential

As already seen in the previous chapters, the individuals involved in the Maker Movement include various personalities, motivations, knowledge, origins and demands. While by far not all makers have entrepreneurial intentions and interest, prior research observed a spectrum of entrepreneurial activity among makers (Browder et al. 2017; Halbinger 2014, 2018; Hienerth 2006).

Whereas, only few empirical studies investigated the linkages between the Maker Movement and entrepreneurship, scholars developed conceptual approaches to map the transition between these two research streams (Halbinger 2018; van Holm 2015; Mortara & Parisot 2016). Thereby, several studies observed differences regarding scale and scope of the individual projects with regard to entrepreneurial intent and action distinguishing four categories of makers regarding their entrepreneurial activities and interest (Browder et al. 2017; van Holm 2015; Halbinger 2014). Following this, Figure 3 illustrates different types of makers within the linkage of entrepreneurship and the Maker Movement.

Figure 3: Entrepreneurship among makers



Source: Own illustration based on Browder et al. (2017).

First, Hobbyists are tinkerers and craftsmen with limited scale and scope. For them, the making process itself is their main focus. Some of them might recognize that others are interested in their products and may try to purchase them. In some cases, makers will decide do increase their income, serve individual customers with their products or offer their expertise to other makers. Therefore, maker entrepreneurs use platforms like Etsy[2] or Tindie[3].

Once an entrepreneurial opportunity is discovered on this path or a small business is initiated, this group is considered lifestyle entrepreneurs. These second sub-group of makers show more entrepreneurial actions and have higher entrepreneurial interest than hobbyists.

Many products offered by this group have a consumer focus and are part of crowdfunding campaigns at Kickstarter[4] or Startnext[5]. Distribution channels can be platforms like Etsy.com or The Grommet. These offer new possibilities to make niche products accessible to a larger market and provide sales support (Pieri & Domeniconi 2016).

Third, growth entrepreneurs enter makerspaces usually when they already have an innovative product or business. They are interested in rapid prototyping, producing small batches and testing hypotheses regarding their products and business models.

[2] www.etsy.com
[3] www.tindie.com
[4] www.kickstarter.com
[5] www.startnext.com

Following this, research has investigated the role of makerspaces in the product development of (hardware) startups (Friessnig et al. 2018; Halbinger 2020). The shared facilities that makerspaces offer, provide startups with opportunities in terms of scarce resources and production facilities which would have been very limited before the Maker Movement arose. A well-known example for a successful startup that had its beginnings in a makerspace is the publicly listed company Block[6] (formerly Square). The success of the business-to-business company is mainly based on the prototyping of its credit-card reader for mobile phones in a makerspace in Silicon Valley. Thus, co-founder Jim McKelvey was able to test the business model and secure venture capital financing for the company. (Anderson 2012) Other examples of successful start-ups rooted in the German makerspace environment include ProGloves[7], Isar Aerospace[8] and air up[9] . (Bruckschlägel 2022; UnternehmerTUM Makerspace GmbH 2023) Moreover, research indicates that prototypes and patents increase the funding probability of new ventures in a positive way (Audretsch et al. 2012). Building on this, these factors underline the importance of prototypes in the context of a new business models, external financing and testing new products.

Finally, corporate innovators have also recognized the strengths of the Maker Movement and are trying to use them for their internal purposes (see chapter 2.2.2). Resources from R&D and product development are used to experiment with materials and processes, ideally leading to improvements and cost savings. In addition, the Maker Movement offers possibilities to foster intrapreneurship and an innovation-oriented mindset among the employees of corporates (Rieken et al. 2020). While large companies usually have their own R&D laboratories, most small and midsized companies do have limited capacities regarding tools, product development and research collaboration opportunities. As a result, some companies without own capacities in this area offer makerspace memberships, as incentives, for their staff to encourage creativity and innovation. In this way, more tools, greater flexibility and exchange possibilities within corporate structures are created. Examples for this

[6] Block offers financial services via the square platform.
[7] ProGlove is an IoT Startup, manufacturing sensor-based gloves for logistic purposes and more.
[8] Isar Aerospace is a 2018 founded German aerospace company based in Munich.
[9] air up is an innovative drinking system that can flavor water only by adding fragrance and using retro nasal smelling.

include the TechShop location in Detroit, where Ford is a corporate cooperation partner, or the shareholding of BMW at the UnternehmerTUM makerspace in Munich. (Browder et al. 2017; UnternehmerTUM Makerspace GmbH 2020)

Throughout the last paragraphs, it became evident that the Maker Movement and the associated individuals who participate virtually and physically in makerspaces offer great potential regarding the creation of new ventures and could spur economic development significantly. Nevertheless, there is still a considerable gap between the entailed potential and the outcomes in reality, to date. Building on this, scholars argue that the goal of policy makers, makerspace executives and entrepreneurs should be to work together and close this gap in order to fully unfold the contained potential. (Bergman & McMullen 2020; Browder et al. 2019a) However, too little is known about the motivations of makers and their actions resulting in entrepreneurial activity. Initial empirical studies suggest that attitude and subjective norm regarding entrepreneurship are among the most important parameters when it comes to understanding and stimulating entrepreneurial interest among makers (Koerkamp 2015). For example, Nair et al. (2019) argue that the probability of entrepreneurial activity among makers can be increased if they are brought into a state of mind called pre-entrepreneurs. Therefore, Nair et al. (2019) defined pre-entrepreneurs as "individuals who have built self-efficacy related to entrepreneurial skills and wish to build on these skills towards more enterprising activities." These findings suggest that early sensitization and education can be crucial in linking entrepreneurship and the Maker Movement in order to leverage the contained potential (Dahn et al. 2023). These early making-related efforts are part of maker education, which is of central importance and of great research interest especially in the area of academic makers (Peppler & Bender 2013; Peppler 2022).

However, besides early approaches to implement a maker mindset, it is important to foster initiatives that promote entrepreneurship directly within makerspaces (Wilczynski & Adrezin 2016; Heinzel & Stang, Richard, Seidl, Tobias 2020; Heinzel et al. 2020). For instance, there are makerspaces at universities that are directly integrated into the entrepreneurship activities of the institutions. In addition, there are special programs and funding for makers offered through federal support.

However, makerspaces, which are operated independently of institutions such as municipalities, universities or libraries, hardly access and use possibilities. At this point, the question arises whether entrepreneurial aspects are desired at all within some makerspaces.

Summarizing, entrepreneurship occurs in various forms within the scope of the Maker Movement. One element that intersects with the Maker Movement is user innovation and potentially resulting user entrepreneurship. Therefore, within the next subchapter, I will take a closer look at user innovation and its linkage to the Maker Movement.

2.3.3 User innovation within the Maker Movement

User innovation and user-entrepreneurship have already been identified as external influencing and enabling factors for the Maker Movement (see Chapter 2.2.4). Prior research suggests that makers frequently engage in user innovation, which might be another starting point for entrepreneurial activity within the Maker Movement. Thus, user entrepreneurship and the Maker Movement intersect frequently, when makers are involved in user innovation and user entrepreneurship activities. Bradonjic et al. (2019) found, that the impact of user-innovation on entrepreneurship is underestimated. Following this, the underestimation of users as a source of innovation might lead to welfare losses and decreased innovation power. Therefore, user-innovation might be a source of entrepreneurial potential within the Maker Movement (Browder et al. 2023).

As early as 1988, Eric von Hippel published a review of studies identifying users as a major driver of invention and innovation across various industries (Hippel 1988). Since then there has been growing research interest in this area (Shah 2000; Shah & Tripsas 2007; Franke et al. 2006b). To date, user innovation is a central topic in innovation research and is still considered an emerging topic (Bogers et al. 2010; Hippel 2016; Baldwin & Hippel 2011).

Shah & Tripsas (2007) defined user entrepreneurship as “the commercialization of a new product or service by an individual or group, who are also users of that product or service”. In practice, people encounter challenges in their day-to-day lives for which they create solutions, are eager to share them with others, and eventually

commercialize them. There are two distinct categories of user entrepreneurs: professional-users and end-users. While professional users are embedded in organizations, where they strive to improve and commercialize products in their professional lives; end-users are engaged in their daily lives with the products they use and work on. (Shah & Tripsas 2007) Following this, the end-user and maker concept overlap, e.g., when an end-user wants to solve a problem and therefore decides to visit a makerspace (Halbinger 2018). Moreover, user innovators tend to use tools that are associated with the Maker Movement like 3D printers (Holzmann et al. 2017), engage in open source innovation processes regularly (Bogers & West 2012) and visit makerspaces for their purposes (Halbinger 2018).

Due to their own use of their own product, user-entrepreneurs differ from traditional entrepreneurs, since they do not only commercialize a product, but also benefit from its use in the first place. Therefore, the path to entrepreneurship is usually different, other entrepreneurial opportunities are preferred and different priorities are set, compared to those mentioned within traditional entrepreneurship theories. (Shah & Tripsas 2007) Although, users are an important source of entrepreneurial activity, in contrary to the traditional model, this process is often emergent and collective. Idea development, experimentation, refinement, and temporary adoption often occur prior to a formal evaluation of the idea as the basis for starting a business. (Haefliger et al. 2010) However, sharing an idea without receiving payment for it can lead to considerable advantages through a high amount of feedback and good word-of-mouth recommendations. These can make later commercialization even more promising and valuable. In this context it occurs that users become entrepreneurs rather coincidentally, thus ‘accidentally’. These entrepreneurial individuals are called accidental entrepreneurs within the literature (Shah & Tripsas 2007). As a result, user entrepreneurship differs mainly in two things compared to a traditional entrepreneurship process: First, various processes occur within the entrepreneurial process before a commercial evaluation or entrepreneurial opportunity is even considered. Second, users are often embedded in a community that can play an important role in the development and diffusion of innovation, as these communities offer first-hand information regarding the needs and preferences of potential adopters or customers. In addition, they are a source of collective creativity, which spurs novelty throughout innovation. (Hargadon & Becky 2006; Franke & Hippel 2003)

Several studies have investigated the occurrence of entrepreneurship within user-innovation (Morrison et al. 2000). Findings suggest that user-entrepreneurship is more likely if the benefit appeals to joy and intrinsic motivators and is not only based on financial factors (Scott et al. 2002). In addition, low costs of an entrepreneurial opportunity seem to promote user entrepreneurship (Amit et al. 1995). Furthermore, niche markets and strongly changing conditions in markets seem to facilitate user-entrepreneurship as we (Baldwin et al. 2006). Looking at research on user-innovation, the diffusion of innovations still remains relatively undeveloped. This assumption is rooted in the believe that users do have primarily non-economic motives and are not able to compete with manufacturers that could use the economics of scale (Hienerth et al. 2014; Hippel 2005)

However, especially with regard to entrepreneurship, diffusion is a decisive factor (de Jong et al. 2015). Products, services and processes developed by users are more beneficial to society when they are used by others who can benefit from them. Hienerth et al. (2014) identifies insights into the process of lead users that commercialized their products. Some lead users took advantage of the opportunity to start selling prototypes in small production quantities when they saw a strategic opportunity to create a market. Motives such as autonomy and individualism were crucial for them when starting their business. (Haefliger et al. 2010) Often these start-ups had clear advantages over traditional manufacturers, as feedback by customers was better integrated, trends were recognized faster and innovation cycles were much shorter. As a result, some of these companies forced larger manufactures out of the market. However, when entrepreneurial activities in a company tend to increase, typical user activities such as testing, development and product usage are likely to decrease. (Hienerth 2006)

Overall, there are many interesting similarities between user-innovation and the Maker Movement, especially with regard to entrepreneurship. Therefore, the topic will be addressed in the further stages of the dissertation.

2.3.4 Inventors vs. makers

In the context of this thesis, it is important to distinguish the terms maker and inventor and to point out important differences of the terminologies. In the literature, inventors are considered as individuals working on their original projects, inventions. Thus, the term ‘individual inventor’ has established itself in research. (Amesse et al. 1991) The phenomenon of inventors has been discussed a lot ever since. Thereby, research investigated their personalities (Dahlin et al. 2004), motives (Rossmann 1931) and inventions (Filho et al. 2017). In addition, scholars investigated their implications for society (Lettl et al. 2009).

Individual inventors have always been perceived as an important economic pillar of society and are therefore related to entrepreneurship. When and how an invention becomes an innovation is the focus of interest at this point. (Khan & Sokoloff 1993; Gideon D. Markman et al. 2002; Filho et al. 2017; Thomas et al. 2009) The crossover between entrepreneurs and inventors gave birth to the term inventor-entrepreneur (Miner et al. 1992). Yet, how large this overlap is a controversial issue. While inventors like Robert Bosch, Werner von Siemens, Melitta Benz and Artur Fischer are regarded as synonyms for the creation of German wealth (Feldenkirchen 1994; Schier 2011; Deutsches Patent- und Markenamt 2022; Liebe 2018), there are hardly any well-known inventors today in the traditional sense as inventor-related activities are transferred into R&D departments of large corporations or research centers (Kaiser 2016; Frankfurter Allgemeine Zeitung 2019). Hence, there is a critical debate about whether individual inventors still have the same significance today, as they once had (Nicolaou & Souitaris 2016; Cassiman et al. 2018). Above all, there is a discussion whether individual inventors have a significant impact on the economy or not, or at least how they can become an important source of innovation again. (Lettl et al. 2009; Dahlin et al. 2004)

Historically, the patent law was developed for the purpose of protecting the inventions of inventors through intellectual property rights and utilizing them commercially (World Intellectual Property Organization (WIPO) 2022).

Inventors and patents are ever since affiliated with each other and were the subject of numerous investigations (Giuri et al. 2007; Torrisi et al. 2016; Balconi et al. 2004; Trajtenberg et al. 2006; Jaffe et al. 2000; Sichelmann 2010; Sirilli 1987; Gambardella et al. 2008).

In summary, the inventor is primarily an individual phenomenon focused on single personalities, while the maker is rather part of a movement. This movement is driven by the democratization of tools and new opportunities, as well as global connectedness and community. The movement is broader and includes more artistic and social aspects. One thing that is common is that the effects on society and entrepreneurial activity still need to be explored much further and are only partially the goal of the actors. However, there are clearly inventor typologies among the makers (see Chapter 8). For instance, makers and inventors seem to have similar motives to engage in their activities. At the moment, two phenomena overlap at this point. One has supposedly reached its climax, the other is just emerging. Research around the Maker Movement should keep inventor literature in mind, but must expand beyond it and see further.

Regardless of where entrepreneurial action originates, it requires the identification, evaluation and exploitation of entrepreneurial opportunities. Thus, in the next chapter, I will describe the concept of entrepreneurial opportunities in more detail in order to provide a detailed understanding of the process of makers encountering entrepreneurial opportunities.

3 Entrepreneurial opportunities

In this chapter I will review past research regarding the concept of entrepreneurial opportunities. Thereby, I consider different perspectives on the concept and present a definition of entrepreneurial opportunities for the further course of the thesis. Of particular interest to this research project is, how an entrepreneurial opportunity is evaluated by individuals. In addition, I describe the characteristics of entrepreneurial opportunities and how entrepreneurial opportunity evaluation is represented within the literature to date.

3.1 The concept of entrepreneurial opportunities

Entrepreneurial opportunities are generally understood as "situations in which new goods, services, raw materials, and organizing methods can be introduced and sold at greater than their cost of production". (Casson 1982) Within the scope of entrepreneurship research, the closer examination of entrepreneurial opportunities is one of the focal research areas and core to a number of entrepreneurship frameworks presented by Shane (2000), Shane & Venkataraman (2000), Gaglio & Katz (2001) and many others. Especially since successful identification and exploitation of an entrepreneurial opportunity is considered to be one of the key capabilities among successful entrepreneurs, the concept is understood as central and influential for the entrepreneurial process. (Mary George et al. 2016) Moreover, the concept is considered one of the fundamental literature streams in the field of entrepreneurship and faces an immense amount of publications over decades. Historically, Schumpeter (1934) considered entrepreneurial opportunities as a way to achieve new combinations of resources. These may include products and services, but also new methods and market organizations. Kirzner (1979), however, refers to opportunities as the core element of market imperfections, which have the potential to generate economic returns. Spanning these differing perspectives, the entrepreneurship literature emphasizes that entrepreneurial opportunities are generally related with processes of value creation (Shane 2000).

Research on entrepreneurial opportunities focuses on three main pillars. First, the nature and sources of entrepreneurial opportunities (McMullen et al. 2007). Second, the process of discovery and identification, evaluation and exploitation (Gaglio &

Katz 2001; Kuckertz et al. 2017; Shane 2000). Third, on the individuals who recognize opportunities and their characteristics (Mary George et al. 2016). In addition, several authors intended to provide a holistic view, emphasizing key elements of entrepreneurial opportunity research. For reviews see Davidsson (2015), Kuckertz et al. (2017) and Companys & McMullen (2007). In the next chapter I will outline some key elements of the entrepreneurial opportunity concept.

3.1.1 Key elements

The understanding that prior knowledge is a major contributor to opportunity recognition, which acts as a moderator in identifying opportunities as such, has developed significantly in recent years. Several publications suggest that access to prior information enables some people to identify entrepreneurial opportunities rather than others. (Shane 2000; Shane & Venkataraman 2000; Vaghely & Julien 2010) Essentially, prior knowledge is considered to be a fundamental cognitive resource for entrepreneurs, which helps during the critical process of opportunity identification in uncertain environments. (Shane 2000; Haynie et al. 2009; Vaghely & Julien 2010) Furthermore, researchers observed some evidence, indicating that a lack of knowledge and skills could inhibit the process of opportunity recognition. (Kourilsky & Walstad 1998; Kourilsky & Esfandiari 1997) Until today, this discovery process and the ability to identify opportunities is still considered as central element for the entrepreneurial education of young individuals in terms of opportunity recognition (Mary George et al. 2016). In addition, research regarding entrepreneurial opportunities mentions external environmental factors as influential factors as well. For instance, shifts in technology, social mores, political climate and demographic circumstances can create new conditions which may facilitate the process of opportunity discovery, creation and exploitation. (Edelman & Yli–Renko 2010)

Nascent entrepreneurs, defined as entrepreneurs in the phase before actually starting a venture, require information and resources during the opportunity recognition process. Therefore, social capital and personal networks are considered important assets. (Shane & Venkataraman 2000; Ardichvili et al. 2003; Alvarez & Busenitz 2001; Baron 2006)

Moreover, connecting with people from different field of education and geographic locations create unique access to paradigms of thought and scarce resources and may help recognizing opportunities and during their exploitation. (Baron & Markman 2000; Tang 2010; Fuentes et al. 2010) However, there are different opinions in the literature about which kind of personal networks are more beneficial for aspiring entrepreneurs. Proponents of the '*strength of weak ties*' network theory argue that a higher number of weak ties is especially valuable (Granovetter 1973). In contrary, several authors suggest that fewer but stronger bonds might be preferable (Dubini & Aldrich 1993).

Individual traits of entrepreneurs and their cognitive behavior are central elements considering entrepreneurial opportunities and the field of entrepreneurship research as a whole. Following this, several studies regarding entrepreneurial opportunities shed light on the relationship of individual capabilities in terms of entrepreneurial opportunity recognition, evaluation an exploitation. For instance, scholars investigated the role of personal traits like optimism, self-efficacy, creativity, risk-taking, resilience and passion. (Ardichvili et al. 2003; Baron 2006) Moreover, research investigated entrepreneurial opportunities in the context of specific entrepreneurial individuals like necessity entrepreneurs (van der Zwan et al. 2016; Block & Wagner 2006).

Moreover, entrepreneurial alertness describes the ability to obtain essential insights into the perception of entrepreneurial opportunities. Since Kirzner (1973) first introduced the theory, many researchers have pointed out its relevance. Scholars have agreed on the idea that a person with a high level of alertness is able to identify entrepreneurial opportunities without actively searching for them. (Martín-de Castro & Fischer 2011; Gaglio & Katz 2001; Shane & Venkataraman 2000; Kirzner 1997; Ardichvili et al. 2003) As a result, individuals vary in their predisposition to create new ventures and create value from them. These individual differences, in turn, are based on other factors such as prior knowledge, experience, and related networks.

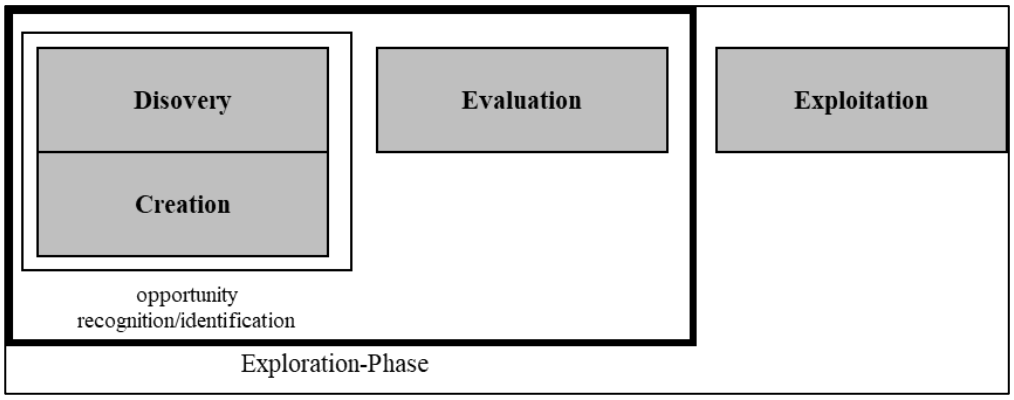
When considering entrepreneurial opportunities, researchers suggest to pay attention to the type of entrepreneurial opportunity. Thereby, scholars emphasized the meaning of value creation capability, value sought, opportunity attributes and prior knowledge. (Ardichvili et al. 2003; Haynie et al. 2009)

Depending on whether an opportunity is sought specifically or discovered rather by chance, there are different starting points for the process of entrepreneurial opportunities. Following this, I present an overview of the life cycle of entrepreneurial opportunities.

3.1.2 The lifecycle of entrepreneurial opportunities

Entrepreneurial opportunities are not viewed as static, but rather as dynamic and often iterative phenomena. Several terms are used interchangeably in the literature to refer to the different steps of the lifecycle, including opportunity recognition, -discovery, -exploration, -seeking, -formation, -enactment, -assessment and -construction. (Mary George et al. 2016) However, three major phases are distinguished by scholars when referring to the lifecycle of entrepreneurial opportunities. Figure 4 provides an overview of the different phases.

Figure 4:Entrepreneurial opportunity lifecycle



Source: Own illustration.

The first phase of the lifecycle involves the identification, discovery or creation of an entrepreneurial opportunity. These different terms are used depending on how the process commences and which market conditions are prevailing. For instance, depending on whether an opportunity is sought specifically (“created”) or discovered by chance. Observing that individual behavioral patterns influence the perception of entrepreneurial opportunities, different research directions emerged. (Mary George et al. 2016; Ardichvili et al. 2003)

Especially the question, why some individuals are able to recognize opportunities – referred to as opportunity recognition – and others are not, has been discussed intensively by scholars lately (Mary George et al. 2016).

Mainly, three publications had strong impact on this research stream. Shane (2000) has been the most cited article, followed by a publication by Shane & Venkataraman (2000) and an article by Alvarez & Busenitz (2001). Moreover, the strong increase in research in this area reaches far beyond entrepreneurship research. Publications spanning various research fields including economics, finance, social science, decision sciences, engineering, psychology, biological sciences, computer science, arts and humanities and neuroscience (Mary George et al. 2016). This rapid growth of the research field has led to a highly fragmented research body, making it difficult for systematic research and the challenge of gaining and preserving a complete overview of the concept.

Historically, research in the field of opportunity recognition was mainly influenced and positioned by the contrary views of Schumpeter (1934) and Kirzner (1973). With regard to the origin of opportunities, there is a dichotomy between these two authors. Schumpeter suggests that opportunities are discovered, whereas Kirzner argued that an element of recognition including even an element of surprise is involved in this process. The tensions between these views are still evident in the literature to date. Authors such as Shane (2000) followed the views of Schumpeter, while Baron (2006, 2004), in contrast, supported the views of Kirzner. The discussion was further encouraged by Sarasvathy's introduction of a clear distinction between opportunity discovery, creation and recognition. For example, situations where products and services are aligned with market demand and facilitate the creation of value are considered entrepreneurial opportunities, while opportunity creation occurs when either products or demand do exist and need to be invented from scratch (Buenstorf 2007). If a product or market demand exists and other conditions need to be identified, this is classified as opportunity discovery (Mary George et al. 2016). If product and market demand are obvious, exploring new ways to organize such demand is referred to as opportunity recognition.

Based on these divergent perspectives, a number of recent researchers have focused on presenting integrative perspectives on business opportunities (Gaglio & Katz 2001; Chiasson & Saunders 2005). Alvarez & Barney (2007) contributed significantly to research demonstrating that entrepreneurial opportunities can be explained by discovery and creation processes (Mary George et al. 2016). Despite the different points of view, the prevailing consensus remains the attempt to explain the process of opportunity recognition (Shepherd et al. 2007; Douglas & Shepherd 2000).

Entrepreneurial decision-making is crucial for the process of entrepreneurial opportunities (Shepherd 2016). Once the potential entrepreneur has gathered sufficient information during the exploration of an entrepreneurial opportunity, a shift from exploration to exploitation of an entrepreneurial opportunity commences (Shepherd et al. 2007). This is often referred to as entrepreneurial action (Kuckertz et al. 2017; Choi et al. 2008) and usually involves the development of perceptible entrepreneurial efforts, such as the incorporation of new projects and is a necessary step in creating a successful business (Choi & Shepherd 2004). Entrepreneurs differ significantly in their decision-making paradigms. For example, there are entrepreneurial opportunities that are exploited after a brief exploration phase. (Choi et al. 2008) Within this context, the first mover advantage of pioneering solutions is being academically discussed (Carpenter & Nakamoto 1989; Shepherd 1997). Other aspiring entrepreneurs, however, invest a significant amount of time in the exploration of potential entrepreneurial opportunities (Choi et al. 2008). In contrast, accidental entrepreneurs seem to stumble into the role of entrepreneurs rather than follow a strategic process (Shah & Tripsas 2007).

If a potential entrepreneur decides to pursue an opportunity, this is referred to as opportunity exploitation .Kuckertz et al. (2017) state that “opportunity exploitation is characterized by developing a product or service based on a perceived entrepreneurial opportunity, acquiring appropriate human resources, gathering financial resources, and setting up the organization.”. He identifies several key activities for this process. The development of a product or service involves destroying existing offerings, building prototypes and testing new solutions, as well as obtaining and taking into account corresponding user feedback. (Gartner et al.

2010) Furthermore, human capital has to be acquired by searching and hiring employees and thus putting together an entrepreneurial team (McGee et al. 2009). Planning a new venture includes the elements business model as well as the development of a business plan (Shane & Delmar 2004). Therefore, understanding customers and the market is crucial. Customer needs must be identified and discussed. The acceptance of the product or service must be evaluated and evaluated in comparison with competing products. (Foss et al. 2013) From a resource point of view, a network must be built, investors or government authorities have to be approached, and friends and family may have to be involved in the fundraising efforts (Haynie et al. 2009; Lassalle & McElwee 2016). Finally, the formal incorporation of the new venture must be completed (Gartner et al. 2010).

These key activities demonstrate the diversity of entrepreneurship. Numerous publications and books with a high degree of practical relevance are available for the various sub-areas and disciplines. (Ries 2011; Aulet 2013; Ferriss & Schwarzenegger 2016; Osterwalder & Pigneur 2011; Moore 2014; Fitzpatrick 2013)

Although some researchers mainly focused on opportunity recognition and exploitation, scholars increasingly argue that opportunity evaluation, the process in between recognition and exploitation, is a distinct and important part of entrepreneurial opportunities and should be included into consideration in more detail. (Haynie et al. 2009; Welpe et al. 2012; Kuckertz et al. 2017) Thus, I will provide detailed information about the process of entrepreneurial opportunity evaluation within the following chapter.

3.2 Entrepreneurial opportunity evaluation

The evaluation of entrepreneurial opportunities is an essential and even necessary part of entrepreneurship (Bryant 2007; Haynie et al. 2009; Ardichvili et al. 2003; Foo 2011), connecting the two central concepts of opportunity recognition and exploitation. During the process towards new market offers and innovations, in terms of products and services, this aspect has a decisive influence. (Wood & McKelvie 2015) Opportunity evaluation involves the individual judgments and perceptions regarding the degree of whether recognized entrepreneurial opportunities appear to be a desirable and feasible path of action (Grégoire & Shepherd 2012; Haynie et al. 2009). As a result, opportunity evaluation is central to entrepreneurship as it can be

seen as the starting point for opportunity exploitation. The perceived attractiveness of an entrepreneurial opportunity and its imagined future development by individuals are key to entrepreneurial actions, such as the launch of a new products on the shelves, the offering of an innovative service or the grand opening of a new business (Wood et al. 2014). Consequently, the interest in opportunity evaluation as a research field has increased.

Scholars strive to understand what makes an opportunity attractive to individuals and eventually leads to action and, ideally, to the emergence of businesses. In recent years there has also been a shift from a third person view to a first person view and opportunity evaluation is perceived as a distinct and important part of the entrepreneurial process to date. (Wood & McKelvie 2015)

This derived from the view that nascent entrepreneurs evaluate each opportunity based on their individual conditions and preferences regarding the opportunity. (Haynie et al. 2009)

However, Wood & McKelvie (2015) identify a number of issues that challenge this promising field of research. The historical focus of researchers thus leads to an imbalance problem. Researchers had mainly focused on other aspects of the entrepreneurial process such as opportunity identification or exploitation (Hmieleski & Baron 2008; Shepherd & DeTienne 2005). Several reviews of the literature on entrepreneurial opportunities, such as Short et al. (2010), Mary George et al. (2016) and Kuckertz et al. (2017) paid little attention to the assessment of entrepreneurial opportunities, while other phenomena were considered in depth. Furthermore, research on opportunity evaluation is largely based on the publication of Shane & Venkataraman (2000) and their interpretation of a multi-phase process consisting of recognition, evaluation and exploitation. However, since this is not the focal point of the article, these phases are not fully defined. As a result, the literature on opportunity evaluation contains an incompleteness problem where theoretical specifications and distinctions are needed. The lack of this distinction is one of the reasons why research in the field of opportunity evaluation is currently highly fragmented. Thus, various concepts have developed to address opportunity evaluation. Among those are the terms opportunity confidence (Dimov 2010) and opportunity feasibility and desirability (Autio et al. 2013).

Wood & McKelvie (2015) have addressed these issues in their systematic review and synthesis regarding opportunity evaluation to provide a more complete and improved understanding of the domain.

Thereby they discuss the distinction between the different process phases (Ardichvili et al. 2003; Shane & Venkataraman 2000). While opportunity recognition focuses on the ways in which entrepreneurial opportunities occur, the role of the entrepreneur and the way in which the respective opportunity is identified or enacted is primarily viewed from a third-person perspective. Whereas opportunity evaluation deals with the first-person perception of the attractiveness of entrepreneurial opportunities on a rather personal level (Wood et al. 2014; Haynie et al. 2009). The differentiation towards opportunity exploitation likewise represents a shift. The transition from cognitive and personal processes to actions.

In the evaluation phase, entrepreneurs engage in interpretive processes, using their experience and knowledge to mentally create future projections that help them judge whether an entrepreneurial idea is worth pursuing (McMullen 2010). Opportunity exploitation involves the actual pursuing of such an opportunity including forms of action such as the assembly of resources for the development of a new product or service offering or the implementation of a new business (Autio et al. 2013). Thereby these elements are inseparably interrelated. Thus, someone who has not perceived an idea that matches their own skills, resources and motivations, cannot evaluate it, nor become entrepreneurially active (Grégoire & Shepherd 2012). Hence evaluation represents the critical bridge between recognition and exploitation. Understanding how individuals act in the context of the evaluation of entrepreneurial opportunities and how the corresponding opportunities become part of the evaluation as well as determining which factors fuel the exploitation is crucial. (Wood & McKelvie 2015)

In order to understand how individuals, evaluate entrepreneurial opportunities and make decisions, it is essential to better understand these opportunities and their characteristics.

3.3 Attributes of entrepreneurial opportunities

Several research projects have already investigated the evaluation of entrepreneurial opportunities. Some of them also with the help of conjoint analysis (Choi & Shepherd 2004; Wood & Williams 2014; Welpe et al. 2012). The attributes of entrepreneurial opportunities used in this context will be described in more detail in the next step.

One of the most commonly used attributes is an economic component of the entrepreneurial opportunity. The specific terms may vary. Examples are economic attractiveness, finance, profit, resource efficiency, return on investment value, reward, growth, market size, number of competitors or demand. (Gruber et al. 2015; Wood & Williams 2014; Welpe et al. 2012; Haynie et al. 2009) In contrast to the economic benefits, the cost of opportunity has also been referred to in some cases. This describes the effort, e.g. monetary or personal, associated with the entrepreneurial opportunity. With regard to the future, forecasts such as worst-case scenarios are sometimes included in the description of entrepreneurial opportunities. (Monsen et al. 2010; Wood & Williams 2014)

The protection possibilities of intellectual property (IPR) are also frequently used in scientific publications to characterize entrepreneurial opportunities. Furthermore, the imitability or rarity of an entrepreneurial opportunity is often considered. (Haynie et al. 2009; Digan et al. 2017) Looking at the potential implementation of the entrepreneurial opportunity, the technical novelty, feasibility, challenge or relatedness (sometimes called fit) towards (personal) capabilities is described as a characteristic of the entrepreneurial opportunity. (Wood & Williams 2014; Choi & Shepherd 2004; Haynie et al. 2009) Moreover, whether support is available from parties such as stakeholders or team partners for the potential entrepreneurial project can be important for the evaluation of an entrepreneurial opportunity (Choi & Shepherd 2004). Personal components such as self-realization e.g. through the chance to learn something are also partially included in the representation of an entrepreneurial opportunity (Kolvereid & Isaksen 2006). Furthermore, the possibility to have an impact on society resulting from an entrepreneurial opportunity is also included (Douglas & Shepherd 2002).

After this review of the literature on entrepreneurial opportunities, I will conduct qualitative research, using interviews with makers and experts from the Maker Movement, regarding their motivations and relevant opportunity attributes. In doing so, the findings from the literature will be validated or discarded in order to provide the groundwork for quantitatively investigating the evaluation of entrepreneurial opportunities in Chapter 5.

4 Qualitative analysis of maker decision criteria

The objective of this study is to obtain insights on how makers are motivated to work on their projects and to take a closer look at their entrepreneurial activities and interest. This helps to identify relevant criteria when investigating entrepreneurial opportunities in the context of the Maker Movement. Therefore, semi-structured interviews with 19 makers and experts from the Maker Movement have been conducted. This chapter describes the approach to this qualitative investigation, outlines the findings, and finally summarizes the key criteria for evaluating entrepreneurial opportunities which serve as the foundation for the quantitative empirical study.

4.1 Motivation and entrepreneurial interest of makers

This chapter uses a combination of primary and secondary data to create an initial understanding of the motivations of makers and entrepreneurial decision-making processes. In a first step, existing data from the literature and further secondary data will be investigated. Based on this, primary data will be collected from active people in the maker scene. This explorative qualitative approach allows the study to make a transition from individual data observations to a more generalized picture of decision-making within the Maker Movement.

Starting with secondary data from the scientific literature, it can be said, that especially the Maker Movement as a phenomenon has been very little researched so far. The literature here is limited to mainly exploratory and conceptual publications. Empirical data is only available in very isolated cases, e.g. single schools or small geographic locations (Papavlasopoulou et al. 2017). However, some studies provide first clues about the underlying motivations of makers (Hausberg & Spaeth 2020; Kwon & Lee 2017). In summary, the initial perception is that makers are motivated primarily by intrinsic motives like self-fulfillment and joy, seeking an inner satisfaction (Mauroner 2017). In addition, working on technical challenges related to innovation seems motivating for makers (Hausberg & Spaeth 2020). Moreover, scholars started to explore the linkage of the Maker Movement and entrepreneurship (Browder et al. 2019a; Halbinger 2018). In comparison to the Maker Movement, the field of entrepreneurial opportunities is quite well researched (see Chapter 3 for

detailed information). However, most studies relate to traditional entrepreneurs. This is a result of the research agenda, in which scholars either look retrospectively at start-ups and their emergence or the study participants are serial entrepreneurs. Studies on nascent entrepreneurs in opportunity evaluation make up only a small portion of all studies. Mainly, these publications research academic environments such as universities or schools or entrepreneurial groups with specific circumstances, such as necessity entrepreneurs (Block & Wagner 2006).

Overall, despite first indications, far too little is known about the motivation of makers and their relationship with entrepreneurship. Therefore, a deeper analysis of motivations and decision-making criteria in relation to entrepreneurship is necessary. Following this, in the next chapter I will briefly review the literature on maker motivation.

4.2 Maker motivation: a brief review of literature

This chapter shortly summarizes the previous research efforts and results that have focused on the motivation of makers. The broad field of motivational theories will not be discussed in detail in this paper. However, using the Self Determational Theory (SDT) framework of three types of motivation based on Deci & Ryan (1987), helps providing an overview of the literature on the motivation of makers. Thereby the SDT framework was used frequently by scholars to explore the motivations of hackers, OSS developers (Lakhani & Wolf 2005; Roberts et al. 2006; Wu et al. 2007; Hars & Ou 2004; Bitzer et al. 2007), inventors and makers (Kwon & Lee 2017; Hausberg & Spaeth 2020). These distinguish intrinsic, extrinsic, and internalized extrinsic types of motivations. In addition to a brief review of the literature, the motivations of makers was analyzed using qualitative interviews to provide the optimal basis for the empirical analysis. In addition, the results from the qualitative interviews did provide valuable guidance in selecting the relevant attributes for the conjoint experiment.

Intrinsic motivation include any task that is considered to be spontaneously approached by an individual and is self-driven from within the individual. Moreover, intrinsic motivation refers to self-determined and autonomous actions without observable external reasons or triggers. Thereby, individuals strive to satisfy their own needs directly through these actions.

Following this, the inner satisfaction resulting from the action and the completion of the task encourage further activity. (Ryan & Deci 2000; Deci 1971)

Looking at the different motivations on a scale from self-related triggers to influence from outside, on the contrary other side of this spectrum lies extrinsic motivation. Thereby the individual needs are satisfied solely indirectly by external incentives (Skinner 1953), usually asserted by someone else then the motivated individual (Johns & Saks 1996). The identified “ideal” example in literature of extrinsic motivation is strict monetary compensation ("pay for performance").

Spanning these two extremes, there is a continuum of hybrid motivations, called internalized extrinsic motivations. (Gagné & Deci 2005; Deci & Ryan 1987) By definition, these are basically extrinsic motivations. However, the individual adopts these motivations via introjection over time. For instance, status and opportunity motivations that contribute to the attainment of ego enhancement and feelings of worth, can become part of the intrinsic motivation of individuals (Lerner & Tirole 2002; Roberts et al. 2006). In addition, use-value motivations (e.g. identification) that refer to solving a problem which is related to personal use benefit are also considered as being hybrid motivations (Roberts et al. 2006; Hertel & Niedner 2003). These motives are described as more or less self-determined within the literature (Ryan & Connell 1989; Ryan & Deci 2000).

To date, little research exists regarding the motivation of makers. For this reason, exploratory research in this dimension will be conducted in the context of this thesis. The limited information available within the literature is summarized below as a basis for further investigation. Looking at the available literature regarding the motivation of makers, intrinsic motives are prevailing. The process of making or hacking itself is considered one of the main motives and also referred to as joy or inner satisfaction. Individuals motivated in this way want to get into a flow ("the zone") and forget about everything around them. (Hausberg & Spaeth 2020; Kwon & Lee 2017; Dougherty 2012; Dougherty & Conrad 2016; Mauroner 2017) Moreover, the broad concept of self-realization is frequently mentioned as a motivation for makers. Experiencing successful projects and developing own skills through learning are stimulating and motivating aspects for makers. (Hausberg & Spaeth 2020; Bergner 2017)

However, learning can also extend into extrinsic or internalized motivation dimensions. Makers sometimes learn in order to have better career opportunities, to solve tasks at work, or to develop their own products, for example to save money or to create improved products. If this is the case, the literature also refers to user-innovation as a motivation for makers (Shah & Tripsas 2016; Hienerth 2006). Related to this kind of motivation, makers show the desire to solve problems, ranging from technical to societal and social challenges. (Geser et al. 2019; Dougherty & Conrad 2016; Hatch 2014; Anderson 2012; Premyanov et al. 2022)

Many makers enjoy interacting with other makers and being part of a community. Thereby this interaction can involve joint projects. (Dougherty 2012; Dougherty & Conrad 2016; Bergner 2017; Mauroner 2017; Hausberg & Spaeth 2020) In addition, joint events – e.g. a gaming event with pizza – can also be motivating for some makers to visit a makerspace and be part of the movement. While some of the makers just want to be part of the community, some of the makers also care about how they are personally perceived in the community. For instance, they are motivated by gaining a good reputation inside the community and want to be recognized for their skills and projects. (Hausberg & Spaeth 2020) Beyond, showing off, the sharing of knowledge is important among the communities and a central element of the Maker Movement. Many makers want to contribute to the open source culture and are fascinated by the underlying ideology. This shows that specific ideologies are also important components of the motivational structure for some makers (Kwon & Lee 2017). Following this, previous research investigated the compatibility of hardware and open-source and its relationship to entrepreneurship (Li et al. 2019; Morreale et al. 2017).

In some cases, makers are also motivated by operating or planning on starting their own business (Browder et al. 2019a; Aryan et al. 2021). Thus, they build prototypes, run experiments in the makerspace or search for tech-savvy people who share their vision or might help exploit an entrepreneurial opportunity. Moreover, it appears that in some cases, entrepreneurial motivation is first realized through positive feedback on the outcomes of maker projects (Dougherty 2012). In addition, makers can be motivated by extrinsic motivations like monetary incentives. For instance, makers

produce prototypes as a service or sell objects they have created themselves e.g. on platforms like Etsy. (Hatch 2018; Aldrich & Browder 2020; Halbinger 2014)

4.3 Method and sample

The goal of the interviews was to gain a deeper understanding of the Maker Movement from a practical perspective and to validate findings from the literature and if necessary, adapt or supplement these findings. This multi-method approach, including this preliminary qualitative study with 19 participants with an average length of 40 minutes, was chosen in particular because a conjoint analysis should reflect the real decision-making process as precisely as possible. The information obtained in this phase was thus crucial for the further course of the study and helped to achieve greater validity. Table 2 shows the characteristics of the interviewed makers and experts from the Maker Movement.

Interview partners were selected based on theoretical considerations rather than on statistical reasons (Strauss et al. 1996). The interviews were conducted until a sufficient number of different perspectives were available for the different questions, which was reflected mainly in confirmatory and congruent statements by the respondents. Particular attention was paid to include people from different areas, various situations and with different perspectives on the topics. The interviewees were thereby split into two main categories. On the one hand, active makers were surveyed. This information was supplemented by experts and people from the scene who come into contact with various makers and offer a broader perspective on the movement as a whole. When selecting the interview partners, a geographical distribution across Germany was ensured. The interviewees were identified and contacted primarily via the internet, as well as by references from other scholars. In some places, inquiries were supplemented by personal contacts. A certain selection bias is possible. However, prestigious international experts were included in the interview. Thus, this risk is negligible.

The focus during those interviews was primarily on the motivation of individuals to become active as makers. Furthermore, the survey asked for the relationship and interest of the respective interviewees to entrepreneurship, in order to find out what constitutes an entrepreneurial attraction for them.

In order to allow the subjects sufficient room for their own input in this exploratory study of the phenomenon, a semi-structured interview was conducted. In a semi-structured interview, usually there are some areas needed to be explored. These can be prepared with some guiding questions to guide the conversation in a certain way and to moderate it, if necessary. However, it is important that the interviewee is given a lot of flexibility and that even not expected responses, made by the participant, receive attention. (Adams 2015; Flick et al. 2004) The Interview guide is provided in the appendix (Table 47). Each interview started with a general introduction of the topic and the research project. The rest of the interview was separated into two sections. The first section asked about the motivations for “making” and the projects that were created. During this process, motivations were questioned again and again until no more motivations were indicated. Once this occurred, motivations that previous respondents had mentioned and motivations identified in the literature that had not yet been mentioned, if any, were asked about. Besides the motivations, all participants were asked about their understanding and opinion of entrepreneurship. Moreover, their own attitude towards entrepreneurship and an estimation of the potential of the Maker Movement and eventual hurdles in this regard were discussed.

Table 2: Interview participants characteristics

ID	Location	Type	Role	Gender	Date	Duration
1	Hamburg	Maker	Founder	Male	Mar. 2021	21 min.
2	Hannover	Expert	Journalist	Female	Mar. 2021	53 min. [10]
3	Hannover	Expert	Journalist	Male	Mar. 2021	53 min.
4	Los Angeles	Expert	Author/ Founder	Male	Mar. 2021	37 min.
5	Stuttgart	Maker	Founder/ Speaker	Male	Mar. 2021	56 min.
6	Brandenburg	Maker	Student	Female	Mar. 2021	44 min.
7	San Francisco	Expert	Author/ Founder	Male	Mar. 2021	58 min.
8	Trier	Maker	Employee	Female	Apr. 2021	41 min.
9	Trier	Maker	Employee	Male	Apr. 2021	41 min.
10	Trier	Maker	Employee	Male	Apr. 2021	41 min.
11	Trier	Maker	Employee	Male	Apr. 2021	41 min.
12	Trier	Maker	Employee	Male	Apr. 2021	41 min.
13	Chemnitz	Expert	Makerspace Manager	Male	Apr. 2021	36 min.
14	Berlin	Expert	Lecturer/ Researcher	Female	Apr. 2021	36 min.
15	Stuttgart	Maker	Makerspace Manager	Male	Apr. 2021	51 min.
16	Ludwigsburg	Maker	makerspace Manager	Male	Apr. 2021	53 min.
17	Karlsruhe	Maker	Founder	Male	May 2021	20 min.
18	Berlin	Maker/ Expert	Employee	Male	May 2021	27 min.
19	Karlsruhe	Maker	CTO	Male	May 2021	23 min.

Source: Own illustration.

[10] The interviews with ID 2 and 3 was one interview with 2 persons. As well as the Interview with the ID's 8 – 12 was conducted together in a group interview with 5 persons, due to the personal preference of the respondents.

Following this, all interviews were transcribed and imported into MAXQDA[11] for quantitative analysis. Then, a coding scheme was applied to the transcripts. There are two basic approaches for developing a coding scheme. The inductive approach involves developing a schema from the collected data, post-survey. In contrast, the deductive approach develops a category system in advance and then sorts the collected data according to these categories. (Mayring 2015) In this thesis, a basic framework of categories was initially developed based on the findings from the literature and further secondary sources. However, this was inductively expanded during the process. Thus, the scheme became increasingly detailed. After the coding process was completed, the data was aggregated into comparable categories for the purposes of better analysis. Table 49 in the appendix provides the final coding schema used for text analysis within this dissertation. Intracoder reliability was tested after seven months, providing an intracoding value of 0.87 percent, which indicates a good intracoder reliability. Intercoder reliability was not tested, which is a limitation of this work.

4.4 Results: Interviews with makers

In the following chapter I will summarize the results of the qualitative study. First, I identify and characterize two different dimensions of motivation among makers and supports these with quotations[12] from the interviews to build on the maker motivation literature, described in Chapter 4.2. Furthermore, the linkage of the Maker Movement and entrepreneurship is discussed in more detail. Finally, with regard to the conjoint experiment, I describe why certain opportunity attributes were selected for further analysis.

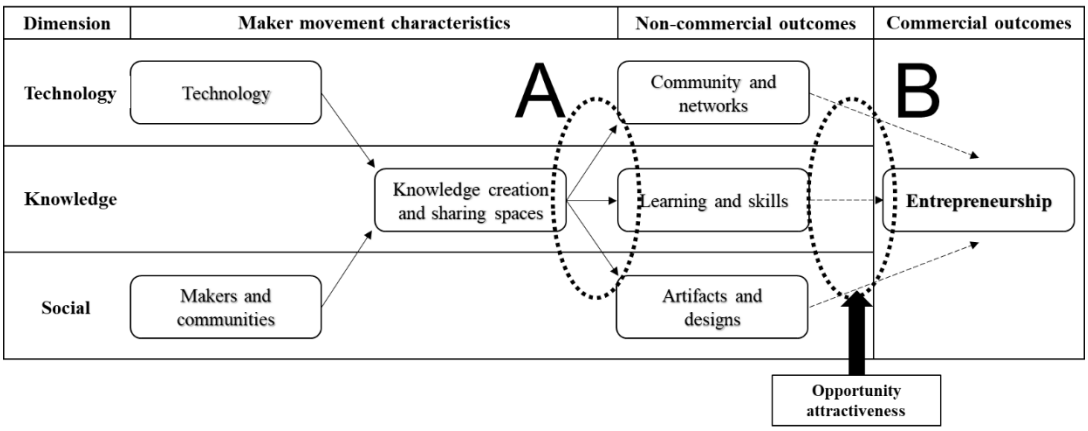
4.4.1 Motivations for non-commercial and commercial making

After gathering information from a number of makers and renowned experts for the Maker Movement, it became evident that the fundamental motivations for making and the underlying motivation to become entrepreneurially active should be considered separately from each other. This aligns with the conceptual model

[11] MAXQDA is a statistical software package designed for computer-assisted qualitative and mixed-methods data, text, and multimedia analysis in academic, scientific, and business settings.
[12] All interviews, except interview numbers 4 and 7, were conducted in German. The other quotes shown in this chapter were translated and reviewed by two native speakers to ensure that they reflect the original meaning as closely as possible.

presented by Browder et al. (2019). Thereby, non-commercial and commercial activities are differentiated. Following this, I argue that the motivations to engage in those activities have different reasons and underlying motivations. Figure 5 illustrates a simplified model of the maker motivation nexus.

Figure 5: Maker motivation nexus



Source: Own illustration based on Browder et al. (2019)

Entrepreneurial activity is just one path of many that makers pursue and might take. Therefore, naturally, there are overlaps between the fundamental motivation to become a maker and the motivation to become entrepreneurially active within the Maker Movement. The basic motivation might be thought of as an intermediate step on the way to becoming an (maker-) entrepreneur for some makers. Furthermore, factors that prevent or decrease the probability of choosing this path are important to consider as well. In the context of this work, these are referred to as entrepreneurial inhibitions.

4.4.2 Motives, why makers become makers

Self-realization is the primary fundamental intrinsic motivation and unites a number of personality-related motivational factors under its roof. Within this group, learning stands out as the strongest factor along those motivations. At this point, the findings from literature were fully confirmed based on the interview results.

According to a majority of the respondents, the learning process within “making” is mainly driven by curiosity and the desire to understand things and processes.

Curiosity and learning enable individuals to solve problems, using and challenging their own skills. This triggers a satisfaction among most of the interviewees.

At this point the image of the successful inventor that solves a problem with innovation and invention was mentioned frequently during the interviews.

> *Yes, I'm definitely a maker, I would totally count myself as one. One reason is because ever since I was a kid, I've kind of always said: I want to be an inventor. And I think a maker somehow is nothing else than an inventor. For me that is the definition of making: when I have a desire for a solution to a problem, I first try to empower myself to solve that problem.*
>
> *[Interview No. 16]*

Considering "making" as a form of self-empowerment, this was another frequently mentioned motivating factor of makers, as it allows them to achieve things they were not capable before. This kind of motivation is closely related to the desire to solve a problem, either within the makers own situation or within a broader environment (e.g. family or even society). During the interviews, makers frequently mentioned the desire to understand things and to empower themselves. In addition, they seek to create something or want to solve a problem. When being asked, why this was important for them, they stated that self-empowerment contributes to the intrinsic motivation to reach a certain degree of autonomy throughout own capabilities and activities.

> *"I am an information junkie and love to learn new things. It is my personal requirement to be prepared if tomorrow is Doomsday and to know about everything, at least a little bit. For example, I don't have to be a baker now, but understand how a loaf of bread is baked."*
>
> *[Interview No. 11]*

Moreover, self-made solutions are a form of self-expression and joy and cause strong intrinsic satisfaction among the respondents, which as well is a motivation for respondents. Makers frequently mentioned this special state of emotion – e.g. the "I made fire"-feeling – as a key driver for their activities within the makerspace.

"[...], what comes on top of that is this "I made fire" feeling that you've done something and it just works."

[Interview No. 10]

However, the outcomes that are developed by makers, do not necessarily address a (social) problem or create immediate value for others, besides the maker himself/herself. During the interviews it became evident that some projects tend to have a rather artistic character and represent a personal (intrinsic) value for the maker himself, which may not always be apparent and measurable from an outsider's point of view. In contrast, for people outside the movement, the large amount of time spent on seemingly "useless" projects can even be irritating.

Next, the social dimension of being a maker is important for many respondents. Thus, it was mentioned frequently by makers within the interviews that it is important for them to be part of a community. This includes local communities within one single makerspace. But in addition, the movement generates a certain pride, which members of the community like to display and externalize, creating a community for the Maker Movement as a whole.

"I've been to the maker Faire in San Francisco myself, I've given talks there, and so on. And that inspired me to add the term maker to my CV, because I saw how amazing that community is."

[Interview No. 5]

Furthermore, the sharing of knowledge has a central role within the scene and is emphasized on a regular basis. This knowledge diffusion takes place in physical and virtual spaces such as online communities and groups, where makers share their knowledge and project instructions.

"[…] I would also say that the community is usually very cooperative. There are lots of opportunities to do things together. There is usually interest and enthusiasm for doing something together, but also because you can learn from each other most of the time. Or because you can show what you can do."

[Interview No. 14]

Some respondents stated that receiving a certain degree of recognition and awareness of their own activities within the community triggers a slightly positive emotion inside them. However, the importance was described as less central in the interviews. Nevertheless, there are also well-known personalities in the maker scene indicating a certain kind of a personality cult that is relevant to at least some makers.

> *"We normally meet every Tuesday. Anyone can come, even those who are not in the club. At the moment, we exchange information digitally. That's when you talk about your projects and people usually understand how much work you've really put into it. I think that's good."*
>
> *[Interview No. 8]*

To a certain extent, the Maker Movement is also driven by ideology (see chapter 2). However, initial findings from the literature indicate that ideology within the Maker Movement is less prominent than for example in the open source community (Kwon & Lee 2017). Nevertheless, ideologies like open source are a relevant factor for some makers. Especially, for the culture within maker communities and their understanding of learning and sharing of knowledge, open source is relevant. Moreover, makers partially mentioned during the interviews that they believe in a successful co-existence of open source, commercial business and economic growth (Li et al. 2019). Thereby, some makers mentioned critical statements regarding intellectual property rights during the interviews, emphasizing the importance of free knowledge.

> *I think open source culture and knowledge transfer are very important, because only then can you build on other people's knowledge. And that is also an understanding of science from my point of view. Science creates knowledge and of course you have to build on things that other people have already done. That's the only way it can continue, otherwise you're constantly reinventing everything. In this respect, I am fully in favor of open source.*
>
> *[Interview No. 15]*

However, besides questions of free knowledge, a majority of the makers, usually concentrates on the process of making and tinkering itself. For them, the process itself is of major importance than the result that it produces in the end.

In particular, they enjoy the independence, flexibility and autonomy within it. It turns out that control and speed of the process make this especially appealing to many makers. This control is attributed by some to the ability to use technology, tools (democratization of innovation) and as much time as they want to accomplish what they want.

4.4.3 Motives, why some makers become entrepreneurs

Despite products that are only made for self-realization, makers create things that have value. However, it is often not immediately obvious for whom the products can generate value and whether the interest extends beyond personal interest.

> *"In the back of their mind, there's a little voice that is saying the reason they're doing this is they think it's cool. And the reason they're spending the time to create an instantiation is so that they can show it to somebody and get some of that love. Very few people do anything without a desire to get something from someone right. People that only do it for themselves, like literally only do it for themselves, is very rare. So that maker wants to create something that is of value to themselves and to someone else. What they may not fully understand is that it is actually much bigger than they are thinking."*
>
> *[Interview No. 4]*

Like already indicated by prior research, the interviews supported the view that economic attractiveness does not usually represent a major factor as a fundamental motivation to become a maker in the first place. However, it does become a key factor when it comes to entrepreneurial activities and the attractiveness of potential opportunities when realizing that this might provide the chance to put even more time into their ideas and earn a living while doing it. Thereby, makers can gain a certain degree of freedom, independence and autonomy and the potential to put even more time into their projects. Thus, economic attractiveness seems to be an important factor when considering entrepreneurial opportunities within "making".

When I sell something, I sell it at break-even. For example, someone may simply not have the resources to produce something, even if the IP is freely available. Then I would feel good to make it available to him or her. However, my costs should then be covered. I am not the charity after all.

[Interview No. 11]

[...] if I only had a 50% job instead of a 100% job like I do now, then at least that should balance out. I don't need a Porsche, but I still need a car.

[Interview No. 10]

In addition, there are also makers who directly recognize an entrepreneurial potential and are motivated by the possibility of their commercialization. Usually, various motivations and conditions and their combinations lead to entrepreneurial activity among makers. This includes, positive feedback from others, the desire to help through innovation, or simply a desire for a higher financial income statement.

Expert 12: I'm a bit more open minded [..] and try to sell my projects as soon as I'm done. However, I have no idea what this will generate. I am in favor of a consistent social market economy.

[Interview No. 12]

Entrepreneurially active makers tend to face an underlying problem, respectively an approach to solve a problem. Some makers do not want to let go of problems that exist from their point of view. Their (maker) mindset drives them to tackle things directly and try to address the problems, at least one piece at a time. This can drive (social) innovation.

Of course, there are also and there is just the connection to the founders, I would say that people see: There is something somewhere that is not yet there. So, they see that I need something or that I have a better solution for something. Maybe it's also the world improver gene, somehow, when it comes to sustainability and the like. And he/she says: I would like to develop something now, because from my point of view it can't be that this is still built or functions in such and such a way. And that means I want to create something new, something that doesn't exist. And that's how innovations come about.

[Interview No. 2]

It became apparent that the social impact of their projects is important to makers. These makers care about creating something that solves or contributes to the solution of a problem, in a way that benefits as many other people as possible. In this case, social impact may be seen as the main return of investment for their "making", while the commercial side of the project serves as an enabler for continuing with the project.

"I think the motivation, in a way, is to see your idea be realized and get into more and more hands, you know, to have impact because of your invention or creation. Right. So, there are different ways that that can manifest itself."

[Interview No. 7]

"And then you think […] this is exactly what we want. […], we have an impact, not in the quiet, but we have an impact in the society. We have impact in the community, in the whatever."

[Interview No. 5]

"For me, it's not about developing machines as an end in itself, but it's really about the society-changing factor in it. That's very important. How can the world of tomorrow look better? And based on that, we think up technical systems."

[Interview No. 1]

The participants noted that feedback, i.e. encouragement and suggestions from third parties and from the community, might result in an increased engagement with the topic of entrepreneurship.

This way, makers often realize for the first time, that there might be a potential demand for their products and services, reaching beyond their own interest and needs. Furthermore, in this way they become aware of the value their projects might create.

> *"Some people liked what I did. Then I thought about offering it as a kit. But the whole thing fizzled out because the project was done for me. I thought if anyone wants it you are welcome to have it, but I moved on project wise."*
>
> *[Interview No. 8]*

While reputation in the community seems to be important for only a subset of makers, there is a fascination among some of the makers for products that are appreciated by consumers. The image of the successful inventor, whose invention spreads widely and is of great benefit, was mentioned several times within the interviews.

> *"[…] There are several reasons. But one reason is, of course, again, this inventor role model, you know. The inventor who makes a cool thing that everyone can use."*
>
> *[Interview No. 15]*

Moreover, the interviews showed a motivation for user-innovation. Makers like to adapt products to their needs and to optimize them. On the one hand, this can have a purely personal interest in the beginning, but might develop into an entrepreneurial project. For instance, commercialization might happen if a company is interested in the result of the maker project, or if the maker is part of a cooperation e.g. a user-innovation hackathon or workshop. In addition, makers might start a business based on positive feedback and resulting demand for their products. Following this, assumptions from the literature regarding accidental entrepreneurship resulting from the Maker Movement were confirmed via the interviews. Thus, makers mentioned that they developed ideas for entrepreneurial projects almost by accident.

"[…] there is often the disappointment of discovering things in the product world. You observe the product world because it exists. So as a designer, you have a strong view of things. And then you are often disappointed by how simple things are or how little effort the manufacturers have made."

[Interview No. 15]

4.4.4 Reasons, why makers don't become Entrepreneurs more often

At this point, however, it is worth mentioning that a large proportion of makers reported (personal) inhibitions towards entrepreneurial activity. These should be considered when investigating the evaluation of entrepreneurial opportunities, in order to map a complete picture of the situation. This is necessary, for understanding the conditions for successful entrepreneurial projects and which opportunities are attractive for makers.

Above all, many makers possess a lack of affinity and identification with entrepreneurship. Often, there is no interest in the associated responsibilities (e.g. bureaucracy), unilateral orientation (e.g. focusing on one product) and loss of autonomy (having an investor or employees). However, the experts from the Maker Movement added that a lack of knowledge in various disciplines (especially financial and business development), as well as the missing relationship and varying expectations regarding entrepreneurship create high obstacles for entrepreneurial activity.

"Well, I just like being a developer and a thinker - and a maker of things too much, so I don't want to get too involved with something just to get it out there. And that's the part of the job that I find really terribly unattractive."

[Interview No. 15]

As a particular strong inhibition some makers state an ideological inhibition towards entrepreneurship. The rejection of (modern) capitalism leads to a mindset which is not compatible with their view of entrepreneurship, according to some participants, resulting in a refusal of entrepreneurial activities at all.

Moreover, based on the view of entrepreneurship of many makers in the scene, it occurs that makers fear to appear negatively within the community by engaging within entrepreneurship.

> *"There are two views on this. I'm more of a left-extremist. In my opinion, software should cost nothing. The basic idea of industrialization was that people have to work less and not that someone who doesn't work becomes poor. However, only the entrepreneurs have profited from the development and not the ordinary population."*
>
> *[Interview No. 11]*

Furthermore, access to entrepreneurship is inhibited by the relationship of the Maker Movement and open source ideology, resulting in a cultural tension. Although some respondents mention ways in which open source and entrepreneurship may be able to interact in a positive way, the majority of makers is arguing that these two approaches are difficult to combine in practice.

> *"[…] there are a lot of licenses for open source hardware, but […] open source hardware licenses don't provide for that. That's a very big gap that keeps a lot of people from even being able to invest time in it. Not to want to. […] but they just can't."*
>
> *[Interview No. 1]*

The open source culture is also seen as a crucial part of the maker culture because of the democratization of innovation. Which is why it is difficult for most people to imagine any synergies in this area. For example, one respondent mentioned an example in which a well-known manufacturer of 3D-printers lost a significant amount of popularity in the maker scene after orienting its strategy more towards commercialization. This is another example of the tension between open source and commercialization, which represents a major challenge for aspiring entrepreneurs, especially from the open source and maker scene.

> *"Then the investors came in and then the thing was dead for the community. First, they made this wooden frame, open source and so on. That was very well received by the community. And then they got investors into their booth. [...] we have to make a product now. We have to secure IP. The first thing they did was to close down the firmware. The firmware was no longer open source. And then you had to go into a subscription model and that killed it for the community. So, the original […] is actually no longer welcome today."*
>
> *[Interview No. 11]*

Next, when it comes to the commercial utilization of their projects, many makers are inhibited due to challenges in the execution of those. The main reason identified in the interviews, is the difficulty of scaling projects from the makerspace, which is primarily due to a lack of platforms and support as well as high costs and resource expenditure for the development of hardware products. Thus, the transition of a prototype into serial production is an extremely challenging task, which many makers either fail, give up on or don't even start with.

> *"Yes, I know the problem with serial production. I have already had negative experiences myself and the 50 euros to an Asian producer were simply gone, because he has not responded. Many projects have broken down because of this."*
>
> *[Interview No. 12]*

Makers may, like other nascent entrepreneurs, receive support for potential entrepreneurial activities, e.g. through accelerator or incubator programs. In addition, they may qualify for support through public grants or private initiatives. However, the funding possibilities and entrepreneurial ecosystems are often not really known in the maker scene. Another difficulty within the funding process is that the vast majority of venture capitalists do not focus on hardware projects, as they are considered to require more resources and are much more cost-intensive. In addition, hardware projects might offer less scaling potential and require long-term allocation of resources. Therefore, it is often necessary to look in special niches for funding. However, as practical experience shows, good companies also find investors here.

Furthermore, the German federal government also invests large sums in the development of technologies and innovations.

> *"[…] So, there is more funding […] and approaches funded by companies, where it's about innovation and commercial interests. And perhaps the scene is larger in this non-commercial area."*
>
> *[Interview No. 14]*

Another possibility to overcome the hurdles in starting a business from the makerspace, are platforms within the entrepreneurship or maker ecosystems. These include wide-reach platforms such as Kickstarter[13], as well as platforms designed specifically for makers, such as Tindie. These platforms support and enable projects through a community approach such as crowd-funding or crowd-sourcing.

> *"What I think fits in well with the makers is what we find under the aspect of crowdsourcing or Kickstarter campaigns, thought of in that way. That one says and there is for me now, for example, a pretty interesting platform, which is called crowd supply. That is now, for example, a very specific platform. Tindie is also such a platform, not Tinder, but Tindie. These are platforms where makers can scale their product."*
>
> *[Interview No. 5]*

Once makers decide to start a business, they face other challenges. For instance, the bureaucratic hurdles can be daunting for aspiring maker entrepreneurs. This includes the process of founding a company itself, as well as concerns regarding the registration of industrial property rights and other entrepreneurial obligations such as accounting, human resources and others. Since many makers do have a strong technical educational background, they often lack knowledge in such fields of knowledge.

[13] kickstarter.com

"Yes, one or the other tries to live from it. One or the other turns it into a Kickstarter project, which may or may not take off. Is there a path from maker to commercial business? I think so. But what I always find aggravating is that we have so many rules now. That means that when I start a business today, I always need a lawyer to guide me through the maze of rules."

[Interview No. 5]

Thereby, the protection of intellectual property rights is generally more important for hardware projects than for other types of projects. However, intellectual property rights are a major challenge that often cannot be handled without the support of professionals, that are usually cost-intensive and require a significant initial investment. Furthermore, even a protected product or innovation bears the risk of substitution or bypassing.

"Since three, four years, a little project I carry around with me. What I've actually always wanted to market, where I think it's so cool. It doesn't exist yet. I even ran to the patent office. With this project and the patent office said: it's a super cool idea. I would do it immediately. Then I ran to a patent attorney and that's when it stopped. Simply because I thought: Boah, if I really want to implement this now, then I have to hang up all my jobs and only do this and then I go into production and am no longer creative."

[Interview No. 16]

Considering the lack of knowledge, especially regarding entrepreneurial activities, it turns out that a team partner could be crucial in promoting a potential entrepreneurial effort by makers. A distribution of tasks could relieve makers of unwanted obligations and tasks and ensure that potential entrepreneurial opportunities are more likely to be tackled. Thus, many Makers expressed interest in collaborating on entrepreneurial projects and indicated a faith in a need for cooperation to succeed in their projects.

"So maybe to get back to the question of what it would take to make that happen: Not me, but someone else. […] And if somehow the right project partner comes my way. A product designer or something, then I will take it in hand again. But at the moment it's really the case that there's a sticking point. Where I say, I'm not getting anywhere, I'm not actively involved with it, but it could have the potential." [Interview No. 16]

Moreover, personal support (as for instance offered by accelerators or incubators) might include discussions with experienced founders, for example from the hardware sector, as well as discussions with mentors from various fields of knowledge. So far, this option is only available in a few, predominantly commercial or academic makerspaces. Thereby, the linkage to entrepreneurship is often intended and considered from the beginning, as part of the makerspace identity. However, within traditional (non-academic and non-commercial) makerspaces, potential entrepreneurial activities must be driven by the own initiative of nascent maker entrepreneurs.

> *"And that's the, I'll put it this way, the space that has venture capital at the top. So, I'd say that's where the startups sit, and that's where they build. And that's where an Hyperloop thing is built, which then somehow wins the prize in Elon Musk's Challenge. I think that's the nucleus where you really find it: That's where maker and commercialization meet. We don't have enough of those space."*
>
> *[Interview No.5]*

4.4.5 Summary and selected Conjoint Attributes

Overall, the interviews with makers and experts from the Maker Movement revealed a high level of consistency with the information found in the literature. However, especially with regard to entrepreneurship, new insights could be added (both positive and negative). Table 3 summarizes the different motivations and attributes of the makers that are important for them. Thereby, I also highlight motivations that are relevant for potential entrepreneurial activity among makers. In addition, I provide the respective entrepreneurial inhibitors to provide a holistic image of the process.

Table 3: Summary of motivations

Attribute/Motive	Example	Entrepreneurial importance
Self-realization	Joy, flow, self-fulfillment, inner satisfaction	medium
Problem-solving/social impact	Social impact, help others, support others	high
Autonomy	Enable self to do something, reduce dependence of existing products and services	medium
Economic attractiveness	Build prototypes for own business, sell unique products	high
Technical newness/challenge	Work with new technologies, understand new technologies, early-adopter	medium
User-Innovation	Improve existing products, sustainable usage of products, avoid buying products	medium
Learning/Skills	Learn new skills, understand new technologies, improve career opportunities and job-related skills, learning from others	medium
Community/Team work	Being part of a community, talk with people that understand the subject, create cooperative projects	medium
Recognition/reputation	Getting recognition for successful projects, having a reputation as skilled within the maker community	medium

Source: Own illustration

Building on the literature and secondary data in combination with the empirical findings from the interviews, the following five attributes were selected to represent an entrepreneurial opportunity in the context of the metric conjoint experiment:

- **Market potential**
- **Technical challenge**
- **Intellectual property rights protection**
- **Social impact**
- **Team partner**

Next, Chapter 5 will describe the selected attributes in more detail and embed them into the conjoint analysis methodology.

Other opportunity attributes such as reputation, user-innovation or autonomy might also play a role within the opportunity evaluation process of makers. However, they have not been integrated within the conjoint experiment in order to avoid an overwhelming complexity of the task and to focus on the most important opportunity attributes identified during the interviews and screening of the literature. In addition, this dissertation measures further motivation dimensions within the questionnaire in order to investigate further details regarding maker motivation.

Summarizing, it seems that the potential of the Maker Movement is rooted in the creative freedom of the movement. The playful desire to solve problems, to learn, create and share knowledge offers a novel and outstanding foundation for innovation and development of new technologies and products. However, the mechanisms of the Maker Movement do not necessarily align with the traditional understanding of entrepreneurship and the related success factors. In order to leverage the strengths of the Maker Movement without destroying the foundation that defines it – e.g. the mindset, values and playful character – subtlety and deep understanding of the movement and the individual's motivations and characteristics are essential. Following this, I will describe the method and materials used for the quantitative part of the study.

5 Method and materials

This chapter describes conjoint analysis, as the main method of this study, in depth. Furthermore, the prior use of conjoint analysis, especially regarding entrepreneurship, will be illustrated. Thereby, I describe the design development process and implementation of metric conjoint analysis in detail, as it will be applied later within this thesis. Subsequently, I describe the sampling process and the development of the questionnaire, including the used variables and scales, following the conjoint experiment.

5.1 Conjoint analysis

5.1.1 Overview

The previous chapter identified decision criteria, that makers use when creating new projects and thus evaluating entrepreneurial opportunities. However, it is still not clear how this information affects makers actual decision-making. It is important to understand how the different motivations of makers interact to clarify makers' entrepreneurial potential, decision-making and identity trade-offs. In doing this, scholars, policy makers and the entrepreneurial ecosystem can possibly improve their understanding of makers' decision-making processes and support entrepreneurial potential and interest among makers. Therefore, this chapter will outline the method to measure decision-making behavior – conjoint analysis – in the context of entrepreneurial opportunities, discuss upon its advantages compared to other methods and describe the design chosen to model real-time decision making.

Decision-making and judgment research has a long-lasting tradition within the management literature and depicts an important stream of research in entrepreneurship. Furthermore, while the field of decision-making occupies a central role in other disciplines such as organizational behavior, psychology, and marketing, there exist many publications on this in the field of entrepreneurship as well. (see Shepherd et al. (2015) and Shepherd & Zacharakis (2019) for reviews) The research stream regarding entrepreneurial opportunities has already been explored in more detail in the theory section of this thesis (see Chapter 3).

Yet, it is important to emphasize that conjoint analysis is a frequently used tool in the field of opportunity assessment and the respective decision-making. (Choi & Shepherd 2004; Haynie et al. 2009; McKelvie et al. 2011; Welpe et al. 2012) Therefor, next I will introduce the background of conjoint analysis.

5.1.2 A short history of conjoint analysis

Although the foundations of the method date back to the 1920s, it is generally agreed by scholars that conjoint measurements originated in the paper published by Luce & Tukey in 1964. (Green & Srinivasan 1978) As a mathematical psychologist (Luce) and a statistician (Tukey), this method was originally designed to measure interrelated ("joint") effects of independent and dependent variables. Following this, the use and scaling of the method was increasingly carried out by usage and publications in the field of consumer research (Westwood et al. 1974; Green et al. 1972; Green & Rao 1971, 1969; Green & Carmone 1970) and economists (Rosenberg 1956; Ratchford 1975; Lancaster 1971; Fishbein 1976). Within a short period of time, conjoint analysis became a very widely used and powerful tool for measuring and predicting consumer behavior. To date, conjoint analysis is frequently used in consumer-oriented disciplines and supports numerous pricing and marketing strategies within the industry. Software solutions for the use and evaluation of the analyses were introduced as early as the 1980s to ensure scalable exploitation and have been further developed over the years.

5.1.3 About conjoint as a method

Conjoint analysis is a distinctive "decompositional" multivariate method that allows investigating individuals decision-making processes. It helps researchers to break down people's decisions into the underlying preference structures. (Rao 2014; Backhaus et al. 2015) Thus, early on in the field of marketing, research was conducted into how consumers select products, often called objects (e.g. a car), on the basis of various attributes (the cars characteristics). An object (e.g. a car) consists out of several attributes, e.g. horsepower (hp), color, petroleum consumption. If the consumer compares multiple objects (e.g. multiple cars), they are represented by the same attributes (e.g. color, horsepower, petroleum consumption), which differ only in their specification (e.g. 70 hp, 80 hp, 120 hp). Usually, these specifications of attributes are called "levels".

Conjoint analysis assumes that individuals view and evaluate objects (e.g. cars) holistically, meaning by viewing all their attributes. The visualization of these holistic product profiles is often referred to as a conjoint card. This is why the method it is often referred to as CONidererd JOINTly, what in addition explains the origin of the abbreviation. This fundamental concept applies to all types of conjoint analysis. They mainly differ in the way how these objects are presented to participants; the way individuals can evaluate these objects and what level of analysis can be done based on the captured data. Figure 6 illustrates the design of a conjoint study as an example.

Figure 6: Illustration of a conjoint study

Attributes	**Car 1** (Object 1)	**Car 2** (Object 2)	**Car 3** (Object 3)	
Color	Black	Blue	Red	levels
Horsepower	100	140	120	
Petrol consumption	6.4 liter	8.9 liter	7.3 liter	
# of seats	7	2	5	
Price	35.000	65.000	49.000	
Which car would you buy? (CBC)	☐	☐	X	dependent variable
Rate each object from 1 to 5 (CVA)	3	1	4	

Source: Own illustration.

There are different types of conjoint analysis, which are relevant for the research question within this dissertation. These include:

- Conjoint value analysis (CVA – sometimes referred to as traditional conjoint analysis (TCA), rating-based (RBC) or metric conjoint analysis
- Choice-based conjoint analysis (CBC – also: discrete choice analysis)
- Adaptive conjoint analysis (ACA)
- Hybrid conjoint analysis (HCA)

The above-mentioned types of conjoint analysis mainly differ in the way how objects are evaluated by participants, defined as the dependent variable in conjoint analysis. CVAs can be implemented in two different ways: First, one way is to present participants with a number of objects and have them rank them in order according to their personal perceived importance. Second, another option is to rate objects individually using a Likert scale, e.g. from 1 to 10. (Kalish & Nelson 1991) In CBC, participants make discrete decisions (Yes/No) and choose their desired option, e.g. object A or object B. Thus, a decision between several objects must be made. Sometimes this discrete decision scenario is accompanied by a "None" option. In this way, the respondent is offered a solution in case that none of the objects is preferably (Chrzan & Orme 2000). Besides, these two basic methods, ACA (adaptive conjoint analysis) and HCA (hybrid conjoint analysis) use a two-tiered approach to investigate decision-making. In the first step, respondents rate the attributes according to their importance. In the second step, pairwise comparisons are created based on this information and presented to the respondents. This results in an increased individual level of data collection. (Rao 2014; Chrzan & Orme 2000) However, due to a high level of complexity and their application in niche areas, these two approaches can be neglected.

Another aspect which is relevant for all conjoint methods is the definition of an appropriate "stimuli" (often "stimulus") for the object. A stimulus, in the context of conjoint analysis, is the combination of attributes and related levels that are presented to the participants. Following this, different variants exist for presenting stimuli: First, within the full-profile method all attributes of an object are presented to a respondent simultaneously. Second, within the two-factor or trade-off-method, not all attributes of an object are presented at the same time, but for instance always two attributes at once. (Rao 2014; Green & Rao 1971) When deciding which option to use for their research, scholars should consider the cognitive abilities of the respondents, the degree of reality of the stimuli as well as the duration of the study. (Gustafsson et al. 2000) Since the close relation to reality is considered one of the great advantages of conjoint analysis, most studies usually use the full-profile method to make the decision scenario as realistic as possible, as the duration of the study does not differ significantly between both (Green et al. 2004).

As seen, the different conjoint methods differ in several ways. With regard to research questions of this dissertation (see Chapter 1), it is important to select the most appropriate method. Thus, I will outline the arguments used to identify the proper conjoint method within this dissertation within the next paragraph.

First, makers usually do not come across a high number of entrepreneurial opportunities at once. Prior research indicates that, under most circumstances, they have to evaluate just one possible opportunity. (Browder et al. 2019a; Halbinger 2014) Second, metric conjoint allows researchers to observe tendencies regarding the overall evaluation of entrepreneurial opportunities (Rao 2013). Thus, using metric conjoint analysis it will become evident, if some respondents do not find entrepreneurial opportunities attractive at all. This provides an interesting additional source of information complementary to the evaluation of the scenario. In this way it is possible to consider individual tendencies, which is not possible using discrete choice methods like CBC. (Orme 2009; Shepherd & Zacharakis 1997) Finally, within the decision process, makers tend to rely on a set of limited criteria that is available to them, instead of an exhaustive guided evaluation process (Hausberg & Spaeth 2020). Combining these factors, I conclude that CVA respectively, metric conjoint analysis is the most appropriate method for the purpose of this dissertation. Thus, metric conjoint analysis and its operationalization will be described within the next chapters in more detail.

5.1.4 Metric conjoint analysis

Metric conjoint analysis is rooted in information integration theory (Louviere 1988; Anderson 1981). Thereby, information integration theory refers to the behavior of individuals that rate different combinations of decision variables (attributes). Complex decision making involves the search, acquiring, and processing of information. Following this, scholars can use information integration theory in order to study information processing, revealed by consumers' responses to multi-attribute options. (Louviere 1988)

According to Zacharakis & Shepherd (1997), metric conjoint analysis is a "technique that requires respondents to make a series of judgments based on a set of attributes (cues), from which the underlying structure of their cognitive system can be

investigated'' (p. 211). Thereby, respondents evaluate single conjoint scenarios on a rating-scale, e.g. a Likert scale ranging from low (1) to high (5).

While ranking-based conjoint (RBC), which also belongs to the class of CVA, only queries an order of the conjoint objects, a decisive advantage can be achieved by rating within metric conjoint analysis. Thus, researchers are able to analyze contingent relationships respectively interactions between variables. (Zacharakis & Shepherd 1997)

Next, I will provide an overview of the application of (metric) conjoint analysis within entrepreneurship research.

5.1.5 Conjoint analysis in entrepreneurship research

Shepherd & Zacharakis (1999) introduced conjoint analysis to entrepreneurship research by investigating the decision-making process of venture capitalists (VC). They noted that VC's are not able to understand der own decisions precisely. This phenomenon is repeatedly observed in decision-making research when respondents are asked to report decision behavior from past decisions by themselves, known as self-report bias.

Moreover, decision-making research is subject to various biases as has been shown in various research disciplines. (Elgar et al. 2005; Golden 1992; Huber & Power 1985; Shachar & Eckstein 2007; Zacharakis & Meyer 1998) There are different reasons for these biased results. First, asking respondents about their decision-making behavior may suffer from their inability to recall their decision-making correctly due to cognitive limitations, circumstances in the past or a higher or lower attribute important back then. This bias is called recall bias or sometimes referred to as post-hoc bias. (van den Brink et al. 2001) The second problem relates to the self-reporting bias. When asking respondents to describe their decision behavior, they regularly under-report aspects that could be considered inappropriate and over-report aspects that others may see as appropriate. This bias exists in various domains, especially when using personal research methods like questionnaires and interviews. (Fadnes et al. 2009; Lam & Bengo 2003; Elgar et al. 2005) Third, another methodological issue relates to the separate measurement of items. Especially in decision scenarios, respondents show a "tendency to the top" (MacMillian et al.

1985). Thereby, participants tend to evaluate each criterion presented as very important to them. In this way, there are hardly any distinctions between the different criteria, which leads to an error in the measurements. Considering these biases, multivariate analysis methods, such as conjoint analysis, do have clear advantages compared to univariate approaches in decision-making processes. The bundled presentation of the attributes provides a more realistic scenario and shows a stronger practical relevance of the decision-making processes. (Backhaus et al. 2015; Lohrke et al. 2010) Moreover, conjoint analysis offers possibilities to overcome the challenges of the mentioned biases.

Thus, conjoint analysis have also been increasingly used in the field of entrepreneurship to study decision-making behavior. Whereas initially it was mainly the decision-making of VCs that was studied, the literature expanded to include decisions made by entrepreneurs in various decision-making processes. This includes the decision to engage as an entrepreneur (e.g. the likelihood of exploitation), decisions regarding business models and persistence as well as the evaluation of the attractiveness of entrepreneurial opportunities. (Shepherd & Patzelt 2017; Lohrke et al. 2010; Shepherd & Zacharakis 1997; Shane et al. 2003) The CVA methodology was predominantly used for this purpose. Thus, this supports the decision to use metric conjoint analysis for this dissertation. Although conjoint analysis is still a relatively little-used method within entrepreneurship research. However, it is gaining popularity due to its success and continues to be recommended for entrepreneurship and entrepreneurial opportunity decision making research. (Shepherd & Zacharakis 1997, 1999; Lohrke et al. 2010; Monsen et al. 2010)

Following this Table 4, provides an overview of (metric) conjoint analysis used in entrepreneurship-related research. Thereby, despite the authors, I present the related source of publication, independent and dependent variables, as well as the main findings of each publication.

Table 4: Metric Conjoint and Entrepreneurship

References	Journal	Attributes (ind. variables)	Dependent variables	Main findings
Wood and Williams (2013)	Journal of Management Studies	• Novelty • Resource efficiency • Worst-case-scenario	• Opportunity attractiveness	• Worst-case scenario diminishes the positive effect of other attributes • Positive significant effects of novelty and resource efficiency
Haynie et al. (2009)	Journal of Management Studies	• Rarity • Value • Competition • Inimitability • Relatedness	• Opportunity attractiveness	• Entrepreneurs are attracted by opportunities complementary to their existing knowledge resources • Opportunity- and firm-specific conditions that encourage entrepreneurs
Holland and Shepherd (2013)	Entrepreneurship Theory and Practice	• Probability • Financial returns • Non-financial benefits • Switching costs	• Decision to persist (Likert 1-9)	• Decision persistence policies are depending on the level of adversity experienced and individual values
Patzelt and Shepherd (2009)	Entrepreneurship Theory and Practice	• Finance • Technology • Network • Knowledge • Administration • Tax	• Academic entrepreneurs' assessment of usefulness	• Usefulness increases with extensive access to finance, technology, networks and business knowledge • Reduced taxes and administration processes increase usefulness
Kier et al. (2021)	Entrepreneurship Theory and Practice	• Financial investment • Time investment • Proximity to project completion • Intensity of team recommendation to persist	• Likelihood of continued investment in a product	• An entrepreneur's decision to persist with a losing project is determined partly by the team's recommendation to persist • The strength of this effect varies across entrepreneurs based on their self-regulation and experience.
Patzelt and Shepherd (2008)	Journal of Management Studies	• Output control • Behavioral control • Social control • Competence trust • Goodwill trust	• Likelihood of allocating further resources	• Output, behavioral and social control, competence and goodwill trust are significant attributes for alliance managers decisions • Interactions between trust and control variables also explain decision making
Bruns et al. (2008)	Entrepreneurship Theory and Practice	• Business risk • Share of investment • Financial position	• Probability of loan support for small firms	• Similarity between the loan officers' human capital and the applicants' human capital was a significant indicator of loan approval • Human capital characteristics had marginal

		• Independence of collateral • Related business experience • CEO tenure • Past performance • Comprehensiveness of the strategic plan			impact on decision policy contingencies • Specific human capital had no significant influence on the probability of loan approval
Warnick et al. (2018)	Journal of Business Venturing	• Startup passion • Domain (product) passion • Openness to feedback • Startup experience (control) • Domain experience (control)	• Probability of investment		• Angel investors and VC with more investing experience emphasize the combination of product passion and openness to feedback • Those with more entr. exp. emphasizes the combination of entr. passion and openness to feedback
Welpe et al. (2012)	Entrepreneurship Theory and Practice	• Success • Profit	• Opportunity attractiveness		• Effects of opportunity characteristics on exploitation are mediated by evaluation • Emotions influence exploitation in addition to evaluation • Significant effects of joy anger and fear on evaluation and exploitation
Choi and Shepherd (2004)	Journal of Management	• Customer demand • Development of enabling technology • Managerial capability • Stakeholder support	• Likelihood of opportunity exploitation		• Entrepreneurs are more likely to exploit opportunities when they perceive more knowledge of customer demand for the new product, more fully developed necessary technologies, greater managerial capability, and greater stakeholder support. • The new product's anticipated lead time acts as an enhancing moderator in entrepreneurs' exploitation decision policies.
Mitchell and Shepherd (2010)	Journal of Business Venturing	• Potential value • Knowledge relatedness • Window of opportunity • Number of potential opportunities	• Likelihood of opportunity investment		• Both images of self – vulnerability and capability – impact one's images of opportunity.

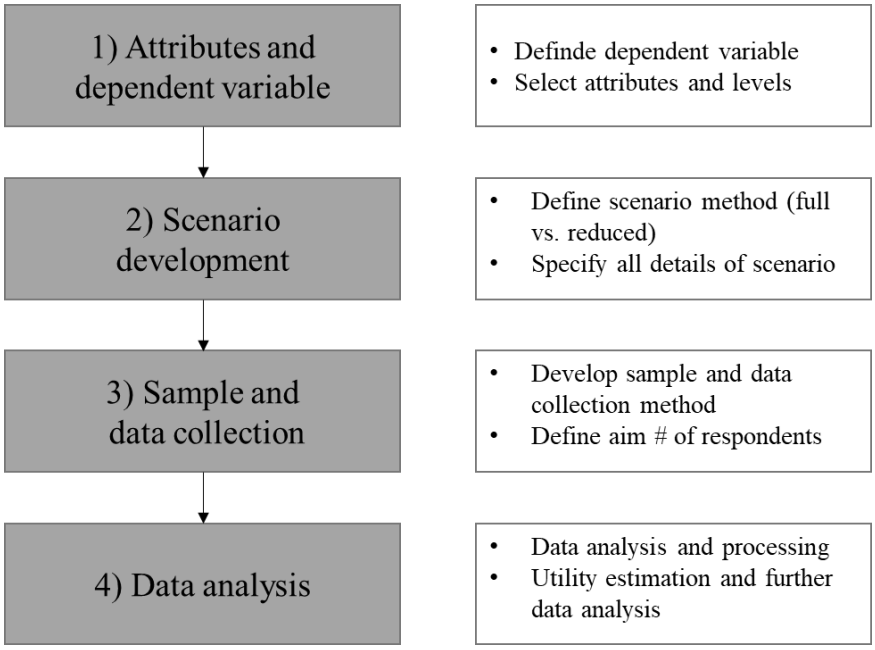
Brundin and Gustafsson (2013)	International Journal of Entrepren-eurial Behavior and Research	• Self-confidence • Hope • Challenge • Frustration • Embarrassment • Strain • Uncertainty of project outcomes	• Willingness to keep up investment	• Self-confidence, challenge, and hope increase the propensity to continue investments as do increased level of uncertainty • In contrast to the escalation of commitment theory, embarrassment does not make entrepreneurs more prone to invest under uncertainty
Wood et al. (2014)	Journal of Business Venturing	• Population level founding rates • Dissolution rates • Density levels • Knowledge relatedness	• Likelihood of investment of time and money	• Entrepreneur's related knowledge, motivation to evaluate the opportunity, prior failure, and fear of failure shape the perception of opportunity attractiveness • When combined with opportunity related data, an individual's cognitive resources play an important role as individuals form opportunity beliefs about the personal attractiveness of pursing an opportunity
Digan et al. (2017)	Journal of Small Business Strategy	• Organizational Form • Fit • Value • Rarity • Inimitability	• Opportunity attractiveness	• Franchise vs. independent form alone did not play a specific and significant role in the evaluation of the attractiveness of entr. opportunities. • Organizational form appears to influence the impact of both human capital relatedness and the inimitability of resource attributes on opportunity attractiveness.
Monsen et al. (2009)	Entreprene urship Theory and Practice	• Employment risk • Pay risk • Required effort • Expected performance • Reward	• Likelihood to participate on the new corporate venture team.	• Employees significantly consider all attributes except pay risk in deciding whether they would participate in a new venture of their company. • Employees willingness increases with decreasing job risk, increasing success probability and decreasing effort associated with the new venture

Building on this, I will describe the conjoint design process, within this dissertation, in detail within the next chapter.

5.1.6 Conjoint design process

This dissertation follows a recommended procedure from literature to develop and execute a conjoint design (Orme 2002; Backhaus et al. 2016; Hanisch & Rau 2014; Gustafsson et al. 2000). As seen in Figure 7 ,when designing a metric conjoint experiment, four different steps are distinguished.

Figure 7: Conjoint design process



Source: Own illustration

Decision attributes and dependent variable

(1) First, the decision attributes (independent variables) and the dependent variable are defined and described. As described in the section above, the attributes are used to characterize the conjoint object. It is very important that the decision criteria are selected carefully. They should be grounded in previous empirical research and ideally additionally strengthened by own in-depth explorations. This is important, because they determine the success of the overall experiment and its validity and provide an important foundation for its explanatory power. (Priem 1994; Orme 2002, 2010; Shepherd & Zacharakis 1997; Patzelt & Shepherd 2016) As a result, attributes und levels should always be highly relevant for the research question.

In addition to a strong theoretical foundation, Shepherd & Zacharakis (1997) recommend to pre-test the developed decision attributes with real respondents and suggest to ask for feedback from scholars to ensure validity within the developed design. This can prevent attributes from being incomprehensible or not feasible. In such cases, multimedia representations of the attributes may help. Furthermore, knock-out attributes should be eliminated before further investigation.

While developing a metric conjoint design, it should be noted that the number of attributes is limited by several factors. First, this is important in order to ensure an appropriate number of decision scenarios for the experiment. Second, the respondents should not be overburdened or even fatigued with too many attributes per decision task. Hence, according to existing literature, it is recommended to select a number ranging from three to up to a maximum of eight attributes (Brundin et al. 2008). However, the focus regarding the used attributes should never rely solely on the number itself, but on choosing the right number of attributes, needed for the successful implementation of the research project. Once again, it should be emphasized, which attributes are really relevant to the research question and which factors can be kept constant, if necessary. As already mentioned, in this thesis, the attributes derived from an in-depth review of the theoretical literature were double-checked with qualitative interviews from practice, reduced to the substantial, and subsequently validated once again with twenty academics and "real-world" makers, within a pre-test, to ensure that the attributes meet the described conditions.

Regarding the number of levels, a balance of levels across the attributes is recommended, to avoid the "number of levels effect". This bias is present if a decision is influenced by the number of levels across different attributes. This occurs due to the phenomena that participants assume higher relevance of attributes with more levels compared to other attributes. (Orme 2002; Steenkamp & Wittink 1994; Wittink et al. 1990; Wittink et al. 1992) In most conjoint studies, only two levels per attribute are used. In the context of this study, however, it is necessary to use three levels for some attributes. Nevertheless, it is not always necessary to strive for a perfect balance of levels across attributes. However, researchers should remain aware of possible effects and plan the appropriate research design, considering the interaction effects that will be investigated.

This dissertation uses a balanced design with three levels per attribute to examine the characteristics of makers and their impact on the perception of the attractiveness of entrepreneurial opportunities. Consequently, the balance of attributes and their levels does not involve a major risk at this point. Moreover, with regard to interaction effects, it should also be ensured that attributes cannot influence each other, i.e. that they are as independent of each other as possible.

In summary, the following attribute and level specifications should be considered during the design of a conjoint experiment.

Table 5: Conjoint Attribute conditions

a	*Attributes and levels need to be preference relevant*
b	*Attributes and levels need to be feasible*
c	*Attributes should be independent*
d	*Levels within each attribute should be reciprocally exclusive*
e	*Attributes should be described adequately*
f	*Levels should be balanced across attributes*
g	*Knock-out Attributes should be avoided*

Source: Own Illustration

Based on the interviews (Chapter 4) and considering the prerequisites (a-g) mentioned above, Table 6 presents the attributes and respective levels that finally were selected to represent an entrepreneurial opportunity within this dissertation. Moreover, it provides a description of each attribute with examples.

Table 6: Conjoint attributes and levels chosen for study

Attributes	Attribute levels	Description
Market potential	(1) low (2) medium (3) high	This characteristic describes the economic attractiveness of a potential market, e.g., based on its size and the consumers' willingness to pay.
Applicability of intellectual property rights	(1) low (2) medium (3) high	This characteristic describes whether the product can be protected with intellectual property rights in order to prevent imitation.
Technical requirements	(1) low (2) medium (3) high	This characteristic describes the anticipated level of technical requirements of the realization of the product.
Social impact	(1) low (2) medium (3) high	This characteristic describes if and how the product may solve social problems.
Project team	(1) no team partner (2) team partner with economic background (3) team partner with technical background	This characteristic describes if there is a project partner for the respective project. The project partner may have different competencies.

Source: Own illustration.

With regard to the dependent variable, studies ask the respondent to decide whether a decision scenario is likely or whether a depicted situation (scenario) is attractive. For instance, this can refer to the probability of an investment or the attractiveness of an entrepreneurial opportunity. (Mitchell & Shepherd 2010; Choi & Shepherd 2004; Haynie et al. 2009) Considering prior research with equivalent methodologies and research questions (Haynie et al. 2009; Welpe et al. 2012; Wood & Williams 2014), the following phrasing was developed for querying the dependent variable within this thesis:

Based on the characteristics described, how attractive is this entrepreneurial opportunity for you personally?

Following this, the answer to this question – the dependent variable – is measured using a Likert scale, usually with five to ten options, ranging from "low" to "high" (Patzelt & Shepherd 2016; Monsen et al. 2010; Choi & Shepherd 2004; Patzelt & Shepherd 2008). Thus, within the scope of this work, the attractiveness of the entrepreneurial opportunity is measured using a five-point Likert scale ranging from one, "not attractive at all", to five, "very attractive".

Scenario Development

(2) In the second step, different scenarios are developed from the various attributes and the corresponding levels (e.g. high and low), that the participants are supposed to evaluate. In theory, it is possible to query all possible combinations. In practice, however, the exponential nature of the function quickly results in an overwhelming number of scenarios. For example, a factorial experimental design with eight attributes at two levels each would result in 256 (2^8) decision tasks. There is always a trade-off between the number of scenarios and the feasible number for participants. One way to keep the number of decision tasks at a manageable level is to use an orthogonal factorial fractional design. Within orthogonality, zero correlation of dimensions (attributes) is assumed. For example, it is possible to reduce 256 possible combinations to 16 scenarios through a fractional orthogonal design. Most studies, even with full replication (running all scenarios twice, in order to obtain test-retest reliability), will not exceed a total of 32 scenarios. However, full-replication is only performed if practicable, e.g. with a small number of attributes and levels. With an increasing number of attributes and levels this might not be the case due to the overwhelming number of tasks participants would have to face. However, the use of an orthogonal design comes with disadvantages. Certain effects – but usually in second or third degree – may not be tested this way. However, depending on the research question and the relevance of the tested interactions, this can already be considered in advance, thus keeping this possible impact negligible.

In addition to the number of scenarios, their positioning and illustration is also important for running a successful conjoint experiment. Scholars recommend, to randomize the position of attributes and scenarios to avoid order effects (Schuman et al. 1981). Moreover, the different conjoint scenarios have to be embedded in a decision environment (Shepherd & Zacharakis 1997). To ensure that every participant makes his decision in the same cognitive environment, it is important to provide a detailed description to the respondents in advance. Furthermore, it is important to consider other factors that may influence the decision. In order to offset the effects that may arise from such factors, these must be integrated as constant. (Hanisch & Rau 2014)

Building on this, the following illustration presents the scenario within the scope of this dissertation, presented to all study participants. As a constant factor, the financial risk of the entrepreneurial opportunity, which was not included as a conjoint attribute, was defined as low.

Table 7: Conjoint scenario

Conjoint scenario
In the context of your hobby, you work on a project as a maker and have developed a prototype of a possible product. Your immediate environment shows a positive reaction to the prototype. This leads to the possibility of an entrepreneurial opportunity. The financial risk is low. The entrepreneurial opportunities differ with regard to the following 5 characteristics.

Sample size and data collection

(3) Third, the sample size and data collection process is developed. Shepherd & Zacharakis (1997) established the rule of thumb that a sample size around 50 to 80 respondents is sufficient for metric conjoint analysis. Thereby, the recommended sample size is considerably smaller than that needed for standard questionnaires, because the maximum amount of information can be extracted from a relatively small sample size using a special method for analyzing the respective decision data.

However, if additional effects, beyond the decision-making scenario, should be investigated and a questionnaire is included, studies tend to have a sample size around 100 respondents. (Brundin et al. 2008; Bruns et al. 2008) Thereby, the determining parameter is the product of the number of participants and the number of decisions or observations per participant. These two parameters can be used to control how many data points from a sample are available for the statistical calculation of the results. For instance, 100 participants with ten decisions per participant create 1.000 (100*10) data points for analysis.

Data analysis

(4) Finally, during the fourth step the collected data is analyzed. Thereby, different ways to analyze metric conjoint data do exist (for an overview see (Rao 2013). Following this, the kind of analysis used for metric conjoint analysis is relying on two main factors: First, the scaling of the dependent variable and second, the desired

level of data aggregation. If an interval scale is used, ordinary least squares (OLS) linear regression is a well-suited analysis method (Rao 2013; Lohrke et al. 2010; Orme 2003). For analyzing data derived from ordinal scales, more specialized tools such as monotonic regression or linear programming are necessary. Similarly, for categorical data, other methods such as multinomial logit or categorial conjoint measurement are suitable. However, since the majority of conjoint analyses are interval scaled, regression methods are the main focus of interest. (Rao 2013; Lohrke et al. 2010) Moreover, Hierarchical linear modeling (HLM) is also used in a number of studies, using metric conjoint (Hanisch & Rau 2014). It allows to analyze nested data. This might become necessary because some of the data derives from different individuals. HLM allows to distinguish variances at different levels of analysis and is therefore well suited for metric conjoint. However, as an alternative, clustering is typically performed at the individual level to determine partworths and relative importance of attributes. (Rao 2013) In this dissertation, OLS regression with individual-level clustering is used to analyze the collected data.

Limitations

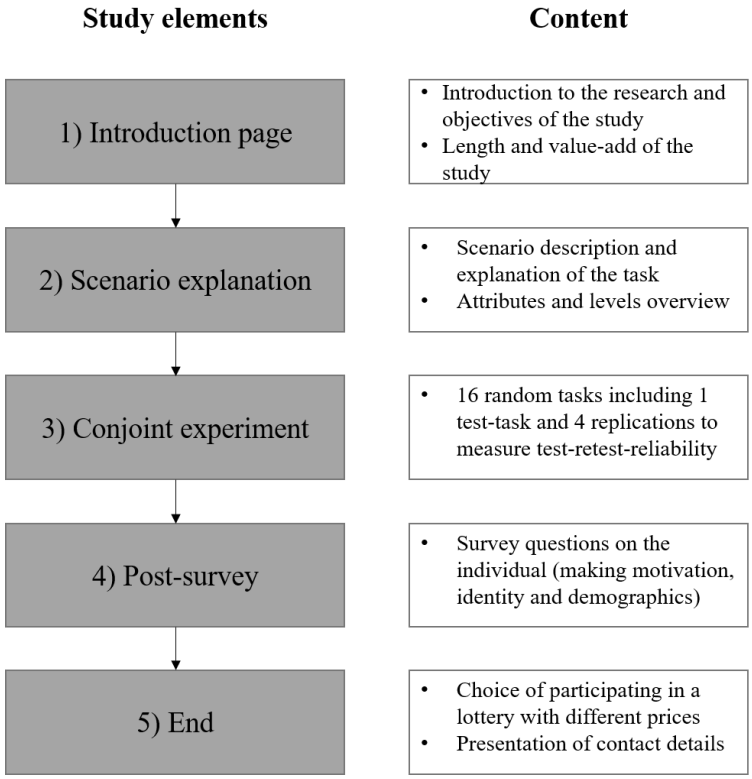
As with any method, conjoint analysis has several limitations and drawbacks that must be considered when investigating and analyzing decision-making. First, because the decisions are based on a scenario, a lack of real-life consequences of the decisions is a major source of criticism (Shepherd & Zacharakis 1999; Lohrke et al. 2010). However, this can be compensated by incentive structures (Ding et al. 2005) and a suitable decision environment. Second, there is a possible pitfall within the design of the experiment. Since the selection of the attributes is done in advance, it is possible that attributes are only considered, because they are part of the experiment. On the other hand, attributes that are relevant for the decision might be overlooked by the scholar. Moreover, external factors, that are not used as attributes, may affect the decision and should be considered as well. Otherwise they may cause biased results. (Lohrke et al. 2010; Hanisch & Rau 2014; Shepherd & Zacharakis 1999) Third, in an orthogonal design, it is assumed that there is no correlation between the attributes. If not taken into account, this might result in unrealistic combinations (Hanisch & Rau 2014; Shepherd & Zacharakis 1999). However, all these critical issues can be addressed by creating a strong foundation for the experiment. As already mentioned, this includes a heavy groundwork of literature, empirical data,

expert advice and testing in advance. In addition to the limitations grounded in the methodology itself, limitations might arise from the respondent's cognitive abilities. These include the unfamiliar and sometimes perceived as repetitive structure of metric conjoint experiments, as well as the difficulty of querying futuristic scenarios (Lohrke et al. 2010). While the first issue may be targeted by measuring test-retest validity (McMullen & Shepherd 2006; Shepherd 1999), scholars developed recommended procedures for future-oriented research projects as well (Hoeffler 2003).

5.1.7 Realization of metric conjoint study

Since the conjoint experiment was considered as cognitively more demanding, it preceded the follow-up questionnaire. For the realization of the metric conjoint experiment, this thesis uses the software *sawtooth*. Sawtooth is the leading software for conjoint analysis and is frequently used by practitioners, as well as academic scholars. In addition to the main conjoint design, Sawtooth offers other additional services, such as surveys and analytic instruments for data analysis. The parameters mentioned within the previous chapters, were subsequently implemented in Sawtooth Software (Lighthouse Studio Version 9.14). Thereby, this allowed the online distribution of the study and enabled participants to participate via their mobile, tablet or desktop. Therefore, Sawtooth includes a default responsive mode that adapts surveys to different devices and the respective screen size. The full study was realized using Sawtooth is organized the following way (see Figure 8).

Figure 8: Realization of Conjoint



Own illustration.

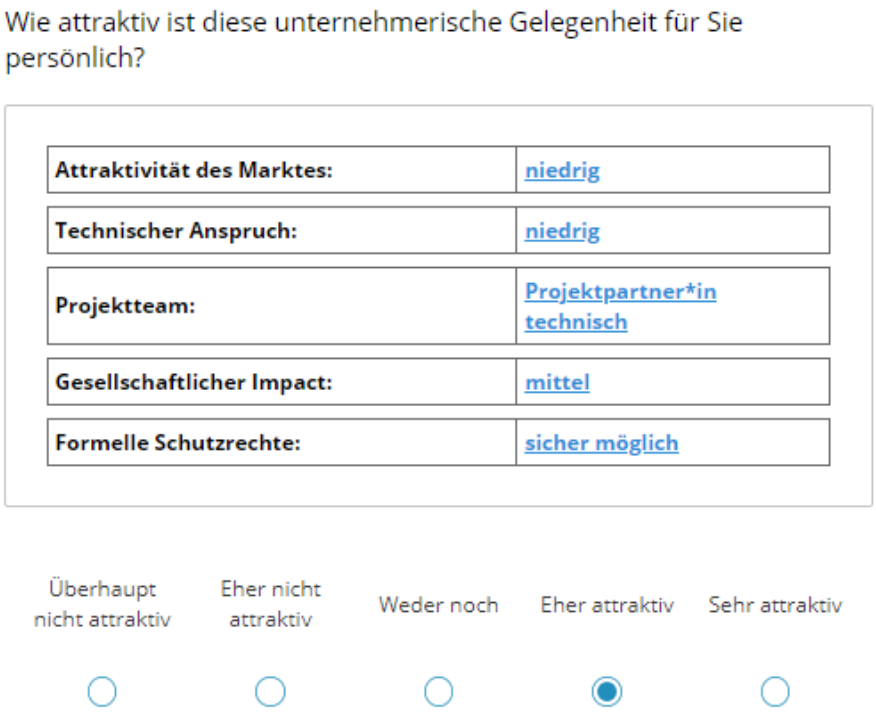
(1) The study starts with an introduction page, providing the information regarding the subject, as well as the objective and purpose of the study. In addition, the introduction page contains information about the duration of the survey and a description of the tasks, the participants will encounter. A progress bar at the bottom of the page always reveals to participants at which point in the study they are currently at. The page finishes with references to contact details of the participating researchers and institutes and shows a contact option in case of problems with the survey.

(2) On the next page, the participant is asked to read through a short scenario and empathize with the described situation. Furthermore, it is described how many scenarios the participant has to evaluate and how to access these. The page concludes with a summary of the conjoint attribute, characterizing an entrepreneurial

opportunity. These are described in more detail, using a hover-over, which is indicated by a hint for all participants.

(3) The following pages display the 16 decision scenarios, including one test-task and 4 replication tasks, each measured on a 5-point Likert scale. On every page, all attribute values are accessible via a hover-over, which contains more detailed information about the respective level. Figure 9 shows a decision task within Sawtooth Software.

Figure 9: Conjoint task example



Source: Sawtooth Software – own illustration.

(4) Following the decision tasks, the participant is informed about completing the conjoint experiment. In addition, the page introduces the follow-up questionnaire. Thereby, the questionnaire covers several pages and is divided into different sections, including experience as a maker, motivation, social identity and entrepreneurial aspects. Finally, demographic information – e.g. age, gender, educational background, etc. – is collected.

(5) At the end of the online study, there is an optional lottery where the participants can choose between three possible prizes. The survey concludes by showing contact details for feedback or possible queries.

Before the first participants were finally invited to take part in the study, it was tested in several iterations by researchers and makers. Furthermore, spelling and grammar were revised and checked by several proofreaders. In addition to the data entered by the participants, Sawtooth also collects various background data, such as the time needed for the study and per-page run times, as well as the date and time, and the device on which the study was conducted. The study was conducted mostly online and by invitation via email or other digital tools. Furthermore, offline surveys were also conducted in dedicated makerspaces, if practicable. These took place on a tablet and were made possible by an offline function, included in Sawtooth Software. Based on several tests, the study is estimated to take about 15-20 minutes in order to complete. In the further course, depending on the response, a maximum of two reminders were sent to repeatedly draw attention to the survey. Detailed information regarding the respondents answering behavior is available within Chapter 5.3.

5.2 Questionnaire and variables

In this chapter I will describe the development and execution of the questionnaire, following the conjoint experiment. The questionnaire was constructed in several iterations based on the literature and the conducted interviews (see chapter 4). Furthermore, experts from different fields were involved for consultation. In addition, the questionnaire was tested in advance (n= 25) with makers and research peers to gradually improve and adapt it. All materials and scales, including the related references from literature, that were used to guide the construction of the questionnaire are presented in Table 50 in the appendix. Next, I will describe the five different sections of the questionnaire in more detail.

(1) Maker experience: The first page of the questionnaire contains nine questions related to the activities and experience as a maker of the respondent. The questions cover how long, often and regularly the participant is involved as a maker. The question also asks the respondents about their prototyping and product development efforts. Participants are also queried whether and to what extent they identify themselves with the Maker Movement and whether they benefit from makerspaces.

Furthermore, the impact of the covid-19 pandemic on the respondent's activity as a maker is considered.

(2) Maker motivation: The second part of the questionnaire investigates the motivational structure of the participants in detail. For this purpose, the scale from Carter et al. (2013) was adapted. This scale is widely used and established in the field of entrepreneurship motivation and has found to be well suited for the investigation of maker motivation as well. Thereby, the respondent's motivation – including motivations such as self-realization, learning, autonomy and problem-solving – is measured using nine item batteries with 27 items, each on a 5-point Likert scale, ranging from "not important at all" to "very important". Chapter 6.3 contains the complete scale used to measure maker motivation.

(3) Maker identity: The next section of the questionnaire investigates the social identity of makers, using a single-item scale introduced by Postmes et al. (2013). Thereby, participants were asked to indicate their personal identification with three different vignettes, representing several maker identities. This approach is widely used in the context of measuring social identity identification and has been used in many studies across various disciplines. Identification was measured using a 5-point Likert scale ranging from "not at all „to "complete" identification. The maker identities presented, included identities with an economic focus, a technical focus, and a social focus. The development of the identities is based on the popular publication regarding entrepreneurial identities by Fauchart & Gruber (2011). Detailed information regarding the maker identities, their development and the vignettes used for identification measurement are available in Chapter 8.

(4) Entrepreneurship: The next section of the questionnaire investigates the entrepreneurial activities and interest of the participants, including entrepreneurial experience. If the participants indicates experience as a founder, further questions are raised about the status of the company, the background of the process of starting a business and the team involved. In addition, participants were asked regarding their entrepreneurial interest and if they consider entrepreneurial activity as a personal future perspective. In addition, the questionnaire enquires whether participants do have entrepreneurial ideas and how they derived. Moreover, the questionnaire investigates the personal network – potential customers, investors, etc. – of

participants that could be useful when starting a business. Furthermore, the questionnaire targets the ability to take risks and the participants image of entrepreneurship.

(5) Demographics: The questionnaire concludes with collecting demographic data, such as age, gender and personal living situation (e.g. whether children, housing situation, migration background). Furthermore, the current employment situation and the educational background as well as the level of education are investigated. Additionally, the experience and knowledge in different areas (e.g. marketing, management, engineering, digitalization, etc.) is queried. In addition, the questionnaire asks for knowledge regarding the protection of intellectual property rights.

Following the description of the development of the questionnaire, I will describe the sampling process within this dissertation and provide insides into the challenging approach to engage with a high number of makerspaces in Germany.

5.3 Sample and sampling strategy

The next chapter provides insights into the sampling strategy of this thesis. In addition, I provide insights regarding the contained sample characteristics and respondent behavior, including tests regarding a potential impact of late response bias.

5.3.1 Sample selection

To create a sample, I used a public repository of makerspaces (hackerspaces.org, see Halbinger 2018) together with the makerspace overview page of Make magazine and the database of the German Association of Community Workshops (VOW). I also added mentioning's of makerspaces from an internet search and recent research (Heinzel et al. 2018). In this way, I intended for complete coverage of makerspaces located in Germany, creating a new database applying several inclusion criteria. The applied criteria and specifications of the sample selection process are presented in Table 8.

Table 8: Sample selection criteria for conjoint study

Item	Characteristic	Reason
Location	Makerspace must be located in Germany and should have a unique location	Avoid makerspaces with invalid or unclear location data
Makerspace focus	Makerspaces must focus on soft-and hardware components and must focus on creation of new things instead of repairing only	Avoid invalid makerspace types like repair cafes or bike shops with one focus only
Makerspace type	Differentiate makerspace types and backgrounds. (academic, commercial, non-commercial, …)	Data must be considered separately here in part because different prerequisites and objectives are evident.
Motivation to use makerspace	Makerspace must be used voluntarily (outside of an employment relationship).	The subject of the research are hobby makers and innovation outside of companies.

Source: Own illustration.

Due to the difficult prevailing data situation, the further approach of the sampling process had to be customized as well. In order to collect and compare data at the makerspace level as well, snowball sampling was rejected as a technique. Instead, it was defined that each makerspace should receive an individual link to the study, that would allow a clear mapping of results, including analysis on the single makerspace level. Duplicate responses were prevented via a built-in cookie policy by Sawtooth Software.

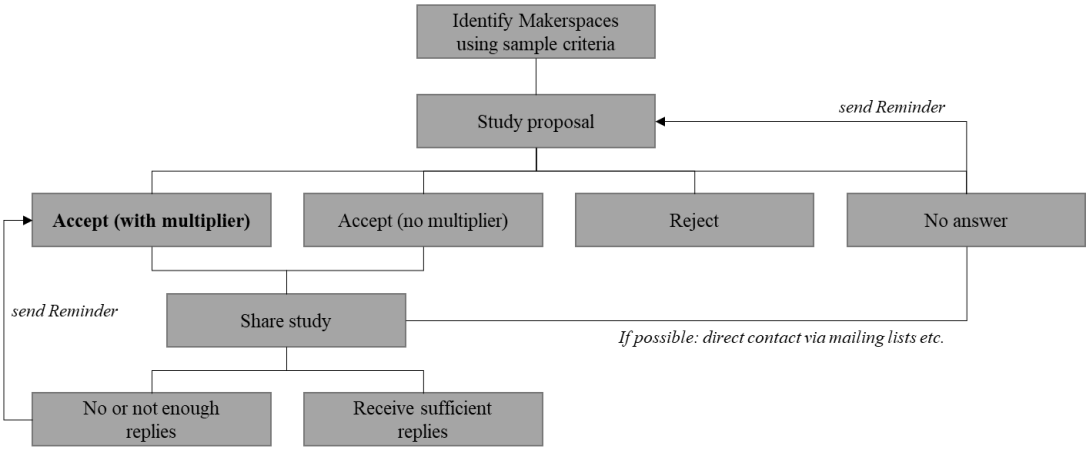
I then reached out to persons responsible for these makerspaces—our multiplicators—and contacted them via email (or their preferred ways of contact) and asked them to forward our survey and conjoint experiment to the makers in their spaces A few weeks after our initial request, I sent a reminder to all those responsible that did not yet participate. I chose this approach due to the strong privacy-oriented culture in the maker scene, assuming that makers are more open-minded regarding queries from people they know and trust. Even in the choice of digital contact tools, that were necessary during the covid-19 pandemic, this culture is evident.

Many makerspaces run their own servers – for instance using Matrix, Mastodon or other tools – avoiding the use of mainstream messengers such as WhatsApp, etc. Thus, it was very important for the research project to establish close relationships

with the participants on site in order to gain insight into this relatively unexplored world, using their preferred contact tools (including Discord, Matrix, Mastodon, Telegram, Signal, Threema, etc.).

In the end, I was able to implement a successful procedure that followed a certain pattern. As a result, a total I identified 219 makerspaces and contacted them. Finally, 307 individuals from 94 different makerspaces participated in the study. This results in a response rate of 46.4 percent referring to the contacted makerspaces. Figure 10 provides an overview of the sampling process within this dissertation.

Figure 10: Sampling process

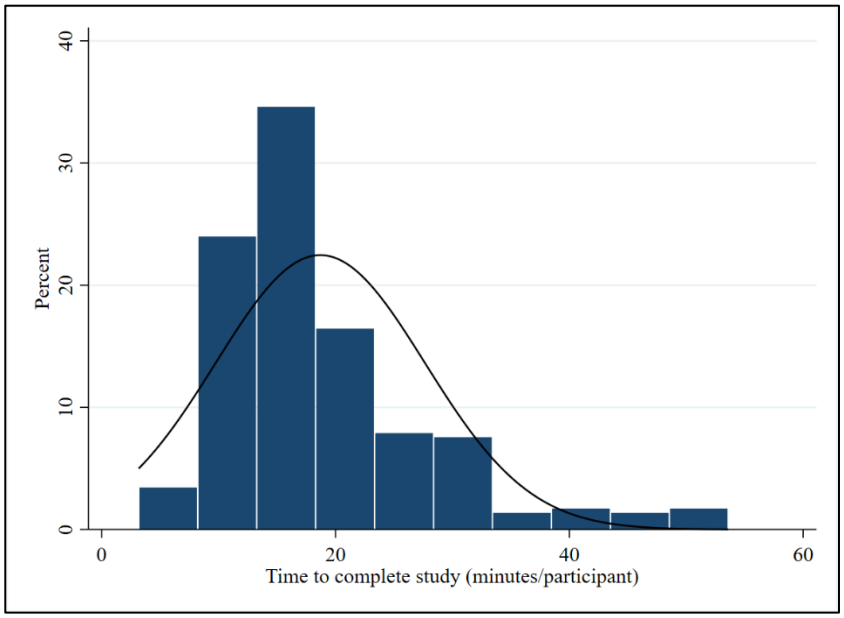


Source: Own illustration.

5.3.2 Sample characteristics

Seven participants (2.2%) of the original sample of 314 makers that finished the study, did not respond reliably and had no variance in their answers. These participants were omitted from further analysis. The remaining 307 participants finished the study with no issues and spent an average of 18.7 minutes (SD = 8.9) completing the questionnaire and conjoint experiment (see Figure 11). Outliers with almost double the time show that the study had been paused for a considerable time, e.g. on one page, in order to resume and complete the study later.

Figure 11: Time to complete study



Source: Own illustration.

I used a late-response bias test to assess the representativeness of our sample in order to determine whether the early respondents differed from late respondents. Therefore, I split the sample in two samples. The first half (N= 154) and the second half (N =153). Following this, I compared the mean values of several individual characteristics of the respondents using a z-test. As a result, I found no significant between the two sub-samples and therefore between early and late respondents (see Table 9). Non-response bias was not tested due to the specific sampling strategy and lack of necessary information for this kind of test, which is a limitation within this dissertation.

Table 9: Assessment of late-response bias

	(1) First half (N=154)	(2) Second half (N=153)	(1) vs (2)
Gender			
Female	0.19	0.16	0.03 (0.769)
Age			
11-20	0.03	0.03	0.00 (1.000)
21-30	0.28	0.45	-0.17 (0.143)
31-40	0.30	0.32	-0.02 (0.861)
41-50	0.18	0.08	0.10 (0.349)
51-60	0.14	0.08	0.06 (0.598)
61 or older	0.03	0.02	0.01 (0.953)
Level of education			
Secondary school	0.08	0.07	0.01 (0.598)
A-level	0.12	0.18	-0.06 (0.558)
Apprenticeship	0.21	0.16	0.05 (0.682)
Bachelor	0.18	0.23	-0.05 (0.682)
Masters or higher	0.38	0.38	0.00 (1.000)
Educational backgr.			
STEM	0.47	0.63	-0.16 (0.143)
IT	0.34	0.34	0.00 (1.000)
Business	0.11	0.14	-0.03 (0.769)
Design/Architecture	0.06	0.08	-0.02 (0.909)
Craft	0.16	0.09	0.07 (0.519)
Social	0.03	0.03	0.00 (1.000)
Entrepr. interest	3.08	3.09	0.01 (0.906)
Founder	0.35	0.29	0.06 (0.558)

Following this chapter regarding method and materials used for this thesis, including the conjoint methodology, questionnaire and sampling strategy, I will outline the descriptive statistics, as first part of the results chapter.

6 Descriptive statistics

In this first results chapter, I will provide initial information and insights about the study participants. Since this dissertation deals with an under-researched and new phenomenon, this chapter offers important explorative quantitative insights into the Maker Movement. Detailed information regarding all variables can be found in the appendix.

6.1 Demographics

As can be seen in Table 10 the majority (79.41%) of the study participants are male. This is consistent with previous studies and estimates of the individuals involved in the Maker Movement (Maker Media Inc. & Intel Inc. 2012) and represents the gender distribution of the movement at this time. Since increasing numbers of women are represented in STEM related education and makerspaces, a shift towards more female makers is likely.

Table 10: Demographics

Variable	**N**	**%**
Male	244	79.48%
Age		
11-20 years	11	3.58%
21-30 years	118	38.44%
31- 40 years	93	31.27%
41-50 years	38	12.38%
51-60 years	31	10.1%
61-70 years	9	2.93%
71 years or older	2	0.65%
Not specified	2	0.65%
Married	154	50.16%
Children (no/yes)	90	29.32%
Immigration background	46	14.98%

Looking at the age of the respondents, the majority (38.44%) of makers are between 21 and 30 years of age. Followed by the age cohort between 31 and 40 years of age (31.27%). The mean age of the respondents is 34.6 years. About half of the respondents (50.16%) are married or in a partnership. 29.32% stated that they do have at least one child. 14.98% of participants reported that they came from a family

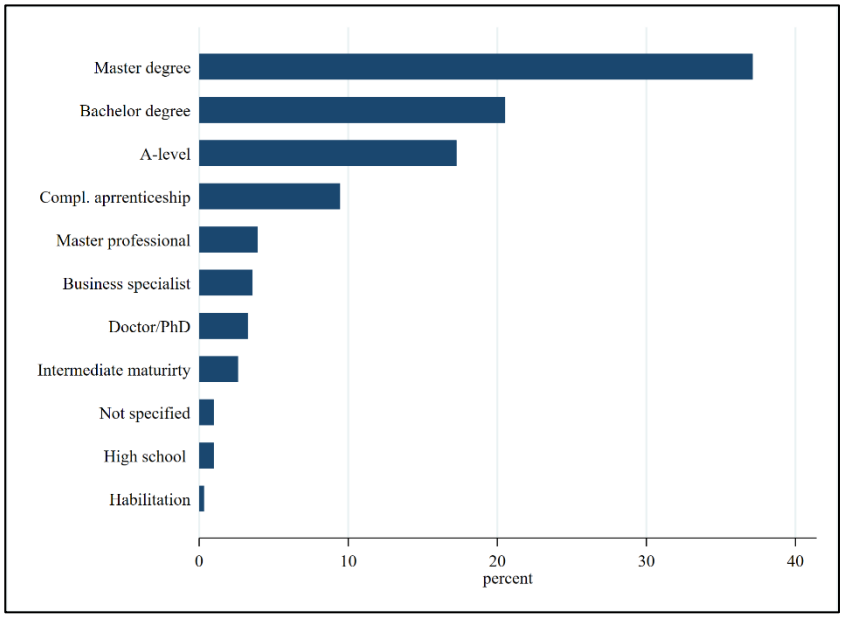
with an immigrant background. Table 10 provides an overview of all demographic variables and their distribution.

6.2 Education

Looking at the educational background of the participants, most of the respondents have an engineering science background (26.47%), followed by information science (21.57%), mathematics and science (10.78%) and craft (9.15%). Overall, the makers are more likely to have a background in technical areas of education compared to the public. All further data regarding the various educational fields can be found in Table 12.

In terms of formal education, Figure 12 shows that most of the respondents holds a master's degree or diploma (37.13%) in their respective field followed by a bachelor's degree (20.52%). In addition, eleven participants (3.59%) obtained a PhD degree. Since university-based makerspaces were included in the study, it is important to note that many respondents are still in education. Thus, 30.29% of the participants are currently pursuing their studies. Based on these results, it is apparent that makers appear to be well educated in comparison with the public.

Figure 12: Level of education



Source: Own illustration.

Looking at the participants' current employment situation it can be noted that most respondents are permanently employed in a full-time profession (35.60%). In addition, 12.39% are employed in a part time job to date. Nearly one-third (30.29%) of the participants are currently enrolled in university, as students, pursuing a bachelor or master's degree. Another 11.78% are active as entrepreneurs, are self-employed or work as freelancers. Table 11 provides an overview of this variable and its distribution.

Table 11: Employment situation

Employment situation	**N**	**%**
Full-time employment	109	35.50%
Student	93	30.29%
Part-time employment	38	12.38%
Entrepreneur/Freelancer	36	11.73%
Other	20	6.52%
Retired	9	2.93%
Pupil	2	0.65%

N=307

In addition, Table 12 provides an overview regarding the educational background of the respondents and the distribution of this variable.

Table 12: Educational background

Field of education	**N**	**%**
Engineering	152	49.51%
Computer science/ IT	105	34.20%
Mathematics/Science	42	13.68%
Management	39	12.70%
Craft	38	12.38%
Media and Communication	24	7.82%
Product design and Architecture	22	7.17%
Other	19	6.18%
Education sciences	13	4.23%
Social sciences	10	3.26%
not specified	8	2.61%
Linguistic and Cultural sciences	7	2.28%
Psychology	6	1.95%
Art and music	6	1.95%
Teaching Studies	5	1.63%
Medicine and Health	5	1.63%
Sports and nutrition	4	0.98%
Public administration	3	0.65%
Agriculture and Forestry	3	0.65%
Law	1	0.33%

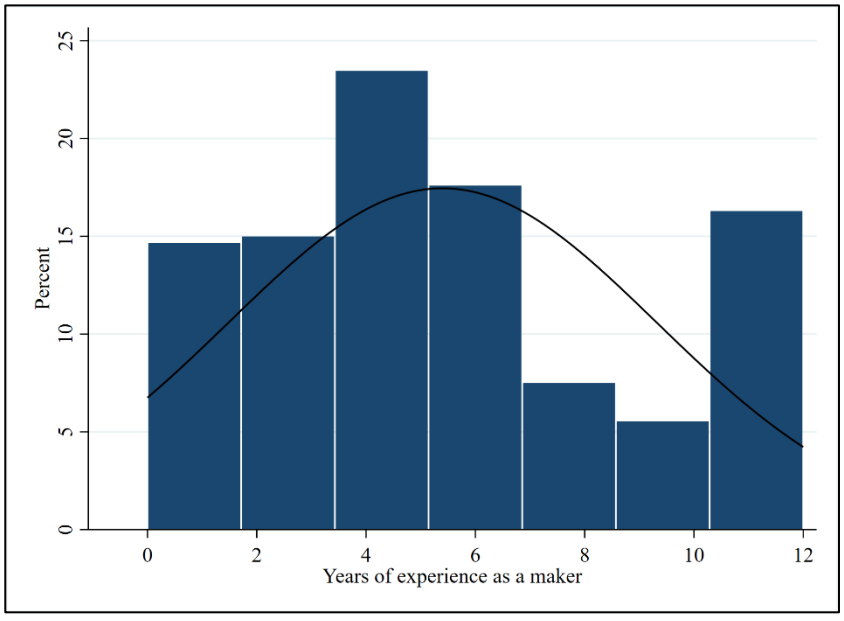
Notes: N=307; Multiple answers permitted.

6.3 Maker experience

This subchapter summarizes the characteristics of the respondents regarding their experience as makers, including time spent for making-related projects, number and characteristics of projects, as well as their relationship to other makers and the Maker Movement itself.

Most of the participants have been active as makers for three to four years (23.45%). Interestingly, however, some of the makers (16.29%) have been involved for more than 10 years. Although this is moderately correlated with the age of the respondents, it can be assumed that constantly new makers are joining the movement and that many makers stay with the movement for a significant period of time, resulting in an increasing amount of people within the movement. Thus, people may be expected to stick with making for a longer period of time once they begin the activity. Figure 13 provides an overview of the respondents' experience as makers.

Figure 13: Maker experience

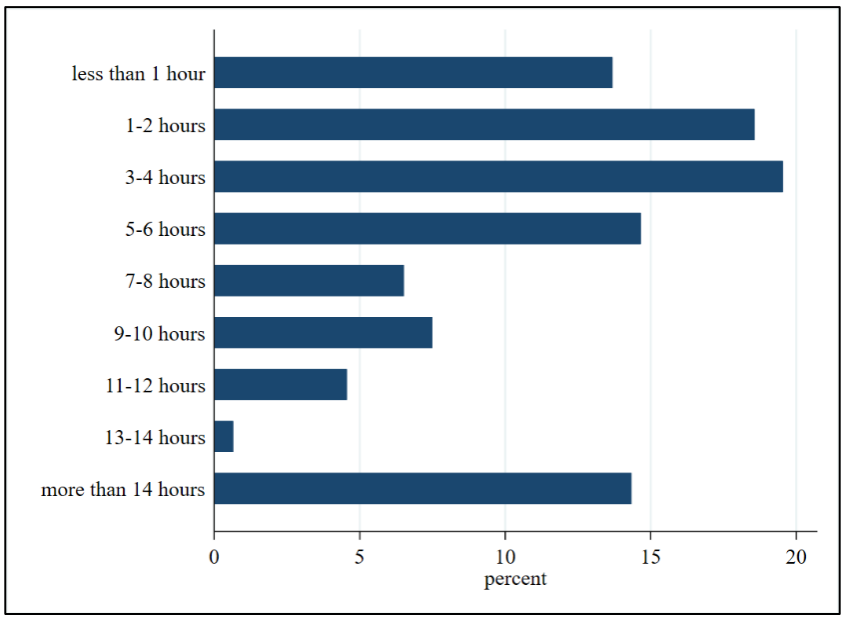


Source: Own illustration.

The intensity of the relationship with the movement is further evident in the amount of time invested in projects by the participants. Figure 14 illustrates that most makers spend around three to four hours per week, working on their projects. However, around 14.33% of the participants spend even more than 14 hours per week working on their projects. Considering that a large fraction of the makers is employed, this

amount of time-invest is even more impressive and indicates a special relationship between makers and their projects. While the motivation of makers will be examined in more detail in a separate subchapter, it can already be noticed that a high level of intrinsic satisfaction seems to be associated with being a maker, considering the significant amount of personal time investment by many respondents.

Figure 14: Making activities per week

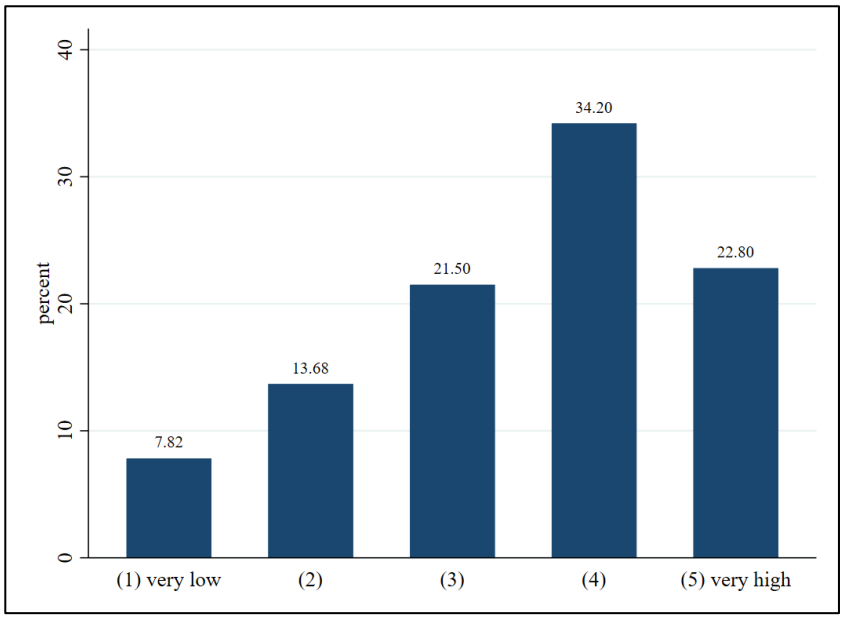


Source: Own illustration.

Of those hours, makers invest in their projects, however, most makers only spend a fraction of that time in a makerspace (see Table 13). Consequently, it can be presumed that a significant part of the effort for the projects takes place in the maker's own environment (e.g. in their own workshops or other private spaces). Regardless, the collected data suggests that the makerspace and its environment play a central role within the makers activities. In fact, more than two-thirds of the respondents indicate that they have benefited strongly (41.37%), or slightly (32.90%), from makerspaces while working on their projects. Only less than 15% stated they had not benefited from a makerspace so far. Moreover, as illustrated in Figure 15 the majority of makers (57.01%) feels personally connected to the Maker Movement mission. This result is specifically interesting for the geographic scope of the data collection.

In Germany, many people in public workshops are not very familiar with the term maker or tend to use other terms such as tinkerer, craftsman and inventor. However, a significant share of the people seems to be aware and identify with the movement.

Figure 15: Identification with Maker Movement



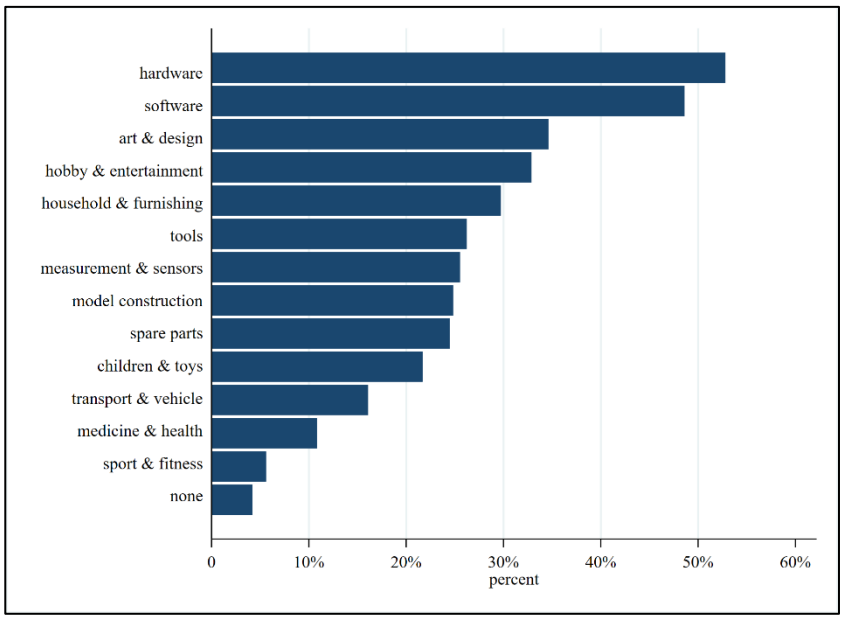
Source: Own illustration.

This aligns with findings from literature that are indicating that makerspaces are more than just a location with tools, but rather a place to come together and collaborate, creating an entire environment for the maker community. In terms of the community affiliation of makers, the study explored how often makers collaborate with others during their projects. Thereby, I find that most makers (36.16%) occasionally collaborate with other makers. At this point it is important to mention that the collaboration on a common project is only one part of many aspects of interaction within the maker community. Therefore, this result cannot be considered as representative for the community construct in general. However, extreme differences can be found at the individual level regarding community engagement, which might be explained by considering the different identities and motives of makers (see Chapter 6.3 regarding maker motivation and Chapter 8 regarding maker identities for more information regarding the maker community).

The majority (36.39%) of participants is working on several projects and uses the makerspace as part of their hobby during free time. Another share of participants uses the makerspace for educational purposes (20.33%) or entrepreneurial purposes, like freelancing activities, prototyping or manufacturing small batches in the early phase of starting a business. (20.20%). At this point it should be noted that corporate makerspaces were not targeted within this dissertation. Nevertheless, some respondents stated that they use the (non-corporate) makerspace for purposes connected to their employment.

Looking at the projects that makers work on, the broad majority of participants (44.30%) has already developed four or more prototypes. Interestingly, only 10.10% have never developed a product or prototype. This shows that nearly every maker has already engaged in product development and prototyping. Looking at the kind of projects that makers work on, the majority of projects are related to the areas of hardware (52.80%) followed by software (48,60%), art and design (34.16%), as well as entertainment and hobby (32.87%). Figure 16 provides an overview of the prototype development areas where makers pursue projects.

Figure 16: Prototyping areas



Source: Own illustration.

Finally, Table 13 and Table 14 provide an overview of all "making" related variables. Moreover, detailed information regarding statistical measures and data can be found in the appendix.

Table 13: Maker experience statistics

Variable	**N**	**%**
Active as maker since		
less than 1 year	45	14.66%
1-2 years	45	14.98%
3-4 years	72	23.45%
5-6 years	54	17.59%
7-8 years	23	7.49%
9-10 years	17	5.54%
more than 10 years	20	16.29%
Time for making activities per week		
less than 1 hour	42	13.68%
1-2 hours	57	18.57%
3-4 hours	60	19.54%
5-6 hours	45	14.66%
7-8 hours	20	6.51%
9-10 hours	23	7.49%
11-12 hours	14	4.56%
13-14 hours	2	0.65%
more than 14 hours	44	14.33%
Share of that time, spent in a makerspace		
<25%	79	25.73%
25%	97	31.60%
50%	59	19.22%
75%	40	13.03%
100%	32	10.42%
Number of prototypes developed		
0	31	10.10%
1	49	15.96%
2	56	18.24%
3	35	11.40%
4 or more	136	44.30%
Reasons for makerspace visit		
Hobby	217	70.68%
Education	74	24.10%
Own company	62	20.20%
Employment	58	18.89%
Other	12	3.91%

Notes: Reasons for makerspace visit: multiple answers permitted.

Table 14: Maker movement perception

Variable	N	%
Makerspace usefulness		
1 (very low)	24	7.82%
2	21	6.84%
3	34	11.07%
4	101	32.90%
5 (very high)	127	41.37%
Maker movement identification		
1 (very low)	24	7.82%
2	42	13.68%
3	66	21.50%
4	105	34.20%
5 (very high)	70	22.80%
Maker collaboration		
never	25	8.14%
rarely	77	25.08%
sometimes	111	36.16%
frequently	75	24.43%
as good as always	19	6.19%
Covid-19 impact on maker activities		
1 (very low)	41	13.36%
2	86	28.01%
3	104	33.88%
4	61	19.87%
5 (very high)	14	4.89%

Following this, I will provide an overview of the entrepreneurial activities and interest of the respondents within the next subchapter.

6.4 Entrepreneurial experience and activities

In this subchapter I will provide an overview of the maker's entrepreneurial activities. Thereby, I take a closer look at makers with entrepreneurial experience and the companies they founded. Furthermore, I queried the participants' entrepreneurial interest and their entrepreneurial ideas and behavior. Finally, I shed light on the image of entrepreneurship among the makers and their preconditions regarding potential entrepreneurial activity.

6.4.1 Entrepreneurial experience

Looking at the entrepreneurial experience that participants in the sample have, the data shows that 30.94% of respondents have already founded a company. Consequently, about one third of the makers does have entrepreneurial experience. With nearly a third of the participants already having been or still being active as entrepreneurs, a surprisingly high degree of entrepreneurial activity is evident among the makers in the sample. Table 15 shows the distribution of this variable in the sample and its frequencies.

Table 15: Entrepreneurial experience

Entrepreneurial experience	**N**	**%**
No	212	69.06
Yes	95	30.94

Notes: N=307

Out of the 95 companies founded by makers, 41.05% are based on a making-related project (e.g. a prototype from the makerspace). Consequently, less than half of the existing companies originated from maker projects. In-depth relationships of the companies and the entrepreneurial projects were not investigated within the limited scope of this project, but offer interesting future research avenues. As seen in Table 16, 75.79% of the founded companies are currently still operating. Moreover, 54.74% of the companies were founded together with other people, as a team.

Table 16: Maker-founded business characteristics

Company characteristics	N	%
Still active	72	75.79
Team-founded	52	54.74
Making-related	39	41.05

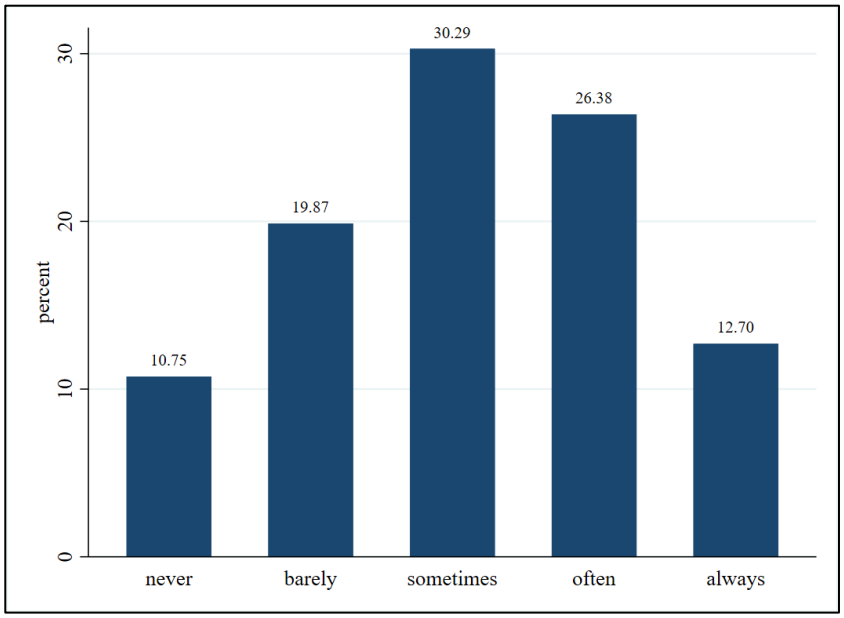
Notes: N=95; Percentages related to 95 respondents that stated that they founded at least one company.

The results show that makers founded many different types of companies with a wide variety of purposes and characteristics. Thereby, some start-ups show a craft- or design-related relationship to the maker activities of the corresponding makers. For example, these companies design or produce furniture, personalized (wooden) objects, or offer the processing and prototyping of different materials such as plastics, cement or metal as a service. In the creative sector, for instance, maker founded companies offer (modular) fashion concepts, develop their own games, education tools or are based in the adult entertainment sector. Furthermore, maker entrepreneurs founded art galleries, workshop or coworking offers. Another focus of maker business are digital business models, such as IT consulting, cyber security companies, software-as-a-service providers or innovative tools, such as IoT applications. However, companies founded by makers are extremely diverse and also operating within food technology, health applications, manufacturing sectors and many more areas. Looking at the size of these businesses, most companies are small business with a maximum of five employees, including a high number of one-person led businesses. However, several companies founded by makers are larger enterprises and employ 10 to 40 people.

6.4.2 Entrepreneurial interest

Looking at the entrepreneurial interest of the participants, there is a majority of makers that thinks at least occasionally about self-employment. 26.38% of the makers even think about it frequently. 12.70% are extremely focused on an individual entrepreneurial perspective and think about personal entrepreneurial activity almost all the time. Figure 17 shows the distribution of this variable in the sample and its frequencies.

Figure 17: Entrepreneurial interest of makers



Source: Own illustration.

6.4.3 Entrepreneurial ideas

Another indicator for the entrepreneurial interest of makers is the presence of entrepreneurial ideas among the makers. As seen in Table 17, 64.17% of the makers said that they have an – at least one – entrepreneurial idea. These findings, combined with the large number of prototypes (see chapter 6.3) that makers create, suggest a strong entrepreneurial potential and innovation capability among makers.

Table 17: Entrepreneurial ideas

Entrepreneurial ideas	**N**	**%**
No	110	35.83
Yes, not concrete	96	31.27
Yes, concrete	101	32.90

N=307

Taking a closer look on the characteristics of these entrepreneurial ideas, two out of three ideas (65.99%) are based on making-related projects. This finding reveals a clear relationship of the ideas to making activity. Furthermore, it was examined how long the ideas already existed.

Thereby, the data in Table 18 shows, that a majority of makers possess the idea for 1-2 years (41.62%), followed by 3-4 years (22.34%) and makers that had the idea for less than one year (21.83%). Interestingly, nearly 5 percent (4.57%) have had an idea for more than 10 years.

Table 18: Idea characteristics

Idea characteristics	**N**	**%**
Idea since		
less than 1 year	43	21.83
1-2 years	82	41.62
3-4 years	44	22.34
5-6 years	12	6.09
7-8 years	3	1.52
9-10 years	4	2.03
more than 10 years	9	4.57
Making-related		
Yes	130	65.99
No	67	34.01

Notes: N= 197; Percentages relate to 197 individuals that stated to have an entrepreneurial idea.

However, when asked specifically about starting a business in the next two years, as illustrated in Table 19, the majority of respondents (30.29%) indicated that this seemed very unlikely or rather unlikely (20.85%) for them. Moreover, 21.17% of makers are undecided. About a quarter of the makers responded in a positive way to this question and considers this to be rather (17.92%) or even very likely (9.77%). This suggests a high degree of hesitation among the makers with regard to the concrete implementation of their entrepreneurial aspirations and ideas. However, this may be explained by the interviews conducted and the high number and impact of perceived obstacles encountered with starting a venture within the maker scene.

Table 19: Likelihood of starting a business

Likelihood of founding within the next 2 years	**N**	**%**
very unlikely	93	30.29
rather unlikely	64	20.85
undecided	65	21.17
rather likely	55	17.92
very likely	30	9.77

Notes: N=307

6.4.4 Personal network and image of entrepreneurship

Looking at the makers individual network that could be beneficial for potentially starting a business, the majority of participants responded, indicating that they have contacts to potential business partners (43.97%) and potential customers (37.79%). Moreover, a significant number of participants stated that they had valuable network connections among friends (33.88%) and connections to potential investors (22.80%). In contrast, around one third (30.30%) of the participants indicated that they did not have a significant individual network that they could use to support a potential founding process, at all. Table 20 shows the distribution of this variable in the sample and its frequencies.

Table 20: Individual entrepreneurial network

Entrepreneurial network	**N**	**%**
Potential business partners	135	43.97
Potential customers	116	37.79
Friends	104	33.88
No network available	93	30.29
Investors	70	22.80
Parents	43	14.01
Family	37	12.05
Neighbors	17	5.54
Partner	14	4.56

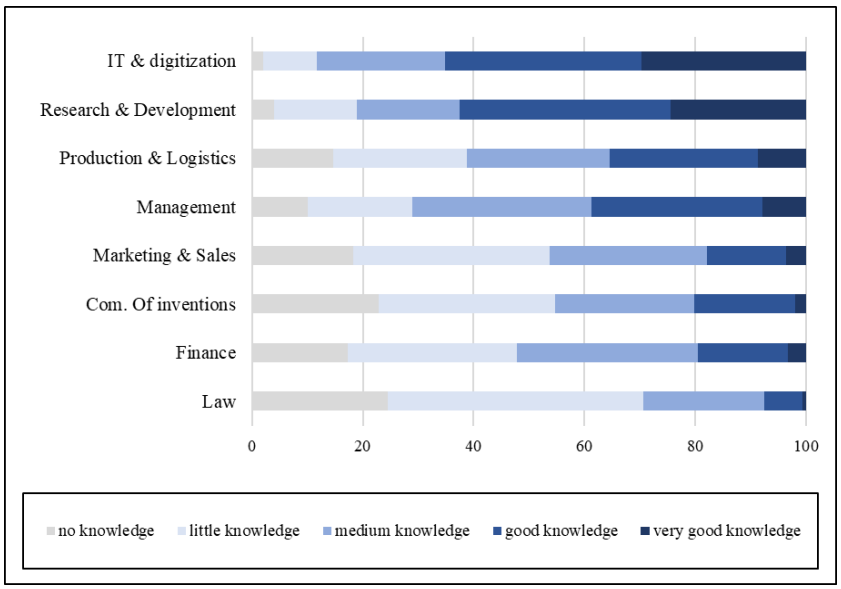
Notes: N=307; Multiple answers permitted.

Considering the participants' image of entrepreneurship, the majority of the respondents personally rather values entrepreneurs (65.15%). About a quarter are undecided, when asked about their opinion regarding entrepreneurs (23.13%). Roughly 12% do not personally value entrepreneurs (11.72%). Furthermore, a majority appreciates the realization of new ideas towards a new business (73.29%). Regardless of businesses and entrepreneurs themselves, a large majority (90.23%) believes that innovative and creative thinking is the path to success. More information regarding the image of entrepreneurship can be found in the summary statistics within the appendix.

6.5 Skills and knowledge

Looking at the knowledge of makers (see Figure 18) in various disciplines, a majority of the participants has very good or rather good knowledge in the field of information science and digitization (65.15%), followed by research and development (62.54%) as well as engineering and construction design (60.59%). Figure 18 provides a detailed overview of the knowledge distribution of makers self-assessment across seven fields of knowledge, ranging from 1=”no knowledge” to 5=” very good knowledge”.

Figure 18: Maker skills (per discipline)



Source: Own illustration

These findings are consistent with previous research (Greenberg et al. 2020), indicating that makers are proportionally overrepresented in STEM disciplines and disciplines related to information science, resulting in stronger knowledge within such disciplines

Thereby, technical oriented educational programs increase the likelihood of getting exposure to the Maker Movement and makerspaces, as they often include hands-on and more physical elements (Halverson & Peppler 2018). Interestingly, 20% of the participants responded that they have good or very good knowledge in the commercialization of inventions.

In this respect, this is particularly relevant, as the commercialization of inventions is a very specific niche discipline with a high degree of complexity.

Furthermore, the commercialization of inventions was mentioned as challenging and daunting during the interviews (e.g., in terms of patenting). Therefore, further investigation of the relationship of commercialization within the Maker Movement would be desirable at this point and opens promising future research avenues.

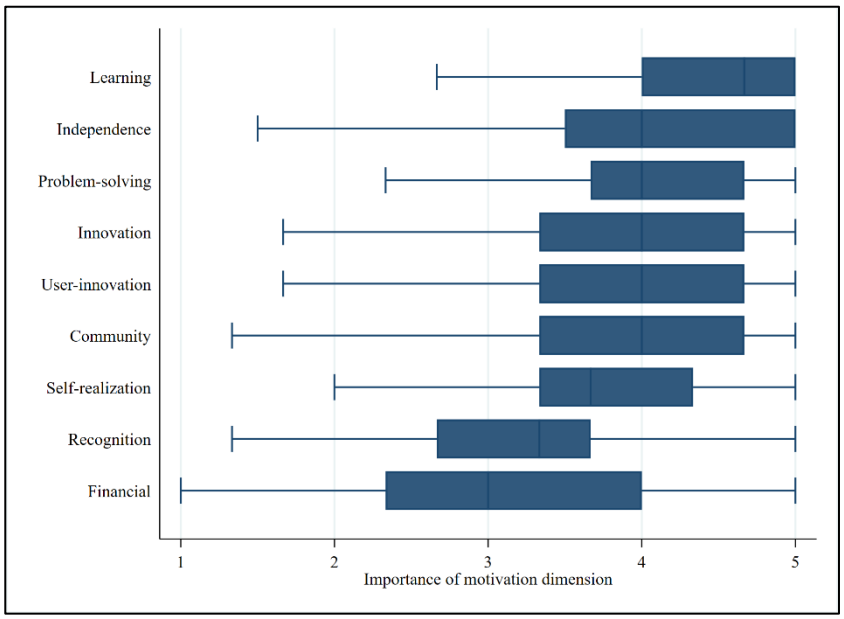
In contrast to the disciplines, where most makers have strong skills, they have little relevant knowledge in the fields of law (7.49%), marketing and sales (17.91%), as well as finance (19.54%). Likewise, as already described, this observation is fairly congruent with earlier findings regarding knowledge and skills within the Maker Movement and might be explained through the maker's educational emphases and fields of interest.

Specifically looking at the field of intellectual property rights, only a small number of participants possess good or very good knowledge. Among these, at least some relevant knowledge is available in terms of non-disclosure agreements (NDA) (19.54%), patents (15.96%) and trademarks (14.33%). In general, however, only a few people seem to have specifically dealt with IPR related issues, while the majority of makers does not have significant knowledge of intellectual property rights. This aligns with findings from the interviews (see Chapter 4), indicating that the handling of intellectual property rights is challenging for many makers. For detailed information regarding the distribution of the variables, please see the summary statistics table in the appendix.

6.6 Maker motivation

As one central element of this thesis, I took a closer look at the motivation of makers to engage in making-related activities. Thereby, nine different motivational dimensions were measured by three items each using an adapted scale by Carter et al. (2013). All items were rated on a 5-point Likert scale ranging from “completely disagree” to “completely agree”. Figure 19 shows the distribution of how the makers evaluate the different motivation dimensions regarding their importance in terms of their individual motivation to engage as a maker.

Figure 19: Motivation dimensions



Source: Own illustration.

Among these nine dimensions, the motivation dimensions learning and autonomy were ranked highest, followed by the desire to solve problems and engage actively in innovation as well as user-innovation. A more detailed examination of the individual statements (items) reveals, that the highest motivation stems from the individual's own empowerment to do things that were not possible previously. Thereby, the high evaluation of another statement suggests that this seems to be increasingly related to technologies and tools. These findings are consistent with our findings from the qualitative interviews and the related literature.

Furthermore, it seems to be very motivating for a majority of makers to work on unsolved problems that they encounter. Moreover, once discovered, many makers find it important and motivating to tackle and solve these problems on their own. Additionally, some makers are strongly motivated to address problems from the social and societal dimension in order to create (positive) impact. As a key element for achieving these goals, many makers perceive innovation as the central factor. Innovation is highly motivating for the makers in general. Following this, for a majority of makers, it is important to interact with new technologies. They want to work with them, create innovations that create an impact, using technology. Furthermore, makers apply these tools and technologies onto things in their own environment, e.g. for the improvement of products that they use themselves. This is referred to as user innovation. The results indicate that makers use many things that they consider insufficient and which they would like to improve themselves. Furthermore, many makers prefer to create things on their own instead of buying them. These results are in line with the findings obtained in the preliminary interviews, where several makers mentioned that some products are literally disappointing for them in terms of their performance.

The dimensions of finances and (individual) recognition were described as least important in terms of motivation to engage as a maker. Especially great wealth and a personal high income are not motivating at all for a majority of makers. However, financial security is a slightly different proposition, as it seems to be important for a significant number of makers. This also aligns with findings from the interviews, indicating that makers strive for financial security in order to be able to work on their projects, without having monetary issues. For makers in the financial domain, this is by far the most important dimension. A similar effect is evident for the motive of recognition. Indeed, it is not really important to most makers. However, there are of some outliers graving for recognition and a good reputation within the maker scene. However, besides a tendency of makers to gain a good reputation recognition is considered a minor motivation, compared to other motivation dimensions.

Table 21 illustrates the used scale to measure motivation and the corresponding statistics regarding the evaluation of several motivation dimensions among the makers.

Table 21: Maker motivation statistics

Motivation	Mean	S.D.	α	Items
Learning	4.53	0.58	0.84	I want to empower myself to do things I couldn't do before. I want to learn to use technologies and tools. I want to achieve important know-how.
Autonomy	4.10	0.81	0.65	I want to practice my own approach regarding work. I want greater personal flexibility for my life. I want to empower myself to do things I couldn't do before.
Problem-solving	4.02	0.72	0.62	I want to approach problems on my own. I want to solve a social/societal problem. I want to work on unsolved challenges.
Innovation	3.97	0.86	0.74	I want to influence things through my innovations. I want to create an idea for a product. I want to be innovative and work with the newest technologies.
User-Innovation	3.95	0.77	0.62	I want to create things myself instead of buying them. I want to modify existing things (products, programs, etc.) and adapt them to my own needs. I want to improve existing things (products, programs, etc.).
Community	3.94	0.80	0.75	I want to work on projects together with others. I want to share my knowledge with others. I want to be part of a community.
Self-realization	3.86	0.61	0.64	I want to learn and grow as a person I want to become more attractive to potential employers. I like to challenge myself.
Financial	3.12	1.02	0.76	I strive for great wealth and a high income. I am aiming for a higher personal income. Financial security is important to me.
Recognition	3.14	0.92	0.75	I strive for recognition in my community. I want to achieve a superior status in society. I want to achieve something and be noticed in return.

Notes: Mean represents the importance of each motivation, measured on a Likert-scale from 1 (not important at all) to 5 (very important); S.D.=standard deviation; α=Cronbach's alpha

In addition, I conducted a t-test to assess the motivation dimensions for male and female respondents. The results in Table 22 show significant effects for the motives autonomy, problem-solving, user-innovation, self-realization and financial motivation. Thereby, women are more motivated by problem-solving, autonomy and self-realization while their male counterparts responded that user-innovation was more important to them when asked regarding their motivation to engage in "making".

Table 22: Motivation t-test

Motivation	**Male** Mean (SD)	**Female** Mean (SD)	**Sig.**
Learning	4.53 (0.60)	4.53 (0.49)	0.893
Autonomy	4.06 (0.83)	4.30 (0.67)	0.000***
Problem-solving	3.99 (0.74)	4.19 (0.58)	0.000***
Innovation	3.97 (0.84)	3.95 (0.97)	0.673
User-innovation	4.01 (0.75)	3.63 (0.76)	0.000***
Community	3.95 (0.77)	3.90 (0.91)	0.106
Self-realization	3.83 (0.60)	3.97 (0.65)	0.000***
Financial	3.09 (1.03)	3.23 (0.95)	0.000***
Recognition	3.14 (0.93)	3.13 (0.89)	0.931

Finally, Table 23 shows a correlation matrix of the motivation dimensions and the dependent variable opportunity attractiveness.

Table 23: Correlation matrix of maker motivations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Opportunity attr.									
(2) Self-realization	**0.06**								
(3) Financial	**0.08**	**0.37**							
(4) Recognition	**0.06**	**0.38**	**0.36**						
(5) Autonomy	**0.05**	**0.31**	**0.30**	**0.27**					
(6) Community	0.01	**0.15**	**0.09**	**0.20**	**0.32**				
(7) Innovation	**0.09**	**0.44**	**0.31**	**0.27**	**0.43**	**0.30**			
(8) Learning	0.03	**0.41**	**0.11**	**0.10**	**0.27**	**0.38**	**0.37**		
(9) Problem-solving	**0.04**	**0.38**	**0.16**	**0.22**	**0.43**	**0.37**	**0.56**	**0.44**	
(10) User innovation	0.02	**0.13**	**-0.04**	0.01	**0.23**	**0.27**	**0.27**	**0.33**	**0.40**

Notes: Bold correlation factors are significant at $p < 0.05$.

6.7 Makerspace data

There is no complete list of makerspaces available yet. Neither for Germany nor for other countries, even less worldwide. Thus, adding information regarding makerspaces can be considered an important task for research within the Maker Movement. Chapter 5 described the challenging process of collecting data within the Maker Movement. However, within this subchapter I provide information regarding the makerspaces in this study.

Considering the criteria for the selection of the study participants and the requested makerspaces, roughly around 250 makerspaces exist in Germany, of which 219 (87.60%) makerspaces were requested as they had available contact information. As a result, 94 makerspaces finally participated in the study with a minimum of one respondent, resulting in a response rate of 42.92%. While these numbers represent a significant share of makerspaces in Germany, future research should investigate the landscape of makerspaces in Germany, Europe and even worldwide in detail.

As for this thesis, Thereby, 14 out of 16 federal states (87.50%) in Germany are represented in the study. As well as the six largest German cities (Berlin, Hamburg, Munich, Cologne, Frankfurt a. M. and Stuttgart) by population. Only Bremen and the state of Mecklenburg-Vorpommern reported no data in the context of this study, although I tried to reach out to them. Overall, this resulted in a representative coverage of the German makerspace landscape.

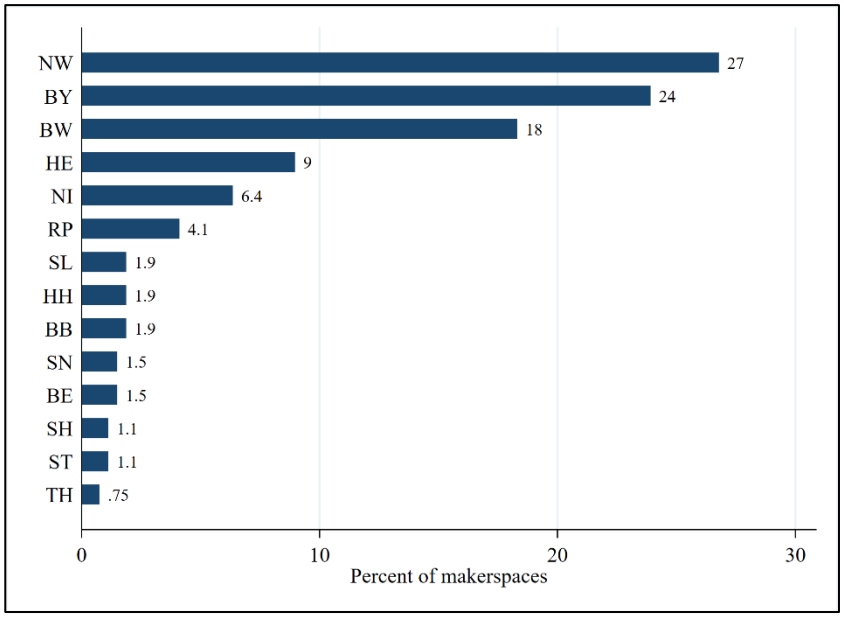
Figure 20 provides an overview of the makerspace locations across Germany and shows the distribution all over the geographic location. Thereby, 14 out of 16 federal states (87.50%) in Germany are represented in the study. As well as the six largest German cities (Berlin, Hamburg, Munich, Cologne, Frankfurt a. M. and Stuttgart) by population. Only Bremen and the state of Mecklenburg-Vorpommern reported no data in the context of this study, although I tried to reach out to them. Overall, this resulted in a representative coverage of the German makerspace landscape.

Figure 20: Map of makerspace locations

Source: Own illustration using mixedmaps.com.

Figure 21 illustrates the distribution of the makerspaces across the federal states in Germany. The results show that this distribution approximately corresponds to the distribution of the population in Germany among the different federal states and thus represents the representative distribution very well.

Figure 21: Makerspaces by federal state



Source: Own illustration.

Looking at the several characteristics of makerspaces in the sample, makerspaces of varying sizes and types were considered in the study. To distinguish between large makerspaces and smaller spaces, I considered makerspaces with more than 100 visitors and 200 square spaces as “big makerspaces”. As a result, three out of 94 makerspaces (3.19%) met these criteria and were considered as “big makerspace”. Furthermore, care was taken to include makerspaces with different approaches and emphases. Thus, free makerspaces, which are often organized by associations, municipality makerspaces as well as university-based makerspaces (28.72%) were included in the study. Additionally, some makerspaces in libraries (2.13%) are represented in the study.

The different types of makerspaces (see Chapter 3) were partially included in the further calculations as control variables or as interaction effects, but do not constitute a central part of the study, which focuses primarily on the individuals involved in the Maker Movement. Following this, the next chapter sheds light on the decision-making and evaluation of entrepreneurial opportunities of makers using conjoint analysis.

7 Conjoint analysis of makers opportunity evaluation

Of the 314 participants that finished the study, seven had no variance in results. These data sets were completely removed and omitted for further data analysis and were also excluded from descriptive data analysis (see Chapter 5.3). In the next step, the reliability of the remaining 307 responses was determined by calculating the Pearson correlation between the original and repeated profiles, measuring the test-retest reliability. All of the remaining respondents were significantly reliable in their responses ($p < 0.05$) with a mean test–retest correlation of 0.87, which is a good value and comparable to similar other studies from the field (Patzelt et al. 2008; Choi & Shepherd 2004; Shepherd 1999). The design of this conjoint experiment resulted in 3419[14] total observations used for in-depth analysis within this chapter.

Therefore, in the first step, I provide insights regarding control variables and their effects, before providing detailed insights into the opportunity evaluation behavior.

7.1 Control variables

The study design controlled for several factors on the individual level and makerspace level. Abreu & Grinevich (2017) suggest that females perceive opportunities in the entrepreneurial opportunity evaluation process differently than their male counterparts. Furthermore, the period in which a venture can generate profit decreases with increasing age (Hossinger et al. 2020). Moreover, with increasing age, the number of people who have a family and therefore tend to assume a higher financial risk increases. It is known from the entrepreneurship literature that people with a higher risk tolerance tend to be more entrepreneurially active and therefore tend to evaluate entrepreneurial opportunities more positively than people who are risk-averse. (Hayter 2015, 2016) Thereby, I investigated the respondents risk-taking behavior regarding the three categories finances, career and personal life (Dohmen et al. 2011). Moreover, people with an immigrant background tend to be more involved in entrepreneurial activities (Constant & Zimmermann 2006). Therefore, the study used migration background as a proxy for cultural diversity and controlled for these effects. Following suggestions from previous research (Kwon &

[14] As part of our iterative development process, the conjoint design was slightly adjusted after the first makerspace had been surveyed and featured one task less per participant, resulting in N=3,419.

Lee 2017), I controlled for additional demographic effects including whether the participant has children and their relationship status.

Furthermore, the participants' previous entrepreneurial activity was considered. People with entrepreneurial experience tend to approach entrepreneurial issues and challenges more again and more routinely. (Stuart & Abetti 1990) Following this, the respondent where asked whether they founded a company or not. As scholars previously outlined that entrepreneurial experience is a critical control for entrepreneurship (Abreu & Grinevich 2013), I investigated the entrepreneurial interest and development of entrepreneurial ideas among the participants. The individual network of the makers was also given attention, as a well-connected network could be helpful and affect the evaluation of an entrepreneurial opportunity in a positive way. (Moog et al. 2015) Therefore, it was controlled for the existence of useful of human capital, meaning the availability of a network for starting a business, among the makers. Furthermore, as education is considered to impact decision-making within entrepreneurship (Hossinger et al. 2021), I controlled for effects regarding the level and field of education of the respondents. Moreover, the experience and activities of makers is likely to impact entrepreneurial decision-making (Hausberg & Spaeth 2020). Therefore, I controlled for the experience as maker, weekly time invest for making and the number of prototypes developed.

At the makerspace level, I controlled for size, orientation, and location of the makerspace. Makerspaces with an academic orientation are often part of a strategy to promote (academic) entrepreneurship in the relevant institutions, such as universities (Heinzel et al. 2020). Thus, it is likely that people with an entrepreneurial interest and connection are more likely to be located there (Halbinger 2020). Furthermore, makerspaces are often directly set up for the use and support of (academic) entrepreneurs and therefore attract people with entrepreneurial ambitions and background. (Barrett et al. 2015; Hilton et al. 2018; Secundo et al. 2020) The size of a makerspace is related to the possibilities a makerspace offers to its users. This refers both to the equipment that can be used, but also to the community and the support provided by assistants as part of the service.

Since entrepreneurs are usually trying to find use-value resources and benefit from them it was controlled for the size of the makerspace as well. (Halbinger 2020; Bergner 2017) Moreover, as entrepreneurship activities also depend on regional clusters and regional policy it was controlled for the federal state in which the respective makerspaces were located. (Kollmann et al. 2022)

Table 24 shows the correlation matrix of the used control variables, including the dependent variable.

Table 24: Correlation matrix of control variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
(1) Opp. attr.																							
(2) Age	**-.06**																						
(3) Female	**-.03**	-.10																					
(4) Immigration background	.01	**-.06**	**.03**																				
(5) Children (no/yes)	-.02	**.49**	**-.12**	**-.03**																			
(6) Occupation: student	**.04**	**-.48**	**.06**	**.12**	**-.38**																		
(7) Employment risk-taking	**.03**	**-.12**	**-.07**	-.01	-.01	**.10**																	
(8) Financial risk-taking	**.05**	**-.08**	**-.15**	-.02	.02	**.06**	**.57**																
(9) Maker experience	.02	**.29**	**-.26**	.02	**.16**	**-.38**	**-.06**	**-.04**															
(10) Number of prototypes	**.04**	**.10**	**-.26**	-.01	**.11**	**-.17**	**.09**	**.09**	**.54**														
(11) Time in makerspace/week	.01	-.01	**-.12**	**-.03**	**.06**	**-.08**	**.11**	**.15**	**.23**	**.37**													
(12) High network quality	.01	**-.09**	-.02	.01	**.04**	.01	**.18**	**.12**	**-.04**	**.09**	**.07**												
(13) Entrepr. interest	**.09**	**-.20**	.00	**.03**	**-.11**	**.06**	**.39**	**.36**	.00	**.10**	**.21**	**.27**											
(14) 2 yrs founding prob.	**.07**	**-.14**	.02	**.07**	**-.08**	**.09**	**.35**	**.36**	-.03	**.09**	**.25**	**.30**	**.70**										
(15) Reason to use: hobby	.01	**.14**	**-.21**	**-.05**	**.10**	**-.10**	**-.07**	**-.04**	**.23**	**.12**	.01	**-.12**	**-.11**	**-.04**									
(16) Reason to use: job	-.01	-.01	.03	.01	**.05**	**-.10**	.01	**.09**	**.10**	**.17**	**.17**	**.07**	**.06**	**.12**	-.02								
(17) Reason to use: entrepr.	.01	**-.06**	**.03**	**.04**	**.10**	**-.12**	**.15**	**.17**	**.05**	**.11**	**.27**	**.18**	**.35**	**.34**	**-.03**	**.07**							
(18) Covid-19 impact	.01	.00	.00	-.01	**.06**	**-.06**	-.01	.01	**-.06**	**.06**	**.13**	.01	.01	**.03**	**-.10**	**.04**	**.04**						
(19) Education: business	.01	.01	**.09**	**.03**	**.06**	**.07**	**.10**	**.14**	**-.14**	**-.10**	**-.10**	**.10**	**.07**	**.12**	-.01	**-.13**	**.15**	**.09**					
(20) Education: STEM	**.03**	**-.03**	**-.19**	**.06**	**-.13**	**.10**	.02	-.01	**.11**	**.10**	-.02	**.07**	.00	.01	**.07**	-.02	**-.13**	.03	**-.15**				
(21) Education: IT	**.06**	**-.13**	**-.12**	**.04**	**-.07**	**.03**	**.08**	**.07**	**.04**	.01	**.08**	-.03	**.06**	**-.05**	**.13**	**-.12**	**-.09**	**-.07**	**.12**	**-.17**			
(22) Education: craftmanship	**.05**	**.13**	**-.12**	.01	**.08**	**-.12**	**-.07**	**-.10**	**.14**	**.16**	**.14**	**.07**	**.06**	**.07**	**.09**	**.17**	**.11**	**.16**	**-.11**	-.02	**-.08**		
(23) Education: other	**-.03**	**.17**	**.17**	**-.11**	**.12**	**-.12**	-.02	**-.04**	-.02	**-.03**	**.06**	-.02	**-.06**	.01	**.04**	**.12**	**.06**	**.04**	**-.08**	**-.35**	**-.15**	**.04**	
(24) Big makerspace	**.04**	**-.25**	**.08**	-.02	**-.17**	**.19**	**.19**	**.06**	**-.21**	**-.14**	**-.04**	**.09**	**.19**	**.19**	**-.04**	**-.13**	**.03**	**-.05**	**.04**	**.07**	**.12**	**-.18**	**-.11**

Notes: Bold correlation coefficients are significant at $p < 0.05$.

Regarding the control variables I found several effects. Table 25 shows the regression model of control variables and the dependent variable, opportunity attractiveness.

On the individual level I find effects for the demographic variables age and whether the respondent has children or not. Thereby, age seems to have a slightly negative influence regarding the perceived opportunity attractiveness. In contrary, respondents with children evaluated entrepreneurial opportunities marginally better than respondents without kids. Different fields of education partly impacted the assessment of entrepreneurial opportunities as well. For example, a positive effect was found in particular for participants with a background in craftmanship. However, other demographic control variables like gender had no significant influence regarding the evaluation of entrepreneurial opportunities in this regard.

On the one hand, looking at making-related control variables I find minor effects for maker experience. Thus, makers with a high amount of experience as a maker evaluate entrepreneurial opportunity attractiveness slightly higher than respondents with less experience as a maker. On the other hand, I did not find effects for other making-related control variables, for instance the number of prototypes or weekly time spent for making-related activities.

Considering the control variables related to entrepreneurship activities, I find effects for entrepreneurial interest and network quality. In detail, makers with a higher entrepreneurial interest evaluate the attractivity of entrepreneurial opportunities higher than their counterparts. In addition, respondents which stated a higher perceived probability of starting a business within the next two years had a significantly higher evaluation of opportunities as well. In contrast, I find minor negative influence on opportunity attractiveness for a maker with a perceived good personal network.

On the makerspace level, I find effects for university-based makerspaces and the geographical location of the makerspace. Thus, makers operating in university-based makerspaces evaluated entrepreneurial opportunities better than their counterparts in non-academic makerspaces. Chapter 9 investigates university-based makerspaces in detail. Moreover, I find effects for makerspaces located in the eastern part of Germany. Following this, makerspaces in eastern Germany had a slightly negative influence regarding the evaluation of entrepreneurial opportunity attractiveness.

Although different effects were found for the control variables in the different sections, the validity of these is limited. Consequently, the individual findings should not be interpreted strongly and require further research to derive any real conclusions. Considering the explained amount of variance, the effect is rather small. On the other hand, this suggests a high explanatory power of the selected attributes within the conjoint experiment.

Table 25: Regression with control variables

Regression type: OLS Regression with clustered standard errors.
Dependent variable: Opportunity attractiveness, evaluated by the decision maker; Clustered standard errors in parentheses; Coeff.=coefficient SE=Standard error
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$;

Variable	**Coeff.**	**(SE)**
Individual level		
Age	-0.006**	(0.003)
Female	-0.041	(0.082)
Immigration background	-0.006	(0.084)
Children (no/yes)	0.120*	(0.070)
Occupation: student	0.041	(0.076)
Employment risk-taking	-0.012	(0.014)
Financial risk-taking	0.011	(0.012)
Maker experience	0.020*	(0.011)
Number of prototypes	0.017	(0.029)
Time in makerspace/week	-0.015**	(0.007)
High network quality	-0.104*	(0.056)
Entrepr. interest	0.071**	(0.035)
2 years founding prob.	0.049*	(0.028)
Reason to use makerspace: hobby	-0.024	(0.061)
Reason to use makerspace:job	-0.101	(0.073)
Reason to use makerspace:entrepr.	-0.058	(0.080)
Covid-19 impact	0.015	(0.028)
Fields of education (20 var.)	p=0.001	
Makerspace level		
Makerspace: big	0.016	(0.089)
Makerspace: university-based	0.133*	(0.079)
Makerspace location: south	-0.081	(0.090)
Makerspace location: north	-0.078	(0.099)
Makerspace location: west	-0.098	(0.096)
Makerspace location: east	-0.287*	(0.153)
Observations	3419	
R^2	0.034	
adj. R^2	0.022	
F-value	2.36	
Respondents	307	

Table 26: Correlation matrix of conjoint attributes and dependent variable

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Opp. attractiveness															
(2) Low market potential	**-0.32**														
(3) Medium market potential	0.03	**-0.53**													
(4) High market potential	**0.29**	**-0.54**	**-0.43**												
(5) Low IPR protection	**-0.15**	0.01	**0.05**	**-0.05**											
(6) Medium IPR protection	0.01	**-0.10**	**0.08**	**0.03**	**-0.45**										
(7) High IPR protection	**0.14**	**0.09**	**-0.12**	0.02	**-0.53**	**-0.52**									
(8) Low technical challenge	**0.05**	**-0.06**	-0.01	**0.07**	**-0.03**	**0.07**	**-0.04**								
(9) Medium technical challenge	0.01	**-0.08**	**0.08**	0.01	**0.09**	-0.01	**-0.08**	**-0.45**							
(10) High technical challenge	**-0.06**	**0.14**	**-0.07**	**-0.08**	**-0.06**	**-0.06**	**0.11**	**-0.52**	**-0.53**						
(11) Low social impact	**-0.29**	**-0.10**	0.02	**0.09**	**0.08**	**0.06**	**-0.13**	**0.04**	**0.11**	**-0.13**					
(12) Medium social impact	-0.01	**0.04**	-0.01	**-0.03**	**-0.05**	-0.02	**0.06**	**-0.03**	**-0.15**	**0.17**	**-0.54**				
(13) High social impact	**0.29**	**0.06**	-0.01	**-0.06**	-0.03	**-0.04**	**0.06**	-0.01	**0.05**	**-0.04**	**-0.46**	**-0.50**			
(14) No team partner	**0.04**	**-0.16**	-0.02	**0.19**	**-0.08**	**0.03**	**0.05**	0.02	**-0.04**	0.02	0.02	**-0.09**	**0.08**		
(15) Partner economic background	**-0.07**	**0.09**	0.01	**-0.11**	0.02	**-0.12**	**0.09**	**-0.05**	**-0.06**	**0.10**	**-0.06**	**0.16**	**-0.11**	**-0.52**	
(16) Partner technical background	0.03	**0.06**	0.02	**-0.08**	**0.06**	**0.09**	**-0.14**	**0.03**	**0.10**	**-0.13**	**0.04**	**-0.08**	**0.03**	**-0.47**	**-0.52**

Notes: Bold correlation coefficients are significant at $p < 0.05$.

7.2 Main effects model

Table 27 shows a clustered OLS regression to answer the research question, taking into account the evaluation criteria of the makers regarding entrepreneurial opportunities. Therefore, the relative importance of each attribute was estimated to allow for better comparability across selection criteria. First, zero-centered utility values were calculated for each attribute level of each decision maker. Second, to assess the impact of a change in an attribute level on the overall importance of a particular opportunity attribute, I measured the range between the lowest and highest utility value of each attribute level. In the third and final step, the range of each attribute level is divided by the sum of all ranges to calculate its relative importance.

displays the relative importance of each opportunity evaluation attribute. The higher the value of an opportunity evaluation an attribute, the higher its impact on the decision of a maker. For example, the two most important opportunity attributes (i.e., market potential and social impact) explain almost 85% of the makers' decisions. Thus, the attractiveness for an entrepreneurial opportunity from the perspective of a maker increases, if an opportunity has high values for these two opportunity attributes.

Furthermore, the results show that the protection of intellectual property rights (IPR) does have a significant impact on the evaluation process of makers, when evaluating entrepreneurial opportunities. It turns out that the better the protection possibilities, the attributes weighting increases. Regarding the project team attribute, it became evident that there is no significant impact of economic or technical team partners compared to having no team partners. Moreover, the availability of a project team has a comparatively low relative importance in the evaluation of an entrepreneurial opportunity for maker and is also not significant in terms of statistical calculation.

Table 27: Regression Model

Regression type: OLS Regression with clustered standard errors. Dependent variable: Opportunity attractiveness, evaluated by the decision maker; Clustered standard errors in parentheses; Coeff.=coefficient Str. err. Standard error
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$;

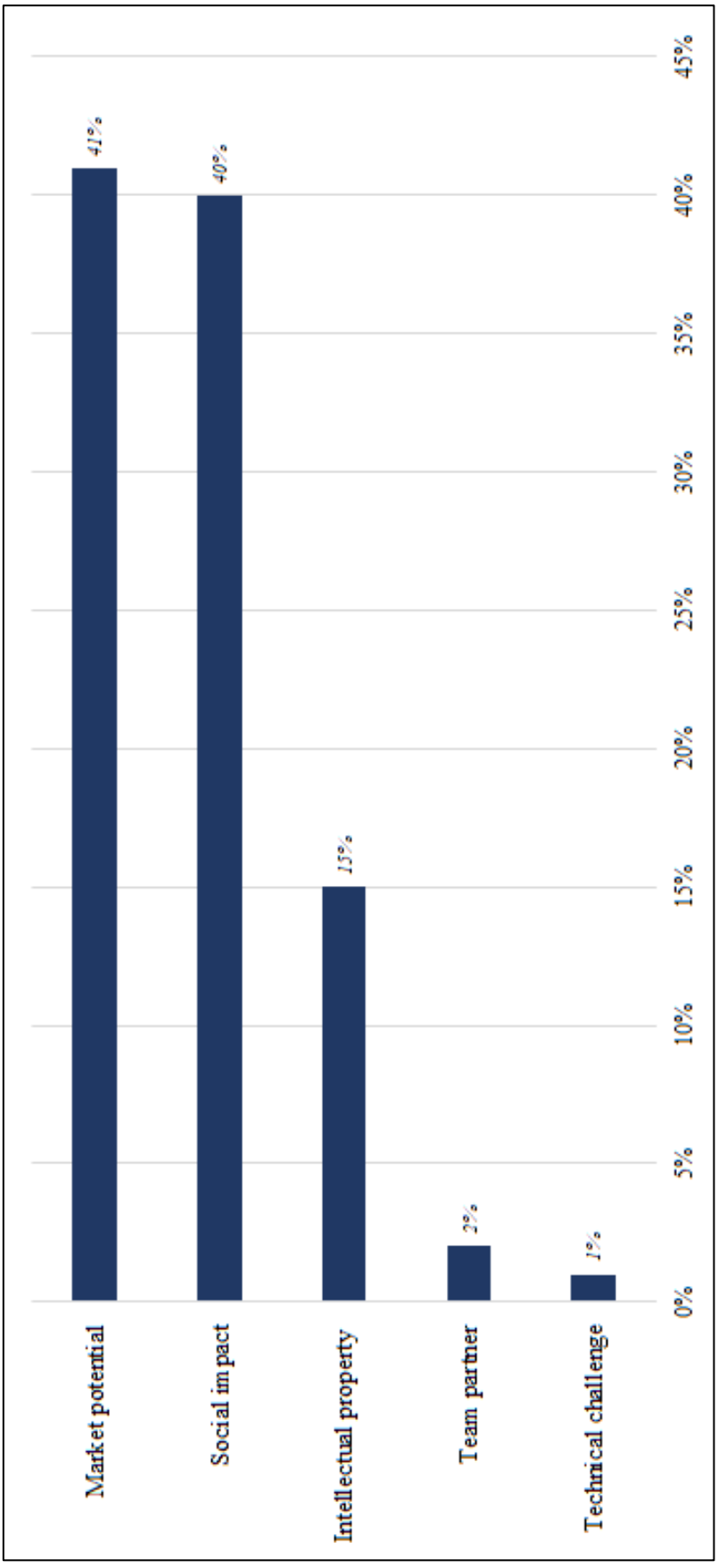
Variable	**Coeff. (Str.err.)**
High market potential	1.168 (0.051)***
Medium market potential	0.704 (0.041)***
(reference group: low)	
High IPR protection	0.413 (0.043)***
Medium IPR protection	0.322 (0.037)***
(reference group: low)	
High technical challenge	-0.092 (0.052)*
Medium technical challenge	0.033 (0.039)
(reference group: low)	
High social impact	1.143 (0.051)***
Medium social impact	0.511 (0.040)***
(reference group: low)	
Team partner with economic background	-0.048 (0.050)
Team partner with technical background	0.068 (0.044)
(reference group: no partner)	
Observations	3419
R^2	0.28
adj. R^2	0.27
F-value	133.24
Respondents	307

In addition, Table 28 presents a combined regression model including the conjoint attributes and control variables. As already mentioned, the control variables do not show considerable explanatory power regarding the opportunity evaluation behavior of makers.

Table 28: Combined regression model

Variable	**Coeff. (Str. errs.)**
High market potential	1.166*** (0.050)
Medium market potential	0.705*** (0.041)
(reference group: low)	
High IPR protection	0.415*** (0.043)
Medium IPR protection	0.323*** (0.037)
(reference group: low)	
High technical challenge	-0.091* (0.052)
Medium technical challenge	0.036 (0.039)
(reference group: low)	
High social impact	1.145*** (0.051)
Medium social impact	0.512*** (0.040)
(reference group: low)	
Team partner with economic background	-0.047 (0.050)
Team partner with technical background	0.069 (0.044)
(reference group: no partner)	
Age	-0.005** (0.003)
Female	0.006 (0.080)
Immigration background	-0.052 (0.079)
Children (yes/no)	0.131* (0.069)
Student	0.113 (0.087)
Full-time employee	0.128* (0.076)
Employment risk-taking	-0.007 (0.014)
Financial risk-taking	0.014 (0.013)
Maker experience	0.013 (0.010)
Number of prototypes	0.022 (0.027)
Time in makerspace/week	-0.016 (0.165)
High quality network	-0.139** (0.064)
Entrepr. interest	0.072** (0.035)
2 years founding prob.	0.036 (0.029)
Reason to use makerspace (3 variables)	p= 0.103
Education: STEM	0.076 (0.065)
Education: IT	0.123* (0.064)
Education: business	0.027 (0.075)
Education: social	0.167 (0.142)
Eduaction:other	0.012 (0.071)
Education: prodd. & arch.	-0.196** (0.091)
Education: craftmanship	0.273*** (0.080)
Covid-19 impact	0.000 (0.027)
Makerspace: university-based	0.126* (0.069)
Makerspace: big	0.024 (0.081)
N	3419
R^2	0.314
adj. R^2	0.306
Respondents	307

Table 29: Relative importance of conjoint attributes



Notes: Calculated based on the coefficients of the main model (Table 27). Reading example: With a relative importance of 27.8%, SII decision makers consider *the authenticity of the founding team* to be almost 7 times as important as the attribute *professional background of the founding team* (relative importance: 4.2%). This value also signifies that the attribute *authenticity of the founding team* accounts for 27.8% of the decision maker's total utility

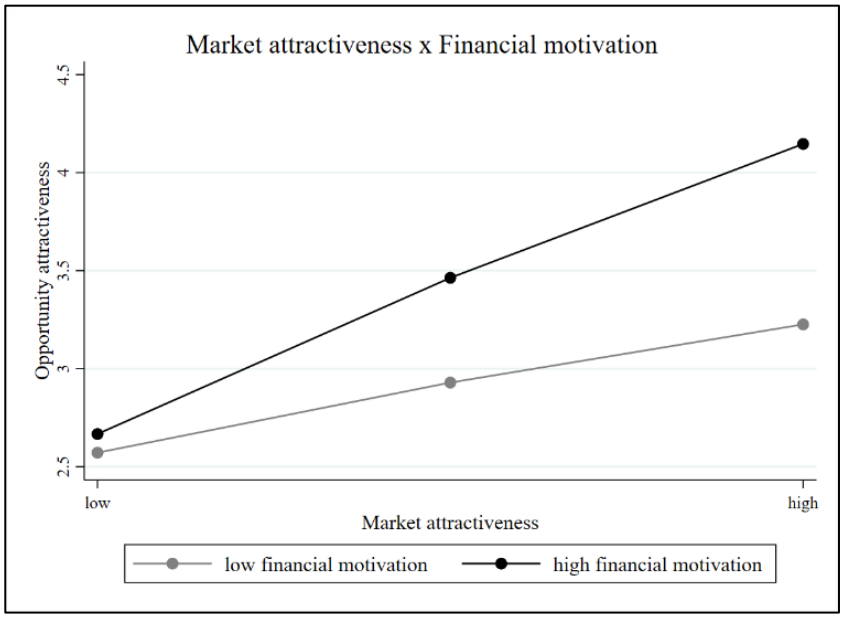
7.3 Interaction effects

In order to further explore the heterogeneity of makers, I investigate the impact of motivation, maker experience and entrepreneurial activities on the evaluation of entrepreneurial opportunities. Therefore, I calculate interaction effects for several interaction variables to estimate their impact on the decision attributes. In addition, include control variables in these calculations.

7.3.1 Impact of maker motivation on opportunity evaluation

Model 1 to 9 show the results of the interaction effects between the makers motives and makers opportunity evaluation criteria. In model 2, I find effects for the importance of a high market potential for makers that are highly motivated by financial factors (see Figure 22). Interestingly, a high social impact was weighted significantly lower by makers with high financial motivation than by makers with less financial motivation. The interaction of the attributes with the community motivation dimension exhibited a positive interaction with the attribute of a technical team partner. This was considered comparatively more important than for makers without high motivation through community aspects.

Figure 22: Interaction Market potential x Financial motivation



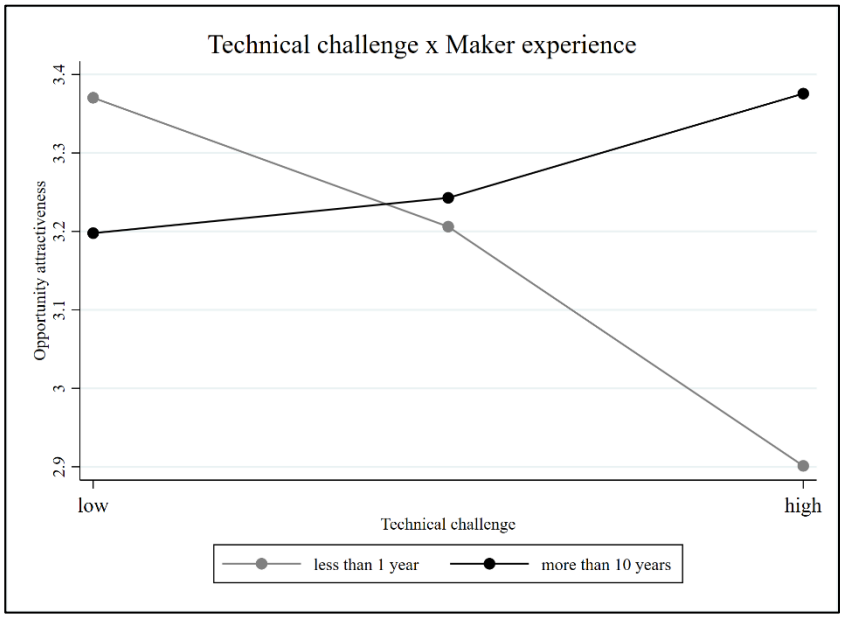
Source: Own illustration.

Looking at the motivation dimension of becoming an active part of innovation, it became evident that makers with a strong motivation through innovation-related aspects, put more weight on the market potential and the degree of protection of intellectual property rights of an entrepreneurial opportunity, than makers with a weak motivation through innovation-related aspects. Furthermore, they tend to prefer technically challenging opportunities. No significant interaction effects regarding the attributes could be found for the motives self-realization, recognition and user-innovation. For the motive of autonomy, a positive interaction effect with the attribute of social impact was found. Makers with a higher importance of motivation in this dimension weighted the attribute impact significantly higher than makers with a weaker motivation in this dimension. A similar effect was found for makers with increased motivation in the dimension of learning and problem-orientation.

7.3.2 Impact of maker characteristics on opportunity evaluation

The interaction of attributes with "making" related variables shows more interesting effects regarding the evaluation of entrepreneurial opportunities. Considering the experience of makers (the amount of time the respondent has been active as a maker), I find effects for the attributes technical challenge and the protection of intellectual property rights. While a high technical demand tends to be a deterrent for the overall sample, very experienced makers rate the technical challenge more positively the longer they have experience as a maker. For instance, Figure 23 shows that makers with an experience for more than 10 years attribute the highest importance to technical challenge compared to their peers. This might be explained due to the effect that makers who have been active and remained as makers for an extended period of time understand the technical challenge as part of the process and attraction of being a maker. This is supported by indications of this effect within the literature and in the interviews conducted as part of this dissertation. In contrary, technical challenge is perceived as an obstacle by a high number of makers, which is why the different effects of this attribute partially neutralize each other and required closer examination in the context of interactions. Moreover, intellectual property rights are perceived as less relevant for makers with more "making" experience. Table 30 provides an overview of the interaction effects of maker charactersitics on opportunity evaluation.

Figure 23: Interaction tech. chall. and experience



Source : Own illustration.

Furthermore, interaction effects were observed for the number of created products. Thereby, those makers who developed more products and prototypes rated a high technological challenge to be positive, while they assigned less relevance to the protection of intellectual property. Regarding the identification with the Maker Movement, only small or negligible effects were detectable with regard to the evaluation of the opportunity attributes. Next, I will analyze the impact of entrepreneurship related maker characteristics on opportunity evaluation.

7.3.3 Impact of entrepreneurial variables on opportunity evaluation

The effect of entrepreneurial interest on the interaction with each attribute to evaluate an entrepreneurial opportunity was also investigated. Significant effects can be seen here in the evaluation of market potential. Makers with a higher degree of entrepreneurial interest rate the importance of the market potential attribute higher than makers with less entrepreneurial interest. Looking at the probability of actually starting a business within the next two years, I found effects for a higher evaluation of market potential as well. This supports the assumption that the part of makers who really seek an entrepreneurial activity are aware of the importance of the proper market. Interestingly, I do not find these effects for makers that founded a company. In the case of founders, I noticed a tendency toward less technically demanding entrepreneurial opportunities rather than attractive market conditions. Focusing only

on the entrepreneurs who stated that they visit a makerspace mainly for their business purposes, it can be seen that there is a higher relative importance of the attractiveness of the market evident.

A major influence on the assessment of the attractiveness of entrepreneurial opportunities was evident in the makers' image of entrepreneurship (see Figure 24). As already expected, there is a wide range among the makers in terms of their individual perceptions of entrepreneurship. Therefore, both personal and environment-related image of entrepreneurship were taken into consideration. Regarding the personal image of entrepreneurship, a positive image of the respondent had a strong positive impact on the relative importance attributed to market potential, intellectual property protection and the availability of a team partner for the potential entrepreneurial opportunity. In contrast, negative effects were found for the same attributes, in the event of a negative image of entrepreneurship among the respondents. In this case, market potential, IPR protection and team partner were each rated significantly less important. With regard to social impact and technical challenge, no effects were found in either direction.

Similar effects were seen for participants who indicated that they perceived a specific image of entrepreneurship in their social environment. The effects in both directions were weaker in each case compared to the personal image, but were particularly evident in the assessment of the importance of market potential and team partner.

Risk-taking behavior had no major impact on opportunity evaluation. I found minor effects for financial risk-taking regarding the evaluation of market potential. Thus, makers that are capable of bearing higher financial risk tend to evaluate market potential more important than others.

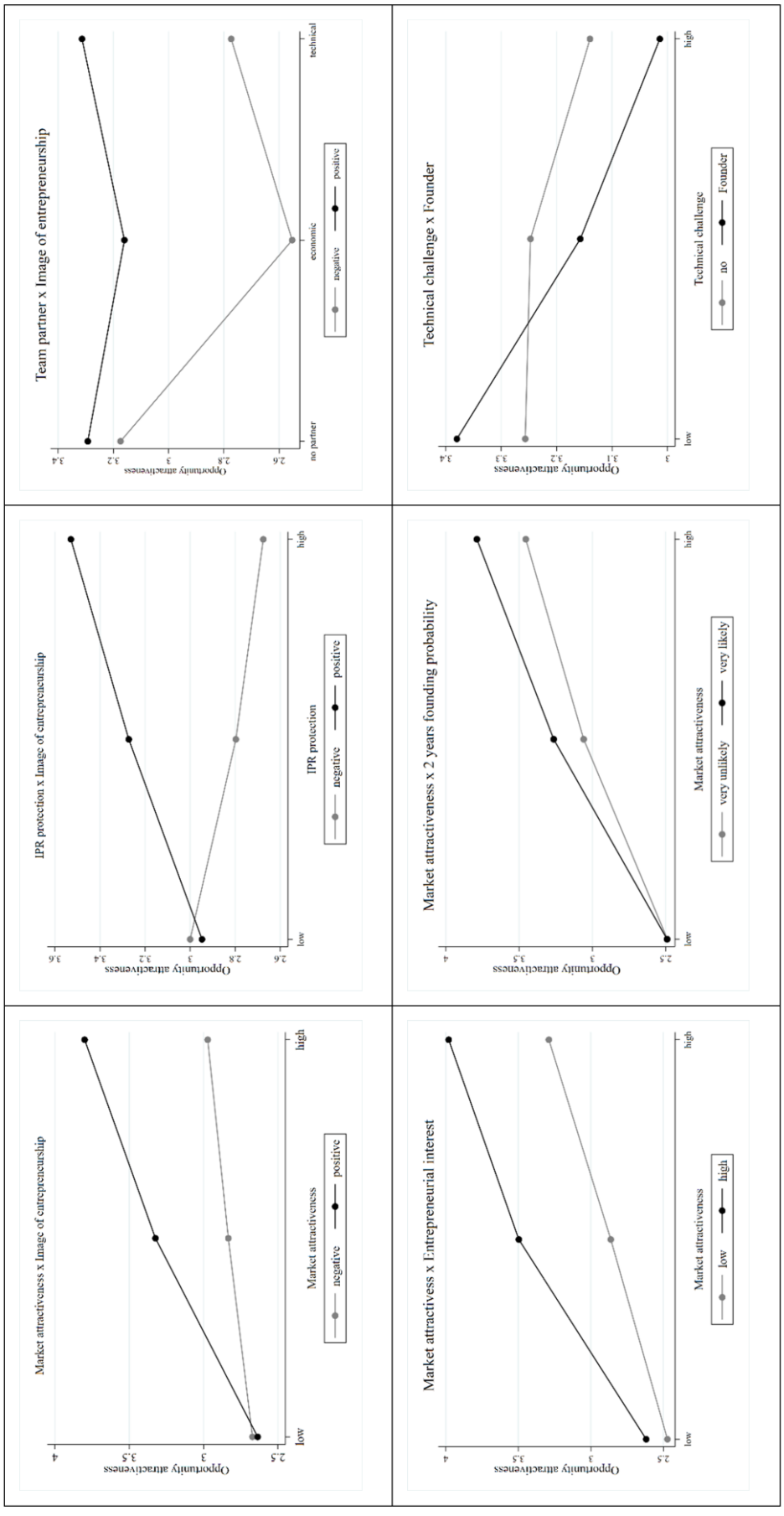


Figure 24: Interaction margin plots of entrepreneurial impact

Source: Own illustration.

7.3.4 Impact of demographics on opportunity evaluation

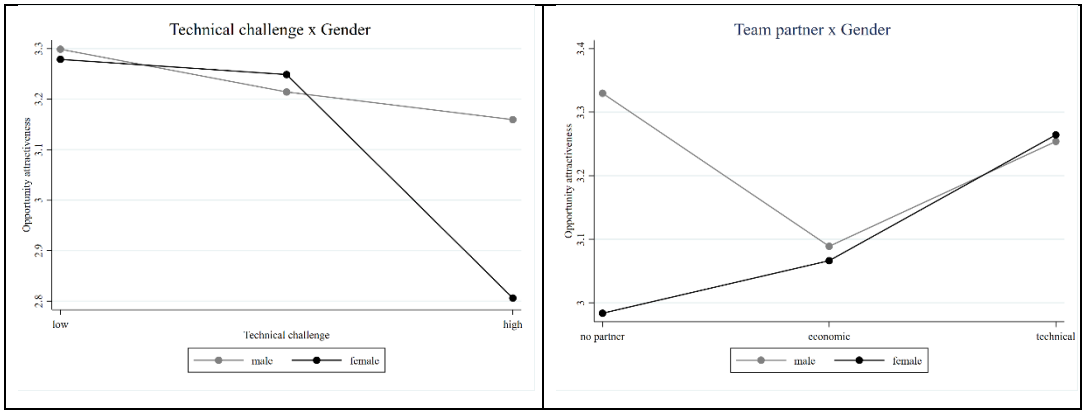
Looking at the moderating effects of demographics (Table 30, Model 14), such as gender, it becomes evident that female makers tend to positively value team members both with technical and economic backgrounds. Given that no other significant relevance of this attribute was found in the entire sample, this is interesting. Female makers seem to be more open to joint entrepreneurship activities with complementary team partners, especially with an economic background.

Furthermore, the protection of intellectual property rights is of higher importance for them. Intellectual property protection consequently is more important for female makers than for their male counterparts. Highly technically demanding projects tend to be perceived as less attractive by female makers. Arguably, technically sophisticated entrepreneurial opportunities are seen as more of a constraint to success in terms of how attractive the opportunities are. However, only indications are apparent here and further research will be necessary in order to prove causal relationships.

With regard to other demographic characteristics of the participants such as age, relationship status or migration background, no significant and/or relevant influences on the evaluation of entrepreneurial opportunities were found.

Figure 25 illustrates the interaction effects of gender on the opportunity attributes technical challenge and team partner.

Figure 25: Interaction effects of gender



Source: Own illustration.

Table 30: Impact on opportunity attributes

Interaction effects between selection criteria and identification with maker identities.
Regression type: OLS Regression Dependent variable: Opportunity attractiveness, evaluated by the decision maker. In Model 1-9 each attribute level interacts with a motivation dimension. For example, in Model 1, every attribute level is interacted with the self-realization motive. The main effects are included in the estimation but are omitted for reasons of brevity so that the coefficients displayed here only refer to interaction effects; Coeff.=Coefficient SE=Standard Error; *p < 0.10, ** p < 0.05, *** p < 0.01.

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample	**Self-realization motive**	**Financial motive**	**Recognition motive**	**Autonomy motive**	**Community motive**	**Innovation motive**	**Learning motive**
Statistic	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**
High market pot.	0.054 (0.059)	0.202 (0.044)***	0.026 (0.056)	0.081 (0.061)	-0.066 (0.080)	0.128 (0.056)**	0.040 (0.093)
Medium market att.	0.085 (0.063)	0.109 (0.037)***	0.034 (0.043)	0.031 (0.053)	-0.024 (0.057)	0.093 (0.047)**	0.021 (0.068)
High IPR prot.	-0.004 (0.061)	0.036 (0.043)	-0.086 (0.048)*	-0.028 (0.050)	-0.091 (0.050)*	0.093 (0.045)**	0.016 (0.061)
Medium IPR prot.	0.088 (0.056)	0.062 (0.035)*	0.016 (0.040)	-0.002 (0.044)	0.008 (0.051)	0.053 (0.045)	0.066 (0.065)
High tech. challg.	0.100 (0.087)	-0.032 (0.053)	0.018 (0.054)	-0.045 (0.055)	-0.038 (0.063)	0.108 (0.057)*	0.105 (0.084)
Medium tech. challg.	0.129 (0.068)*	0.007 (0.039)	0.061 (0.042)	-0.070 (0.041)*	0.038 (0.047)	0.104 (0.042)**	0.133 (0.068)*
High social impact	-0.023 (0.077)	-0.130 (0.050)**	-0.002 (0.056)	0.209 (0.064)***	0.132 (0.074)*	0.027 (0.066)	0.232 (0.083)***
Medium soc. impact	-0.049 (0.057)	-0.030 (0.040)	0.038 (0.042)	0.146 (0.049)***	0.058 (0.056)	0.067 (0.048)	0.160 (0.067)**
Economic team part.	-0.115 (0.072)	0.036 (0.048)	0.062 (0.058)	0.019 (0.060)	0.066 (0.070)	0.057 (0.065)	-0.130 (0.086)
Technical team part.	-0.028 (0.070)	0.061 (0.037)	0.050 (0.050)	0.087 (0.055)	0.159 (0.062)**	0.034 (0.058)	-0.003 (0.087)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N (observations)	3419	3419	3419	3419	3419	3419	3419
N (respondents)	307	307	307	307	307	307	307

Model	(8)		(9)	(10)	(11)	(12)	(13)	(14)
Sample	**User-innovation motive**		**Problem-solving motive**	**Maker experience**	**Weekly time in space**	**# of products created**	**Maker mov. identification**	**Female makers**
Statistic	**Coeff. (SE)**		**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**
High market pot.	-0.115 (0.071)		-0.088 (0.069)	-0.019 (0.028)	-0.001 (0.012)	0.030 (0.036)	-0.117*** (0.041)	-0.066 (0.129)
Medium market pot.	-0.049 (0.060)		-0.016 (0.053)	-0.010 (0.021)	0.001 (0.009)	0.013 (0.029)	-0.046 (0.034)	-0.016 (0.115)
High IPR prot.	-0.032 (0.050)		-0.047 (0.052)	-0.058 (0.020)***	-0.019** (0.008)	-0.103*** (0.030)	-0.073** (0.032)	0.253 (0.118)**
Medium IPR prot.	0.011 (0.047)		0.020 (0.053)	-0.032 (0.019)*	-0.018** (0.007)	-0.063** (0.026)	-0.018 (0.032)	0.149 (0.096)
High tech. challg.	0.051 (0.069)		0.129 (0.069)*	0.101 (0.025)***	0.010 (0.009)	0.090** (0.036)	0.003 (0.045)	-0.299 (0.143)**
Medium tech. challg.	0.046 (0.054)		0.092 (0.050)*	0.039 (0.019)**	0.013 (0.008)	0.040 (0.027)	0.084** (0.035)	0.086 (0.107)
High social impact	0.007 (0.066)	0.267 (0.066)***	0.029 (0.028)	0.001 (0.011)	0.042 (0.037)	0.019 (0.044)	0.144 (0.142)	
Medium soc. impact	0.007 (0.066)	0.238 (0.054)***	-0.004 (0.020)	0.004 (0.008)	0.010 (0.029)	-0.001 (0.033)	0.170 (0.101)*	
Economic team part.	-0.081 (0.061)	-0.050 (0.074)	-0.023 (0.026)	-0.002 (0.011)	-0.037 (0.032)	-0.019 (0.046)	0.356 (0.114)***	
Technical team part.	-0.091 (0.063)	-0.027 (0.067)	-0.030 (0.023)	-0.002 (0.009)	-0.047 (0.030)	-0.019 (0.041)	0.287 (0.111)**	
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
N (observations)	3419	3419	3419	3419	3419	3419	3419	
N (respondents)	307	307	307	307	307	307	307	

Model	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Sample	**Entr. int.**	**2 years founding probability**	**Founder**	**Positive image of Entr.**	**Negative image of Entr.**	**Positive image (social group)**	**Negative image (social group)**
Statistic	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**		
High market pot.	0.156 (0.042)***	0.081** (0.038)	0.136 (0.114)	0.584*** (0.152)	-0.823*** (0.152)	0.359*** (0.102)	-0.253* (0.136)
Medium market pot.	0.129 (0.030)***	0.060* (0.032)	-0.033 (0.090)	0.405*** (0.124)	-0.496*** (0.175)	0.214** (0.083)	-0.203** (0.100)
High IPR prot.	0.027 (0.035)	0.051 (0.031)	-0.106 (0.087)	0.592*** (0.133)	-0.893*** (0.208)	0.012 (0.095)	0.036 (0.136)
Medium IPR prot.	0.026 (0.031)	0.033 (0.027)	-0.101 (0.078)	0.370*** (0.118)	-0.534*** (0.188)	0.100 (0.080)	-0.076 (0.098)
High tech. challg.	0.031 (0.044)	0.001 (0.038)	-0.215 (0.109)**	-0.029 (0.136)	0.217 (0.202)	0.078 (0.106)	-0.167 (0.134)
Medium tech. challg.	0.032 (0.032)	0.021 (0.028)	-0.165 (0.085)*	0.116 (0.110)	-0.060 (0.183)	0.055 (0.081)	-0.133 (0.101)
High social impact	-0.025 (0.043)	-0.067* (0.038)	0.024 (0.114)	-0.147 (0.185)	0.111 (0.294)	0.035 (0.110)	0.017 (0.138)
Medium soc. impact	0.008 (0.033)	-0.018 (0.031)	0.103 (0.088)	0.001 (0.132)	0.061 (0.202)	0.159* (0.085)	-0.140 (0.096)
Economic team part.	0.025 (0.044)	0.025 (0.037)	0.119 (0.102)	0.529*** (0.199)	-0.657** (0.292)	0.357*** (0.117)	-0.307* (0.167)
Technical team part.	0.022 (0.037)	-0.022 (0.034)	0.059 (0.091)	0.312** (0.141)	-0.486** (0.206)	0.249** (0.097)	-0.216* (0.123)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N (observations)	3419	3419	3419	3419	3419	3419	3419
N (respondents)	307	307	307	307	307	307	307

Based on the investigation of the makers heterogeneities by investigating interaction effects, it became evident that there are different types of makers with different characteristics – clustered motivations, skills and evaluation behaviors– within the sample. Therefore, in the next step I will illustrate three different maker identities that match certain patterns regarding their motivations and behaviors using an established framework from the founder literature by Sieger et al. (2016). This explorative approach might be a starting point to identify and understand different subgroups within the complex framework of the Maker Movement and might open up new research agendas within the Maker Movement.

8 Maker identities

Decisions of individuals regarding an entrepreneurial opportunity cannot be evaluated and understood only based on the attributes of the opportunity. In fact, this decision must also be embedded in the context of the decision maker. Thus, a maker's attitudes, values, experiences, and specific knowledge are relevant when it comes to making these decisions. Following this, I will describe an approach to develop different identities of makers. Thereby, I use the social identity framework and a publication regarding founder identities as a guiding reference.

8.1 Identity and Maker Movement

In this chapter, I briefly describe the theoretical foundations of (social) identity theory and its related concepts. This is necessary, because in addition to considering the attractiveness of entrepreneurial opportunities, this thesis explores the (social) identity of makers. Furthermore, I demonstrate what impact these maker identities have on the evaluation of entrepreneurial opportunities.

8.1.1 Introduction: Identity Theory

Identity theory refers to a cluster of different theories trying to explain the human self and behavior in terms of peoples' identities (Powell & Baker 2014), including the characterization of the self, the I and me concept (Mead 1934), and one's own perception, which is also shaped by interaction with other people (Cooley 1902). These concepts are important nested elements from the early 1900s which are still relevant for identity research to date.

The understanding of identity today is mainly formed by two popular theories (Petriglieri 2011). First, the research stream of identity theory emerged from sociological social psychology. (Stryker & Burke 2000; Stryker 1968; Burke & Stets 2009; Wagenschwanz 2021; Burke & Tully 1977) Second, social identity theory developed at about the same time from the field of psychological social psychology. (Tajfel 1974; Tajfel & Turner 1979; Tajfel 1982) Intuitively, these terms may seem somewhat confusing, since social identity theory has its roots more in psychology and identity theory originated in the area of sociology. Although these two theories have historically been viewed as rather competitive, there are also linking elements

and publications. For instance, Mael & Ashforth (2001) argue that both theories are applicable to certain types of roles. In addition, Powell & Baker (2014) argue that founder identities build up on this complementary picture. Building on these basic theories, a wide variety of other concepts and theories regarding the identity of individuals (e.g. role-identity theory and identity accumulation theory) have been developed. However, within the limited scope of this thesis, I only consider fundamental concepts and their main ideas. As a central concept, I will take a closer look at social identity theory within the next subchapter.

8.1.2 Social Identity Theory (SIT)

Social Identity Theory (SIT) was first introduced by Henri Tajfel and his graduate student John Turner in the 1950s and 1960s and published a few years later. (Tajfel 1974; Tajfel & Turner 1986, 1979) Together they conducted various experiments in which participants were randomly assigned to groups with no apparent purpose. During these studies, they discovered the essential role of group membership in determining an individual's social identity, which they used as a basis for developing this theory. Underlying for their research is one central question each individual face: Who am I and what is my place in society? Understanding how the self is conceptualized in the social context addresses these underlying human needs.

Therefore, scholars argue that social interaction is central to an individual's social identity and has a direct impact on their social behavior. Thus, social identity is important to an individual's self, such as a person's feelings, values, beliefs, and actions. (Hogg 2000) People derive self-worth from belonging to social groups and categorize themselves as part of groups within their identity development. After Tajfel's death, Turner went on to develop an subsequent theory, Self-Categorization Theory (SCT), building on these underlying central assumptions. (Turner et al. 1989) His distinction of “in-group” and “out-group” has been the center of various investigations. Thus, it is known today that people evaluate their group rather positively and in contrary tend to evaluate people outside the group more negatively, while sometimes even rejecting them.

Following this, social identity theory has acquired the status of a central concept in explaining and describing the behavior and actions of individuals. The strength of this approach lies in its ability to describe and clarify the different meanings that

individuals associate with cognitive processes, e.g. entrepreneurial opportunity evaluation. (Gioia 1998) Following this, by supporting scholars in order to understand "what it means to be a maker", the application of social identity theory on Maker Movement research provides the opportunity to obtain fundamental insights into makers and their (entrepreneurial) behavior.

8.1.3 SIT in entrepreneurship research

Although social identity theory has become a key lens of the identity literature (Stets & Burke 2000), its deployment in the entrepreneurship literature has been quite recent. Within the last decade, identity has been studied as a predictor of entrepreneurs' behavior and decisions more frequently. For instance, Franke et al. (2006a) explored social identity in venture capital decision making, in terms of their similarity hypothesis. Social identity research within entrepreneurship received a significant boost from the publication of Fauchart & Gruber (2011) on founder identities. Their research explored the impact of entrepreneurs' social identity on venture creation. They used a systematic approach of Social Identity Theory based on Brewer & Gardner (1996) to assess the identities of founders. Within the framework of this approach, social identity is represented by three criteria, as presented in Table 31: basic social motivation, basis-for self-evaluation, and frame of reference.

Table 31: Social Identity Framework

Basic Social Motivation	**Basis for self-evaluation**	**Frame of Reference**
The way the individual views the basic goals of social interaction.	The elements from which self-worth is derived	The way in which and in relation to whom (relevant others) self-worth is derived.

Source: Own illustration based on Sieger et al. (2016)

Thereby, Fauchart and Gruber (2011) identify three pure identities based on a qualitative study in the sports industry. But also indicate that hybrid forms exist between them. They distinguish between the three founder identities Darwinian, Communitarian and Missionarian.

The three developed founder identities are described in Table 32. As a result, they found that although everyone identifies as an entrepreneur, the individual social identity of entrepreneurs results in completely different ways of creating and leading a company and shows a divergent behavior in the context of the foundation and acting as an entrepreneur. Building on this research paper and its growing importance within entrepreneurship research, Sieger et al. (2016) developed a scale for measuring founders social identity.

Table 32: Founder Identities

Founder Identity	Description
Darwinian Founders	Founders with this type of social identity are highly self-interested when engaging with others in firm creation. They derive self-worth by behaving and acting in ways that are congruent with a professional "business-school" approach to management and view the competition as their primary reference in the social space, as competitors pose a threat to the development of their own ventures (construct III).
Communitarian Founders	Founders with this type of social identity want to support and to be supported by their personal social community. They derive self-worth primarily from being able to provide products and services that help to advance their social community and view the community as the primary social reference when setting up their firms.
Missionary Founders	Founders with this type of social identity want to advance a particular cause. They derive self-worth from being able to behave and act in a responsible manner that allows them to pursue their political vision and establish a better world. They view society-at-large as their primary reference in the social space.

Source: Own illustration based on Fauchart & Gruber (2011)

Since no scale has yet been developed for the identity of makers, the next chapter addresses how initial measurements of this concept could be conducted in the context of this thesis.

8.1.4 Measuring social identity

The vast research field of social identity has produced various methods for measuring social identity. To describe this extensively would go beyond the scope of this paper. Therefore, only a few methods are outlined here to create a rough understanding. Abdelal et al. (2009) have provided an overview of the various methods with their guide. Hence, researchers would have to be aware of whether they want to find out whether identity causes people to perform a certain action (independent variable), or whether something else causes people to adopt an identity (dependent variable). Once this elementary question is settled, there are various ways to measure identity, such as surveys, content analysis, discourse analysis and ethnography, cognitive mapping, and experiments.

Postmes et al. (2013) introduced a single-item social identification scale (SISI), which is now widely used to measure individuals' identification with a social group or identity. (Chadborn & Reysen 2018; Reysen et al. 2013) Thereby, the social identity is usually represented by a written identifier, if it is a non-explanatory kind of social identity (e.g. nationality or gender). If more complex subjects are involved, vignettes are used (see next section). Based on this representation of social identity, identification is usually asked on a Likert scale of 5, less frequently 7. They also validated the validity of this single-item scale towards comparable multi-item scales in the area of (social) identity measurement. These results have also been replicated in several studies. They also validated the validity towards comparable multi-item scales in the area of identity measurement. These results have also been replicated in several studies. (Haslam 2004; Haslam et al. 1999; Bergkvist & Rossiter 2007) Especially for studies that do not have their focus in identity research, such a plain scale is suitable. However, the single character of the scale has to be considered when talking about limitations of the study.

One of the possible ways to measure social identity involves communicating the scenarios (e.g. the identity descriptions), using vignettes. Experimental Vignette Methodology (EVM) is used to “present participants with carefully constructed and realistic scenarios to assess dependent variables including intentions, attitudes, and behaviors […]” (Aguinis & Bradley 2014; Mok et al. 2007). Atzmüller & Steiner (2010) define vignettes as ‘‘a short, carefully constructed description of a person,

object, or situation, representing a systematic combination of characteristics'' (p. 128). Furthermore, vignettes may be presented as images, videos, or other media besides a written illustration. (Hughes & Huby 2002) In general, two main types are distinguished. On the one hand, studies that investigate explicit processes and outcomes (paper people studies) and, on the other hand, the investigation of implicit effects through conjoint studies and policy capturing. (Aguinis & Bradley 2014)

Paper People Studies have been around for decades and have been frequently used in research fields such as business ethics. The participants are presented with written vignettes. Following this, they are asked for explicit choices, decisions, and judgments regarding the written scenarios. In contrast, policy capturing and conjoint studies use an implicit approach (Aiman-Smith et al. 2002). Scenarios are carefully manipulated to understand the implicit processes behind participants' decisions. The objective is to understand the effect of the manipulation of variables. (Caroll & Johnson 1990) Further information on this topic can be found in chapter 5, providing a more detailed explanation of the conjoint methodology. Aguinis & Bradley (2014) provide an extensive literature review and show the use of EVM in different journals. They even offer a best practice guide in order to develop and implement successful EVM studies, including a step by step process model, scholars may apply within their studies. This was also helpful in the context of this work, since both EVM methods were used. On the one hand in the context of the conjoint experiment and furthermore to measure maker identity within the questionnaire.

Next, I will describe the application of the EVM methodology, development and measurement of the maker identities within this dissertation.

8.2 Development of maker identities

8.2.1 Preliminary considerations

During the course of the research project, three identity clusters were identified among makers based on the literature and during the interviews. The basic concepts that formed the basis for the development of the identities and experimental vignettes in the context of the study are explained in Chapter 5.

Previous studies have shown that makers do not always see themselves as makers or that they affiliate themselves with a wide variety of groups (Maker Media Inc. & Intel Inc. 2012). However, these designations often only scratch the surface of heterogeneity within the Maker Movement. In this work, makers are considered and analyzed on the basis of in-depth investigation regarding their characteristics, motivations and desires. For this purpose, makers were divided into different identity types, which are distinguished by different motivations and characteristics, such as knowledge or community affiliation. However, despite pure identity types, I identify hybrid identities among makers. The assumptions regarding identities were later quantitatively confirmed by the empirical data.

As already described, in the questionnaire, identification with three different maker identities was measured using vignettes, based on the literature reviews on different the qualitative analysis of the motivation of makers (see chapter 4) Next, the collected data was mapped using Brewer & Gardner's (1996) social identity framework and the founder identities developed by Fauchart & Gruber (2011).

Table 33 provides an overview of the three developed maker identities, including an economic, technical identity and social identity cluster. Moreover, in the next subchapters, I will describe each identity in more detail.

Table 33: Maker identity types and vignettes

Maker social identity type	Social identity dimension	Item text (Vignettes)
Economic Identity	Basic social motivation	"My motivation as a maker is of an economic nature. The interaction with potential customers and the prospect of earning money is what motivates me."
	Basis for self-evaluation	"I see my activity as a maker as a way to achieve something, and I strive for success in the market."
	Frame of reference	"I use other commercially successful entrepreneurs as a reference point."
Technical Identity	Basic social motivation	"My motivation as a maker is of a technical nature. Dealing with interesting technologies and new equipment is what motivates me."
	Basis for self-evaluation	"To me, I see my activity as a maker as an opportunity to experiment and learn, and seek technical success."
	Frame of reference	"I use other outstanding inventors as a reference point."
Social Identity	Basic social motivation	"My motivation as a maker is of a social nature. The exchange with other members of the community and to work on joint projects is what motivates me."
	Basis for self-evaluation	"I consider my activity as a maker as a platform for social exchange and seek contact with other members of the community."
	Frame of reference	"I use other visible and valued members of the community as a point of reference."

Source: Own illustration based on Sieger et. al (2016)

8.2.2 Economic maker identity

Already in the preliminary stages of the quantitative study, some characteristics emerged on the basis of the qualitative investigations and evaluation of the literature. For instance, I recognized that makers with financial motives had a desire for self-realization. Furthermore, I assumed that makers with this kind of identity would have a stronger tendency to commercialize their projects and would therefore be more likely to become entrepreneurially active than other makers. During the interviews, I observed these tendencies among several makers and especially within academic makerspaces in universities. Later, most of these assumptions were confirmed by the quantitative results of the investigation, supporting the development of the first identity: the economic identity.

Thus, when considering the different motivations of makers, the economic identity shows a significant positive relationship regarding finance, self-realization and innovation. On the other hand, a significant negative relationship can be observed for learning and community, that are perceived as de-motivating for makers with an economic identity. (see Table 34)

Makers with an economic identity did show increased entrepreneurial. For instance, many makers with an economic identity stated that they would visit a makerspace in order to work on entrepreneurial projects (e.g. prototypes). Furthermore, the empirical data shows a stronger identification with the economic identity leads to a significant positive relationship to the individual entrepreneurial interest of the respondents. Moreover, makers with an economic identity seem to have a larger network of potential when starting a business, compared to other identities. In addition, makers with an economic identity responded to have a more positive image of entrepreneurship than makers with other identities and tend to take more risks.

Looking at the respondents' educational background, makers with economic identity had a positive correlation with education in disciplines such as economics and law. Furthermore, a significant positive relationship between individual skills regarding the commercialization of inventions, finance and controlling is observable.

Interestingly, makers with economic identity do have less experience than makers with other identities and tend to stick with the Maker Movement rather for a short

time. This may be explained by the fact that makers with an economic identity tend to be younger than makers with other identities. Moreover, economic makers are mainly active within academic makerspaces. In addition, makers with an economic may visit the makerspace because of their entrepreneurial activities and therefore do not possess a large amount of experience. Furthermore, once their entrepreneurial project is finished, economic makers tend to not visiting the makerspace anymore.

8.2.3 Technical maker identity

Next, analyzing the interviews and literature, I found that many makers emphasized their desire to engage with technology and tools. Based on these findings I developed the hypothesis of a second identity type: the technical (and somehow inventor-related) identity. Regarding motivation, Table 34 shows that makers with a technical identity are mainly motivated by innovation, user-innovation and learning. Individual autonomy and finances are not important or even discouraging for makers with a technical identity. Thus, these makers primarily demonstrated a desire to experiment and to learn and understand things like technologies, products and processes. Other tech-savvy people with a high level of expertise were especially valued by these makers. For instance, many makers mentioned famous inventor personalities and the image of the inventor as desirable for them.

Throughout the interviews, I found that the interpersonal level is often of minor importance for makers with a technical identity and rather a source for technical knowledge exchange and learning. Moreover, when considering the number of developed products and prototypes, a significant positive relationship between technical identity and a higher number of developed products can be observed. Thereby, makers with technical identity developed the highest number of prototypes, on average. Following this, it can be hypothesized that an increased use of tools and technologies could contribute to a higher number of prototypes. However, prototypes do not necessarily lead to entrepreneurial activities as the decreased entrepreneurial affiliation of the technical identity indicates.

Looking at the educational background of makers with a technical identity, I find a positive relationship between engineering, computer science, craftmanship, as well as scientific disciplines such as mathematics. Moreover, a significant positive relationship between a technical identity and skills in tech-oriented disciplines like

information technology and digitization, engineering and construction as well as research and development can be empirically quantified based on the data from the questionnaire.

8.2.4 Social maker identity

Third, I identified a social identity among makers. Thereby, makers with a social identity strive for exchange and being part of a community. The direct contact to other makers and the related exchange and sharing is a key motivation for them. For them, the community is important and a central part of their life. During the interviews, makers mentioned that the maker community is comparable to a soccer club for other people. Often the makerspace is a place to go a lot during their free time, where numerous evenings and many hours are spent with like-minded people. This quantitatively is backed up with insights from the empirical data in the questionnaire, showing that makers with a social identity like to collaborate with other makers and do that, more often, than makers with a technical or economic identity.

Makers with a social identity also spend significant higher amount of time on site in the makerspace, which suggests that they value and strive for (physical) interaction and collaboration at the makerspace. In addition, makers with a social identity tend to feel a stronger connection with the Maker Movement than other makers, which is evident in the data from our sample. Therefore, it might be possible that the Maker Movement as a global movement is driven by makers with a social identity. Moreover, it can be assumed that having makers with a social identity in a certain makerspace environment, can helpful for the related community building process.

Considering maker motivation, Table 34 shows that social makers are strongly motivated by the community and related aspects such as cooperation, sharing of knowledge and interaction. Furthermore, social makers are strongly motivated by the desire to solve problems. In contrary, financial matters and individual self-development opportunities (e.g. learning, self-realization, etc.) are of minor importance to makers with a social identity.

Considering the educational background of social makers, while the results indicate an emphasis of education in the fields social, cultural and humanities, however I did

not find significant effects for that. The same applies to the analysis of knowledge in a variety of disciplines.

Furthermore, considering demographic differences between the identities, I find a positive correlation between social makers and non-male makers. Interestingly makers with a social identity responded to have a significant stronger negative impact of Covid-19 regarding their projects compared to the other identities. This could be a result of the difficulties regarding collaboration with other makers and less community exchange at all due to the Covid-19 pandemic.

Table 34: Motivation dimensions and identities

Relationship of maker identities with maker motivations.
Regression type: OLS Regression
Dependent variable: Identification with each maker identity, evaluated by the decision maker.
In Model 1-3 each motivation is regressed with an identity identification. For example, in Model 1, every motivation dimension is regressed with the economic identity identification; Coeff.=Coefficient, SE=Standard Error
*p < 0.10, ** p < 0.05, *** p < 0.01.

Model	**(1)**	**(2)**	**(3)**
Variable	Economic identity identification	Technical identity identification	Social identity identification
Statistic	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE**
Self-realization	0.407*** (0.116)	0.172 (0.105)	-0.111 (0.139)
Financial	0.504*** (0.064)	-0.130** (0.059)	-0.223*** (0.071)
Recognition	0.113* (0.068)	0.065 (0.061)	0.130 (0.081)
Autonomy	-0.003 (0.085)	-0.268*** (0.076)	-0.121 (0.089)
Community	-0.234*** (0.081)	0.028 (0.069)	0.698*** (0.103)
Innovation	0.346*** (0.074)	0.368*** (0.089)	-0.155* (0.084)
Learning	-0.477*** (0.138)	0.409*** (0.127)	-0.304* (0.166)
Problem-solving	-0.049 (0.095)	-0.158* (0.095)	0.313*** (0.098)
User-innovation	-0.031 (0.080)	0.270*** (0.072)	0.073 (0.096)
Observations	3419	3419	3419
Respondents	307	307	307

Table 35: Individual skills and identities

Relationship of maker identities with maker skills.
Regression type: OLS Regression
Dependent variable: Identification with each maker identity, evaluated by the decision maker.
In Model 1-3 each skill dimension is regressed with an identity identification. For example, in Model 1, every skill dimension is regressed with the economic identity identification; Coeff=Coefficient, SE=Standard error
*p < 0.10, ** p < 0.05, *** p < 0.01.

Model	**(1)**	**(2)**	**(3)**
Variable	**Economic identity identification**	**Technical identity identification**	**Social identity identification**
Statistic	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**
finances/ controlling	0.212*** (0.074)	0.017 (0.089)	-0.098 (0.082)
management/ leadership	-0.043 (0.077)	-0.048 (0.053)	-0.006 (0.077)
marketing/ sales	0.088 (0.091)	-0.094 (0.068)	0.124 (0.099)
law	-0.107 (0.093)	-0.076 (0.075)	0.139 (0.101)
production/ logistics	0.029 (0.066)	-0.019 (0.047)	-0.062 (0.073)
research/ development	-0.053 (0.077)	0.143** (0.066)	-0.029 (0.081)
engineering/ construction	-0.003 (0.066)	0.240*** (0.06)	-0.042 (0.068)
IT/digitization	-0.130* (0.067)	0.249*** (0.051)	-0.02 (0.077)
commerc. of inventions	0.363*** (0.078)	0.035 (0.056)	-0.041 (0.083)
Observations	3419	3419	3419
Respondents	307	307	307

Finally, Table 39 provides a correlation matrix of the maker identities and the dependent variable.

Table 36: Correlation matrix of maker identities

Variables	**(1) soc.**	**(2) eco.**	**(3) techn.**	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Maker identities														
(1) Social identity														
(2) Economic identity	**-0.21**													
(3) Technical identity	-0.01	**-0.07**												
Maker experience														
(4) Maker experience	**0.13**	**-0.19**	**0.14**											
(5) Weekly time spent	**0.10**	**0.14**	**0.08**	**0.23**										
(6) Number of prototypes	**0.04**	**-0.04**	**0.16**	**0.54**	**0.37**									
(7) Covid-19 impact	**-0.13**	-0.01	**-0.06**	**-0.06**	**0.13**	**0.06**								
Entrepreneurial														
(8) Entrepr. interest	**-0.08**	**0.44**	**-0.05**	0.00	**0.21**	**0.10**	0.01							
(9) 2 yrs founding prob.	-0.03	**0.42**	**-0.13**	-0.03	**0.25**	**0.09**	**0.03**	**0.70**						
(10) Own company	**0.04**	**0.37**	**-0.16**	**0.05**	**0.27**	**0.11**	**0.04**	**0.35**	**0.34**					
(11) Good personal network	-0.02	**0.26**	**-0.06**	**-0.04**	**0.07**	**0.09**	0.01	**0.27**	**0.30**	**0.18**				
(12) Entrepr. idea	0.01	**0.16**	**-0.06**	**0.09**	**0.24**	**0.08**	**-0.07**	**0.51**	**0.55**	**0.14**	**0.21**			
Risk														
(13) Employment risk-taking	-0.01	**0.22**	0.02	**-0.06**	**0.11**	**0.09**	-0.01	**0.39**	**0.35**	**0.15**	**0.18**	**0.19**		
(14) Private risk-taking	**-0.12**	**0.09**	-0.03	**-0.11**	0.01	0.01	**0.06**	**0.20**	**0.22**	0.03	**0.12**	**0.21**	**0.45**	
(15) Financial risk-taking	**-0.07**	**0.24**	-0.01	**-0.04**	**0.15**	**0.09**	0.01	**0.36**	**0.36**	**0.17**	**0.12**	**0.23**	**0.57**	**0.36**

Notes: Bold correlation coefficients are significant at $p < 0.05$

8.3 Identification of respondents with maker identities

This subchapter investigates the identification of the respondents with the developed maker identities in detail. Thereby, I show how many makers identify themselves with each identity and to which extent they do that. Furthermore, I discuss the relevance of hybrid maker identities in this context and provide starting points for in-depth investigation by scholars in the future.

First, I investigated the identification of the respondents with the three identities. Table 37 displays the identification of the makers with each identity measured on a Likert scale from 1 to 5 (1= no identification at all; 5=complete identification), including mean values and standard deviation. Furthermore, I provide detailed information regarding the identification of the respondents with each identity in total responded numbers and percentages.

Table 37: Identity summary statistics

Identity	Identification with identity (percent)					**Mean (SD)**
	(1)	(2)	(3)	(4)	(5)	
Technical identity	7 (2.3%)	20 (6.5%)	31 (10.1%)	107 (34.9%)	142 (46.3%)	4.16 (1.00)
Social identity	28 (9.1%)	63 (20.5%)	80 (26.0%)	91 (29.6%)	45 (14.7%)	3.20 (1.19)
Economic identity	136 (44.3%)	67 (21.8%)	50 (16.3%)	37 (12.5%)	17 (5.5%)	2.13 (1.27)

Notes: N= 307 makers. Identification with each identity rated on a 5-point Likert scale. (1= no identification at all; 5= complete identification)

Thereby, I find that the strongest identification of makers with the three identity constructs occurs within the technical identity (mean=4.16; SD=1.00), followed by the social identity (mean=3.20; SD=1.19). The weakest identification appears with the economic identity (mean=2.13; SD=1.27). Considering these results, in combination with other factors such as motivations, skills and other characteristics, the impression of different identity patterns within the Maker Movement is reinforced.

Moreover, considering the total numbers of makers, a majority of makers identifies strongly with the technical identity, followed by the social identity. Only a small number of makers identifies strongly with the economic identity.

In addition, Table 38 illustrates a t-test regarding the identity identification of male and female makers, showing significant effects for the technical and social identity. Thus, I find that male makers possess a significantly stronger identification stronger with the technical identity, while female makers show stronger identification with the social identity construct. Furthermore, I do not find significant effects for differences regarding identification with the economic identity.

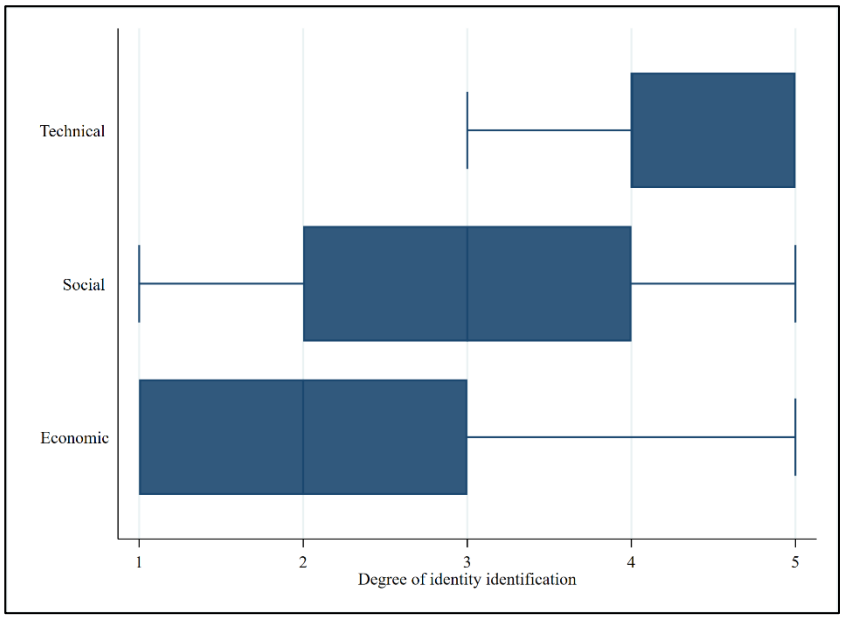
Furthermore, I created Figure 26 in order to illustrate the identification of the makers with the identity constructs in a graphical way. Thereby, I use a boxplot to provide detailed information.

Table 38: Identity identification t-test

Identity	**Mean (SD)**	**Male** Mean (SD)	**Female** Mean (SD)	**Sig.**
Technical	4.16 (1.00)	4.28 (0.89)	3.58 (1.25)	0.000***
Social	3.20 (1.19)	3.18 (1.18)	3.31 (1.23)	0.006***
Economic	2.13 (1.25)	2.12 (1.27)	2.13 (1.14)	0.831

Notes: Male = 255 Female= 52; SD= Standard Deviation *t-test for independent samples; *p < 0.10, ** p < 0.05, *** p < 0.01.

Figure 26: Identity identification



Source: Own illustration.

In addition, Table 39 shows a correlation matrix of the three maker identities, including opportunity attractiveness as the main dependent variable of this dissertation. Looking at the correlation coefficients the social identity shows a weak negative correlation (Coeff.=-0.21) with the economic identity. Moreover, none of the other correlation coefficients remain of interest.

Table 39: Correlation matrix of maker identities

Variables	(1)	(2)	(3)
(1) Opportunity attractiveness			
(2) Social identity	-0.02		
(3) Economic identity	**0.06**	**-0.21**	
(4) Technical identity	**0.05**	-0.01	**-0.07**

Notes: Bold correlation coefficients are significant at $p < 0.05$.

However, despite the three identified "pure" identities, makers can identify themselves with more than one identity. I argue, that these makers possess so-called hybrid identities. In the appendix (see Table 52) I illustrate the identification of the respondents, considering all possible forms of hybrid identities. Furthermore, I find that the dominant hybrid identity form is a hybrid identity between the social and technical identity. Thus, 6.21% of the participants fully identify with both identities. Since these hybrid identities always consist of the combination of two identities, the assignment of individual makers to all three identities – which is theoretically possible – was also examined. As a result, I did not find any participant to have a strong identification with all of the three identities.

Hybrid identities offer an interesting research opportunity for the future. However, basic characteristics of maker identities should first be explored in more depth, before continuing research in this regard. Although this is not possible within the limited scope of this dissertation, it offers a starting point for future research. In the next step, I will shed light on the influence of maker identities on the evaluation of entrepreneurial opportunities.

8.4 Influence of maker identity

Following the description and characterization of the different identities, their influence on the evaluation of entrepreneurial opportunities will be examined and discussed in more detail within this chapter. For this purpose, I calculate several interactions of variables with conjoint attributes. Table 40 shows the interaction effects of maker identity and the opportunity attributes.

Table 40: Interaction between identities and attributes

Interaction effects between selection criteria and identification with maker identities.
Regression type: OLS Regression
Dependent variable: Opportunity attractiveness, evaluated by the decision maker.
In Model 1-3 each attribute level interacts with an Identity identification. For example, in Model 1, every attribute level is interacted with the technical identity identification. The main effects are included in the estimation but are omitted for reasons of brevity so that the coefficients displayed here only refer to interaction effects.
Coeff.=coefficient, SE=standard error
*p < 0.10, ** p < 0.05, *** p < 0.01.

Model	**(1)**	**(2)**	**(3)**
Dependent variable	**Opportunity attractiveness**		
Sample	**Technical Identity identification**	**Social Identity identification**	**Economic Identity identification**
Statistic	**Coeff. (SE)**	**Coeff. (SE)**	**Coeff. (SE)**
Market pot.: medium	0.002 (0.041)	-0.099 (0.036)***	0.107 (0.034)***
Market pot.: high	0.014 (0.047)	-0.177 (0.045)***	0.211 (0.046)***
IPR prot.: medium	0.015 (0.039)	-0.078 (0.307)**	0.045 (0.03)
IPR prot.: high	-0.004 (0.044)	-0.069 (0.364)*	0.039 (0.032)
Tec. challg.: medium	0.107 (0.04)***	0.007 (0.329)	-0.016 (0.032)
Tec.challg.: high	0.207 (0.049)***	-0.068 (0.436)	-0.011 (0.042)
Soc. impact: medium	0.012 (0.039)	0.060 (0.357)*	-0.063* (0.033)
Soc.impact: high	0.027 (0.052)	0.090 (0.045)**	-0.147*** (0.044)
Team part.: economic	-0.121 (0.05)**	0.108 (0.044)**	0.037 (0.034)
Team part.: technical	-0.051 (0.052)	0.062 (0.039)	0.056* (0.037)
Control variables	Yes	Yes	Yes
Observations	3419	3419	3419
Respondents	307	307	307

Thereby, I find significant effects in the evaluation of an entrepreneurial opportunity regarding the interaction of the attributes with the economic identity regarding the attractiveness of the market and social impact. Thus, it appears that people with an economic identity attribute significantly higher importance to the attractiveness of the market, while the social impact is of minor importance to them. This indicates that what matters most to makers with an economic is the attractiveness of the market that is associated with the entrepreneurial opportunity.

Whether or not there is a social challenge to be tackled associated with it, even seems to be perceived as disturbing for makers with an economic identity. This could be explained by perceived "hidden" challenges of entrepreneurial opportunities that are associated with societal challenges. In addition, to date many people, including aspiring and nascent entrepreneurs, are under the impression that social and commercial objectives of business models lack compatibility (Austin et al. 2006).

The interaction of the attributes with the technical identity also exhibits some interesting effects. For instance, I find that having a technical identity strengthens the importance of the technical challenge attribute significantly. Following this, makers with a technical identity tend to seek out technologically challenging entrepreneurial opportunities. This is especially interesting as other makers perceive technical challenge of an entrepreneurial opportunities as something negative and relate to an obstacle. A possible explanation for this affinity could be the intrinsic motivation of technical identity makers to engage in technical challenges. Furthermore, technologically more demanding entrepreneurial projects could achieve competitive advantages and technological leadership, which may potentially also be legally protected through intellectual property rights.

Interestingly, makers with a technical identity attach less importance to a team partner with a business background than other makers. This could suggest that technical makers are primarily oriented towards technical makers and consider the assistance of business know-how to be less important in the context of an entrepreneurial opportunity, since they may underestimate its importance or provide the necessary knowledge for the process by themselves.

Next, the results show that the social identity of makers affects the attributes of entrepreneurial opportunities quite differently. For instance, for makers with a social

identity affiliation, a social challenge increases the attractiveness of an entrepreneurial opportunity beyond proportion.

In contrary, they attach comparatively little importance to the attractiveness of the market, and a high attractiveness of the market even decreases the attractiveness of an entrepreneurial opportunity in their eyes. In addition, this applies for high technically challenging entrepreneurial opportunities as well. Moreover, makers with a social identity tend to specifically value a team partner with a business background and evaluate that attribute with higher importance than makers with technical or economic identities. This might be explained by the fact that makers perceive economic competence as highly relevant and important for entrepreneurial activities. In addition, makers with a social identity might lack economic knowledge and therefore view economic team partners as an especially important attribute for entrepreneurial opportunities.

Overall, I find very interesting interaction effects of maker identity on opportunity evaluation. However, these interesting findings only scratch the surface of something bigger. Concluding this first investigation of maker identities, I will show the significance for theory, practice, and further research possibilities, in the next subchapter.

8.5 Discussion

8.5.1 Summary of results

This study investigated the characteristics and opportunity evaluation behavior of makers. Inspired by Fauchart's investigation of founder identities, I explored the identity of makers in more detail. This chapter, regarding the identities of makers, expands this research as makers in the sample could frequently be classified as belonging to one of three social identity types, with each of these associating particular characteristics: technical makers, who want to solve technical challenges and aim for opportunities to learn and innovate; economics , who strive for commercial success and the realization of their self; and social makers who deviate from the economic typology by viewing the Maker Movement as a source of community and like-minded individuals, searching for interaction and cooperation with peers.

Beyond showing the existence of three maker identity types and describing their features, the results of this study provide evidence of how these identities are influencing the evaluation of entrepreneurial opportunities. In particular, the in-depth analysis provides detailed examples that indicate strong differences in the perceived importance of distinct opportunity attributes such as market potential, technical challenge and social impact.

8.5.2 Contributions to literature

The results presented in this chapter add to the Maker Movement literature in several ways. Generally ,the study findings suggest that social identity theory has the potential to serve as a precious platform from which to expand the general understanding of individuals – makers – within the Maker Movement. Thereby, I provide empirical evidence on first indications that suggest a great heterogeneity among the individuals within the Maker Movement (Hausberg & Spaeth 2020; Maker Media & Intel 2012), quantitatively outlining three distinct identity types. This is especially interesting, as the results have implications for the frequently discussed potential for innovation and entrepreneurship of makers (Browder et al. 2019a; van Holm 2015). Moreover, I indicate hybrid forms of identities among the

makers. However, more in-depth research is essential in this regard to validate these first assumptions.

I use a common frame of reference by Fauchart and Gruber (2011) to explain the different evaluations of attractiveness that makers attribute to an entrepreneurial opportunity. Thereby , the results illustrate that ratings reach beyond the recent views that makers are primarily motivated by the prospects of intrinsic motivations (e.g., Mauroner 2017). As social identity theory describes that individuals strive for behaviors and actions which are consistent with their identity (Tajfel 1974), the social identity approach assists to explain why makers prefer certain attributes when evaluating entrepreneurial opportunities, or in addition, do not find to perceive entrepreneurial opportunities attractive at all. Consequently, this study contributes to the broader literature on entrepreneurial opportunity evaluation (Ardichvili et al. 2003; Haynie et al. 2009; Foo 2011).

The relationship between maker identity and behaviors and actions seems to be particularly tight in the case of economic identities. The meanings internalized by social and technical makers are somewhat more abstract, suggesting a larger scope of potential actions; however, for a variety of reasons, social makers also restrict themselves to a subset of potential actions when setting up a firm. For instance, their pursuit of primarily "non-commercial" activities and their strong social and technical oriented views lead them to discard entrepreneurial opportunities that appear rather commercial. Consequently, a maker's social identity leads to an important restrictive corridor regarding entrepreneurial opportunities, because only some behaviors and actions are perceived as suitable in their personal view of "making". Moreover, persisting on a narrow view of appropriate making characteristics, could also lead to fundamental conflicts – similar to conflicts within entrepreneurial teams – when a community of makers is compiled of individuals with different identities, or even collaborates within a specific project or venturing activity.

Next to contributing to the Maker Movement literature, this dissertation provides implications for the broader literature on entrepreneurship and its linkage to social identity (Fauchart & Gruber 2011; Murnieks et al. 2020; Mmbaga et al. 2020) By applying the social identity concept to the individuals involved within the Maker Movement, we expand the literature regarding the impact of social identity on

entrepreneurial opportunities beyond the established work, focusing on founders, by Fauchart and Gruber (2011). Thereby, we quantitively support the impact of identity characteristic such as financial motives (Choi & Shepherd 2004; Haynie et al. 2009) on the evaluation of opportunities. In addition, we empirically show that the identity of a maker is a potential proxy for the entrepreneurial interest and activity, expanding views regarding different types of entrepreneurially active makers, such as hobbyists, lifestyle entrepreneurs and growth entrepreneurs (Browder et al. 2019a, 2017).

8.5.3 Limitations and future research avenues

This chapter has several limitations. First, and most importantly, the patterns that have emerged in this chapter must be interpreted within the constraints of a cross-sectional, exploratory research design. Specifically, its inability to determine directions of causality. Given that the development of an individual's social identity is considered a long-term process that begins in childhood, I suggest that longitudinal studies should consider differences between makers of different ages and how their identity develops over time, as it is usually influenced by actions and activities in their lives Second, since we cannot completely rule out the possibility of such a pattern in the present research, in-depth biographical or longitudinal research projects would be useful to clarify the causal relationships and feedback loops between the above-mentioned concepts. Third, a complex construct such as social identity should be the subject of in-depth research with a sophisticated scale in order to take full advantage of the potential of this research agenda. Finally, one central limitation of experimental vignette methodology studies is that they may not accurately reflect the complexity of real-world decision-making, as they typically involve presenting respondents with simplified scenarios. However, compared to other methods, EVM still provides high degrees of realism due to its use of indirect interrogation. In addition, the sophisticated design of the vignettes is accomplished using an established frame of reference and supported by qualitative data and evidence from the literature.

Following this, in order to overcome these limitations and to explore new interesting relationships, I provide future research avenues for scholars to explore. First, to address the methodological limitations of this study, future research could test other methodologies to extend the external validity of this experiment.

Second, while this study provides preliminary evidence of distinct maker identities, we emphasize that scholars should develop scales to measure maker identities to make the concept of identity accessible to large-scale and longitudinal empirical studies. This will help to determine whether the findings of this study can be generalized more broadly. Finally, I recommend expanding the research agenda on maker identities – for example, research on the influence of maker identity on entrepreneurial activity – to uncover its valuable causal mechanisms.

9 Academic makers and opportunity evaluation

Many universities set up makerspaces to support innovation and academic entrepreneurship. Yet, so far, we know little about the entrepreneurial motivations and interests of academic makers and what makes an entrepreneurial opportunity attractive for them. Based on a conjoint experiment combined with a survey of 144 academic makers, this study analyzes the entrepreneurial motivations and interests of academic makers and examines the criteria that increase the attractiveness of entrepreneurial opportunities for them. We find that academic makers are mostly from technical fields of education and are primarily motivated by learning, autonomy, and the goal of becoming an innovator. We also provide insights into the decision-making process when makers evaluate entrepreneurial opportunities. Both market potential and social impact make an entrepreneurial opportunity attractive for them. More involved and experienced makers prefer technically challenging opportunities and consider intellectual property rights less important. In addition, a maker's entrepreneurial interest increases the perceived attractiveness of opportunities with high market potential. Makers with entrepreneurial experience avoid technically challenging opportunities and value team partners with a technical background. Our findings have important implications for university administrators and entrepreneurship policymakers aiming to stimulate academic entrepreneurship.

This chapter is based on Block, J. H., Brandstetter, C. and Zaggl, M.A. (2023). Academic makers and opportunity evaluation. (in Review)

9.1 Introduction

Many policymakers in public administrations and universities aim to facilitate innovation and growth through academic entrepreneurship, which is defined as initiatives focused on generating entrepreneurial ventures from university research (Grimaldi et al. 2011). The rich literature on academic entrepreneurship has focused on different aspects of academic entrepreneurship, such as the role of university institutions and policies (Sandström et al. 2018), the motivations of academic entrepreneurs (Hayter 2015), the role of digital technologies (Secundo et al. 2020), challenges of technology transfer (Siegel et al. 2003), and university-industry relations (Perkmann et al. 2013). As a new approach to academic entrepreneurship, many universities have most recently begun to set up makerspaces, which are "open access communities for individuals to meet, socialize, exchange ideas and to work on projects related to technology, science and arts" (Halbinger 2018, p. 2028) and where makers engage in practical activities such as prototyping, application of new technologies, and collaboration. Prior research on makers and related phenomena, such as hackers and user innovators, shows that such "making" activities can lead to promising entrepreneurial opportunities (Browder et al. 2019), thus underscoring the potential of makerspaces as a tool to foster academic entrepreneurship.

So far, however, we know little about the entrepreneurial interests and motivations of academic makers. In particular, we need a more detailed understanding of the characteristics of academic makers, what motivates them to become entrepreneurs, and what constitutes an attractive entrepreneurial opportunity for them. Addressing this gap is important from a policy and university administration perspective in order to justify investments in makerspaces and utilize them as effective tools for academic entrepreneurship. It also allows university administrators to implement measures that reduce barriers to entrepreneurship and design an effective entrepreneurship support environment.

Our study aims to address this research gap and focuses on the individual maker and poses the following research questions: What are the individual characteristics of academic makers and what are their entrepreneurial experiences, interests, and motivations? What constitutes an attractive entrepreneurial opportunity for them?

To address our research questions, we combine a detailed survey with a conjoint experiment. Based on data from 144 academic makers from 27 university-based makerspaces in Germany, we find that makers are primarily male and educated in technical fields. On average they are approximately 29 years old and many are students. Their motivations are mainly focused on learning, autonomy, and aiming to become active innovators. In contrast, recognition, financial, and community-related motives are considered less important. Moreover, we find that many academic makers have a considerable record in prototype development (four or more prototypes on average). They regularly encounter entrepreneurial opportunities during their making activities, and they are generally interested in entrepreneurial activity. To be considered attractive by academic makers, an entrepreneurial opportunity should have a high market potential or create social impact. By contrast, team aspects and the desire to solve technical challenges matter less.

Our study contributes in three principal ways to the literature. First, we address the literature on the characteristics of makers, particularly their underlying motivations (Hausberg & Spaeth 2020) and entrepreneurial interests (van Holm 2015). Our study highlights the overall entrepreneurial potential of makers in university-based makerspaces and reveals their particularities in the entrepreneurial evaluation process. Second, we address the topic of the evaluation of entrepreneurial opportunities by makers. Our study complements prior conceptual research (Browder et al. 2019) by empirically identifying the factors that turn a maker project into an attractive entrepreneurial opportunity. We also extend the research by outlining individual differences in opportunity evaluation. For example, we show that highly involved makers (those spending many hours as makers and having a lot of experience) prefer technically challenging opportunities but care less about intellectual property rights; makers with high entrepreneurial interest value opportunities with higher market potential; and makers with entrepreneurial experience avoid technically challenging opportunities and value team partners with a technical background. Third, we contribute to the general literature on entrepreneurial opportunity evaluation (Haynie et al. 2009; Ardichvilli et al. 2003) by identifying the criteria that make an entrepreneurial opportunity for prospective entrepreneurs attractive. This literature has not considered makers as a specific group of prospective entrepreneurs. Besides that, finding social impact being a critical

opportunity criterion speaks to the literature on social entrepreneurship, which so far has been largely silent on makers as a source for social innovation (Browder et al. 2022a; Langley et al. 2017; Millard et al. 2018)

9.2 Related literature

This section provides a brief overview of the main concepts relevant to our study; these concepts are, academic entrepreneurship and makers at university-based makerspaces.

9.2.1 Academic entrepreneurship and the motivations of academic entrepreneurs

Academic entrepreneurship can be seen as a catalyst for innovation and growth through the creation of new ventures (Rothaermel & Thursby 2005). Universities increasingly highlight this "third mission" on the same level as research and education (for reviews (Hayter et al. 2018; Miller et al. 2018; Grimaldi et al. 2011)). Universities seek to transfer their research through technology transfer efforts and academic spin-offs into industry and society, leveraging innovation and economic growth. The roots of the concept of academic entrepreneurship can be traced back to the Bayh-Dole act in 1980, which led to significant changes in the commercialization and diffusion of technologies and innovations developed in academic institutions (Aldridge & Audretsch 2011) and transformed the role of the university fundamentally.

Academic entrepreneurship activities involve different academic groups, such as students, postdoctoral fellows, academic staff, and university scientists, as well as collaboration partners from the industry. For instance, students are introduced to concepts of entrepreneurship within lectures and provided with resources and support in startup activities through university incubators. In addition, universities provide facilities, such as laboratories, funding, and industry connections (Hayter et al. 2018).

Several studies (e.g. Hayter 2015) have investigated the motivations of academics to engage in entrepreneurial activities, emphasizing the importance of intrinsic and extrinsic motivations (Ryan & Deci 2000). As intrinsic sources of rewards, academic entrepreneurs engage in entrepreneurial activities to pursue autonomy, self-realization, inner satisfaction, skill enhancement, and self-esteem motivations. They

are also driven by a feeling of social responsibility, such as having a "public mission" to improve living standards through technology, or a "need for utilization", referring to the application of research results in practice (Lam 2011). Academic entrepreneurs' extrinsic motivations can take the form of direct financial rewards—e.g., through patenting or establishing academic spin-offs—from their entrepreneurial activity, and indirect rewards—reputational gains that in turn are career-enhancing or might create employment while being able to continue with their research agenda (Hayter 2015; Hossinger et al. 2020).

9.2.2 University-based makerspaces and the Maker Movement

Makerspaces are a new form to facilitate academic entrepreneurship (Farritor 2017; Rothaermel & Thursby 2005; Mersand 2021; Halbinger 2020), which are defined as "open access communities for individuals to meet, socialize, exchange ideas and to work on projects related to technology, science and arts" (Halbinger 2018, p. 2028). They provide physical spaces and fabrication tools for their users (i.e., the makers). The term makerspace is not limited to the physical space but includes the community and the surrounding ecosystem. Makerspaces have the purpose to foster entrepreneurship by generating "accidental entrepreneurs" (Shah & Tripsas 2007), creating an innovative environment, and enabling prototyping on the way to marketable products (van Holm 2017).

Makerspaces are at the heart of the "Maker Movement" (Dougherty & Conrad 2016), which is a growing phenomenon consisting of people utilizing technology to collaborate in creating tangible, material artifacts (Browder et al. 2017) and gained increased research interest recently. Rooted in the idea to make innovation capabilities more accessible to individuals (von Hippel 2006), the Maker Movement encourages the value of working with one's hands and stresses innovative applications of technologies such as 3D-printing, laser cutting, microcontroller programming, and prototyping (Mauroner 2017). Along with related developments including do-it-yourself, rapid prototyping, sharing economy, open source, crowdfunding, and user-entrepreneurship, the movement promises economic growth through new innovation approaches and technology transfer and even might be a starting point for "the next industrial revolution" (Browder et al. 2019, p. 459).

The number of university-based makerspaces has tremendously increased in recent years due to various initiatives and funding programs (van Holm 2021; Halbinger 2020) aiming to foster entrepreneurial ecosystems within universities (Aldrich 2014; Cuntz & Peuckert 2023). In contrast to other facilitators of academic entrepreneurship, such as incubators or technology transfer offices, makerspaces address a much broader audience, encouraging hands-on learning and prototyping, and are typically set up with a less straightforward entrepreneurial emphasis (Mauroner 2017). They include very individual offers to a diverse range of projects and individuals. While the majority of university-based makerspaces is set up in universities predominantly for engineering and technology-related (STEM) departments (van Holm 2021), their multidisciplinary nature can encourage the interaction of disciplines that have traditionally been separated (Walsh et al. 2021).

9.2.3 Makers and entrepreneurship

Since makerspaces are a very recent phenomenon, little is known about them and especially about the individuals within makerspaces and it has been called for research into their role in fostering entrepreneurship within academic institutions (Halbinger 2020). Prior research introduced conceptualizations of makers and their entrepreneurial activities (e.g. Browder et al. 2019). Makers that engage in "do-it-yourself" (DIY) projects have been found to exhibit high levels of innovation and creativity, and many have turned their hobbies into successful businesses (Halbinger 2018). Different entrepreneurial makers can be distinguished (Browder et al. 2017). For example, hobbyists primarily focus on the process of making (Mauroner 2017) while lifestyle entrepreneurial makers are usually consumer-oriented and their products appear on crowdfunding campaigns (e.g. Kickstarter). Hobbyists and lifestyle entrepreneurial makers differ in whether and how they exploit entrepreneurial opportunities (Browder et al. 2017).

Studies have shown that makerspaces might be enablers for entrepreneurship and innovation (Cuntz & Peukert 2023). In addition, research can report successful cases from practice, e.g. the founding of Square, a publicly listed payment service provider from the US out of a makerspace (Browder et al. 2019). Also, Li et al. (2022) provide early quantitative evidence for the positive relationship of makerspaces on

entrepreneurial activity. However, despite positive indications, little is known about the impact of makerspaces on innovation and entrepreneurship.

Entrepreneurial opportunities for makers emerge rather serendipitously (Halbinger 2018) but some patterns can be recognized, for example, whether and how opportunities are exploited depends on the lifestyle of the makers (Browder et al. 2017). Unlike unintended entrepreneurs (Franke et al. 2006), growth entrepreneurs enter makerspaces in order to create prototypes or produce small batches for their entrepreneurial activities (van Holm 2015). Browder et al. (2019) structures the relationship between the Maker Movement and entrepreneurial opportunities in a conceptual model, arguing that individuals, technology, and the resulting knowledge creation enable project-based – non-commercial - outcomes like artifacts and designs, communities and networks as well as learning and skills. In addition, they propose that, in the next step of the model, these non-commercial outcomes can function as triggers for further potential commercial activity. Following this, we will investigate the relationship of makers and entrepreneurship in depth in order to understand the way from "making" to entrepreneurship.

9.3 Material and methods

9.3.1 Research context and sample

We research academic makers in university-based makerspaces in Germany, where multiple initiatives and funding efforts have contributed to the ongoing expansion of makerspaces affiliated to universities in recent years (see also Halbinger 2020). However, little is known about the people—the makers—within these spaces and their contribution to academic entrepreneurship efforts in German universities.

To create a sample, we used a public repository of makerspaces (hackerspaces.org, see Halbinger 2018) together with the makerspace overview page of *Make magazine*[15] and the database of the German Association of Community Workshops (VOW)[16]. We also added mentioning's of makerspaces from an internet search and

[15] https://maker-faire.de/makerspaces
16 https://www.offene-werkstaetten.org/werkstaetten

recent research (Heinzel et al. 2020). In this way, we aimed for complete coverage of academic makerspaces located in Germany. In total, we identified 53 makerspaces with a direct link to a German educational institution, such as a university or a university of applied sciences.

We then reached out to those responsible for these makerspaces—our multiplicators—and contacted them via email asking them to distribute our online survey and conjoint experiment to the makers in their spaces. A few weeks after our initial request, we sent a reminder to all those responsible that did not reply to our earlier requests.

Each of the makers contacted was asked to answer a questionnaire and take part in a conjoint experiment. In total, our final sample consists of 144 makers from 27 university-based makerspaces.

9.3.2 Questionnaire and variables

In the questionnaire, we investigated multiple characteristics of academic makers, for example, their experience as a maker. We used several items from related investigations. To measure the motivation of makers to participate in making-related activities, we adapted the scale from Carter (2013). The participants were asked to evaluate nine motivation dimensions (e.g. self-realization, financial motives, and community recognition). To measure entrepreneurial interest, we adapted a scale from Wilson et al. (2007). Time spent with making activities (hours per week spent on a maker project and in the makerspace) and community participation (the degree of affiliation with the Maker Movement) were measured using adapted scales by Hausberg and Spaeth (2020). In addition, we used a scale by Linán and Chen (2009) to investigate the entrepreneurial ideas of makers. We used a scale by Halbinger (2018) to investigate entrepreneurial experience (binary variable of experience in firm foundation) of makers as well as their involvement in prototyping efforts (number of prototypes created). Table 57 in the appendix provides an overview of all theoretical constructs and their operationalization.

9.3.3 Conjoint experiment

Experimental design

We used a metric conjoint experiment to examine makers' entrepreneurial opportunity evaluations. Conjoint experiments are suitable because they force participants to reveal their preferences given trade-offs in opportunities (Lohrke et al. 2010; Louviere 1988). Opportunities are therefore decomposed into attributes and attribute levels. Conjoint experiments are widely used in a range of disciplines, including entrepreneurship (e.g. Patzelt & Shepherd 2016; Choi & Shepherd 2004; Lohrke et al. 2010), innovation management (e.g. Pullmann 2002), and strategy (e.g. Priem 1992). To make the decision-making situation more comprehensible, the participants received a brief description of a decision-making scenario, which set the context and put them into the situation of rating the attractiveness of different entrepreneurial opportunities (see Table 56 in the appendix).

Conjoint attributes

We asked the participants to evaluate the opportunity attractiveness of 16 different entrepreneurial opportunities. Each opportunity was specified by five attributes: market potential, IPR protection, technical challenge, social impact, and project team. To define the opportunity attributes, we conducted a multistep approach. We started by identifying a list of the most relevant attributes from the literature and conducted semi-structured interviews with 19 experts from the Maker Movement to validate this list. Then, we pre-tested our conjoint experiment and questionnaire iteratively in two pilot studies with researchers and makers. This resulted in the representation of each entrepreneurial opportunity based on five attributes. Each attribute could be instantiated by one of three levels (see Table 41 for the five attributes and the three levels for each attribute). The participants evaluated the attractiveness of 16 randomly created configurations ("Based on the attributes described, how attractive is this entrepreneurial opportunity for you personally?") on a 5-point Likert scale ("not attractive at all" to "very attractive").

To avoid an impact by the order of attributes' appearance, we randomized the order of attributes for each participant but kept it constant for each participant. In a pretest with five makers and ten researchers, we ensured face validity of our experimental design.

Table 41: Attributes and attribute levels of conjoint experiment

Attributes	Attribute levels	Description
Market potential	(1) low (2) medium (3) high	This attribute describes the economic attractiveness of a potential market, e.g., based on its size and consumers' willingness to pay.
Applicability of intellectual property rights	(1) low (2) medium (3) high	This characteristic describes whether the product can be protected with intellectual property rights in order to prevent imitation.
Technical challenge	(1) low (2) medium (3) high	This attribute describes the anticipated level of technical challenge of the realization of the product.
Social impact	(1) low (2) medium (3) high	This attribute describes if and how the product may solve social problems.
Project team	(1) no team partner (2) team partner with economic background (3) team partner with technical background	This attribute describes if there is a project partner for the respective project. The project partner may have different competencies.

A fully-crossed metric conjoint analysis design with the five attributes and the three levels each would require each participant to evaluate $3^5 = 243$ configurations, which would have been not possible because fatigue kicks in much earlier and has been shown to adversely impact conjoint results (Reibstein et al. 1988). Thus, we reduced the number of configurations for each participant with an orthogonal fractional design exposing each participant to only 16 configurations, consisting of a practice profile as the first configuration to familiarize the participants with the conjoint procedure, four replicated profiles to estimate the test-retest reliability of participants, which were not included in the main analysis (Patzelt & Shepherd 2016), and eleven regular configurations.

Control variables

We include a range of control variables; specifically, gender, age, education, migration background, previous entrepreneurial activity, entrepreneurial experience, personal network, whether having children, risk tolerance, and influences by covid-19.

These control variables have been shown to be relevant. Abreu & Grinewich (2017) suggest that gender accounts for differences in academic opportunity perception. Age is a critical control for entrepreneurial decision-making (Hayter 2015). Education also is likely to play into entrepreneurship decision-making (Hossinger et al. 2021), and people with a migration background tend to be more involved in entrepreneurial activities (Hossinger et al. 2021). Furthermore, the participants' previous entrepreneurial activities were considered. People with entrepreneurial experience tend to approach entrepreneurial issues and challenges repetitively and more routinely (Abreu & Grinevich 2013). In addition, we controlled for the entrepreneurial interest of the makers and the likelihood that they would start a business within the next two years. We also controlled for the personal network of the makers, because a well-connected network could affect the evaluation of an entrepreneurial opportunity (Moog et al. 2015) and whether the family situation of the respondent involved children.

Especially risk tolerance is a critical control. People with a higher risk tolerance tend to be more entrepreneurially active and therefore tend to evaluate entrepreneurial opportunities more positively than more risk-averse people (Hayter 2015). Thereby, the three dimensions (finances, career, and personal life) were considered (and consistent with the literature each dimension was measured on an 11-point Likert scale, see Dohmen et al. 2011). In addition, we controlled for the impact of the covid-19 disease. Finally, we controlled for makerspace size because larger makerspaces tend to offer more tools and services and have a stronger commercial orientation than smaller makerspaces. Table 42 shows descriptives and pairwise correlations of our control variables and our dependent variable. (see Table 60 in the appendix for further correlations).

Method of data analysis

In line with the literature on metric conjoint analysis (Rao 2013; Lohrke et al. 2010), we analyzed the data with an ordinary least squares (OLS) regression with clustered standard errors on the participant level. Participants' decisions regarding opportunity attractiveness served as our dependent variable, and the attribute levels represented our independent variables.

Table 42: Correlation matrix and summary statistics

Variables	**Mean**	**S.D.**	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)
(1) Opp. attr.	3.29	1.27																							
(2) Age	29.9	9.18	-.04																						
(3) Female	0.19	0.39	-.02	**-.12**																					
(4) Immigration background	0.18	0.38	.02	**-.09**	**.10**																				
(5) Children (no/yes)	0.15	0.35	-.02	**.58**	**-.10**	**.06**																			
(6) Occupation: student	0.50	0.50	.01	**-.42**	.02	**.14**	**-.34**																		
(7) Employment risk-taking	7.13	2.30	.03	**-.12**	**-.08**	**-.08**	-.01	**.07**																	
(8) Financial risk-taking	5.66	2.64	.05	**-.06**	**-.24**	-.01	-.01	.04	**.58**																
(9) Maker experience	4.04	3.38	.02	**.42**	**-.24**	-.03	**.27**	**-.40**	**-.11**	-.03															
(10) Number of prototypes	3.49	1.43	.02	**.24**	**-.23**	-.02	**.12**	**-.17**	.03	**.05**	**.64**														
(11) Time in makerspace/week	5.69	4.79	-.02	**.09**	**-.13**	**-.06**	**.09**	**-.12**	**.07**	**.08**	**.30**	**.36**													
(12) High network quality	0.33	0.47	-.02	-.04	**-.08**	-.03	**.04**	.03	**.23**	**.09**	**-.15**	**.05**	.01												
(13) Entrepr. interest	3.27	1.13	**.06**	**-.22**	**-.08**	-.02	**-.17**	-.03	**.42**	**.35**	-.02	**.10**	**.21**	**.21**											
(14) 2 yrs founding prob.	2.76	1.31	.05	**-.12**	**-.06**	**.10**	**-.06**	**.06**	**.38**	**.40**	**-.06**	**.06**	**.17**	**.30**	**.71**										
(15) Reason to use: hobby	0.63	0.48	.04	**.07**	**-.22**	**-.08**	-.01	.01	**.05**	-.04	**.22**	**.13**	.03	**-.06**	**.08**	**.11**									
(16) Reason to use: job	0.24	0.42	-.03	**.14**	-.02	.04	**.05**	**-.22**	**-.05**	.02	**.21**	**.22**	**.11**	**-.05**	-.02	**.05**	-.01								
(17) Reason to use: entrepr.	0.17	0.38	-.01	**.08**	.01	.02	**.12**	**-.20**	**.13**	**.20**	-.04	**.06**	**.21**	**.14**	**.33**	**.28**	.01	.01							
(18) Covid-19 impact	2.69	1.06	-.02	**-.07**	**.06**	-.03	**.06**	**-.11**	**-.07**	**-.07**	.01	.01	**.17**	**-.05**	**.11**	.04	**-.08**	**.05**	**.05**						
(19) Education: business	0.16	0.37	.01	**.10**	**.08**	**.05**	**.09**	**.06**	**.10**	**.15**	**-.13**	**-.12**	**-.15**	**.13**	.01	**.08**	**-.06**	**-.24**	**.15**	.02					
(20) Education: STEM	0.61	0.48	-.01	**-.14**	**-.24**	**.08**	**-.12**	**.20**	.03	**.09**	.04	**.12**	.04	**.11**	**.07**	**.14**	.03	**.07**	**-.12**	.03	**-.16**				
(21) Education: IT	0.38	0.48	**.07**	**-.06**	**-.12**	**.04**	.01	.03	**.13**	**.11**	.02	**.08**	**.06**	-.03	**.11**	.01	**.12**	**-.16**	-.02	**-.06**	**.17**	**-.29**			
(22) Education: craftmanship	0.08	0.28	.02	**.16**	**-.15**	-.02	.01	**-.12**	**.09**	.01	**.17**	**.16**	**.16**	.03	**.06**	**.06**	**.09**	**.23**	**.05**	**.10**	**-.14**	**.05**	**-.15**		
(23) Education: other	0.18	0.38	-.02	**.22**	**.19**	**-.08**	**.06**	**-.11**	-.02	**-.15**	**.05**	-.04	**-.05**	.01	**-.11**	**-.08**	**.07**	.01	-.02	**.16**	**-.16**	**-.25**	**-.14**	**.04**	
(24) Big makerspace	0.47	0.49	.01	**-.11**	**.08**	**-.11**	.01	**-.07**	**.20**	**.05**	**-.14**	**-.15**	**-.06**	**.11**	**.21**	**.19**	**.09**	**-.32**	**.12**	-.04	-.03	**.06**	**.14**	**-.25**	**-.08**

Notes: All bold correlation coefficients are significant at $p < 0.05$. S.D.=Standard Deviation. N=144; Age, maker experience, and time in makerspace per week are converted into metric variables. Education and Reason to use are binary variables.

9.4 Results

Four participants of our original sample of 148 did not respond reliably and had no variance in their answers and were omitted from the analysis. The remaining 144 participants spent an average of 17.3 minutes (SD = 4.26) completing the questionnaire and conjoint experiment.

9.4.1 Survey results: Who are the active makers in university-based makerspaces?

The analysis of our survey data provides insights regarding the characteristics of academic makers, their motivations in engaging in making-related activities as well as their entrepreneurial activities and interests.

General characteristics of makers in university-based makerspaces

We find that the majority of the participants have an educational background in information science and digitization, followed by research and development and engineering and construction design, and less in finance and law. Many of them are students pursuing technically oriented fields of study. Moreover, we find that academic makers use academic makerspaces to build prototypes or produce small product batches. Most academic makers have been active makers for three to four years, spending up to four hours per week in the makerspace and having developed four or more prototypes. Most of the makers indicated that they personally benefited from the makerspace during their maker projects. In addition, we find that half of the respondents identify as part of the Maker Movement and occasionally collaborate with members of the community.

Motives for makers to be active in university-based makerspaces

Table 43 presents the mean importance values and standard deviations of the motivation dimensions. We find that makers' most important motive is learning (mean = 4.60). The motive of becoming an active innovator (mean = 4.23) and autonomy (mean = 4.20) rank second and third, respectively. Recognition (mean = 3.23) and financial motive (mean = 3.35) are of the lowest importance for the makers.

Table 43: Maker motivations of academic makers

Motivation	Mean	S.D.	α	Items
Learning	4.60	0.48	0.79	I want to empower myself to do things I couldn't do before. I want to learn to use technologies and tools. I want to achieve important know-how.
Become an active innovator	4.23	0.77	0.77	I want to influence things through my innovations. I want to create an idea for a product. I want to be innovative and work with the newest technologies.
Autonomy	4.20	0.73	0.58	I want to practice my own approach regarding work. I want greater personal flexibility for my life. I want to empower myself to do things I couldn't do before.
Problem-solving	4.14	0.68	0.58	I want to approach problems on my own. I want to solve a social/societal problem. I want to work on unsolved challenges.
Self-realization	4.00	0.58	0.48	I want to learn and grow as a person I want to become more attractive to potential employers. I like to challenge myself.
User-Innovation	3.93	0.75	0.53	I want to create things myself instead of buying them. I want to modify existing things (products, programs, etc.) and adapt them to my own needs. I want to improve existing things (products, programs, etc.).
Community	3.84	0.76	0.66	I want to work on projects together with others. I want to share my knowledge with others. I want to be part of a community.
Financial	3.35	1.01	0.77	I strive for great wealth and a high income. I am aiming for a higher personal income. Financial security is important to me.
Recognition	3.23	0.91	0.60	I strive for recognition in my community. I want to achieve a superior status in society. I want to achieve something and be noticed in return.

Notes: Mean of the importance of each motivation, measured on a Likert-scale from 1 (not important at all) to 5 (very important); S.D.=Standard Deviation; α=Cronbach's alpha

Entrepreneurial interest and activities among makers in university-based makerspaces

We find that approximately one-quarter of the respondents had founded one or more companies and three out of four of these companies are still active at the time of the survey (see Table 59 in the appendix for more information). Investigating the entrepreneurial potential of the makers, we found that two-thirds of the respondents have an entrepreneurial idea (see Figure 27) resulting from their making-related

activities. Consistent with that, three-quarters of the makers regularly think about engaging in entrepreneurial activities (see Figure 28).

Figure 27: Academic makers with entrepreneurial ideas

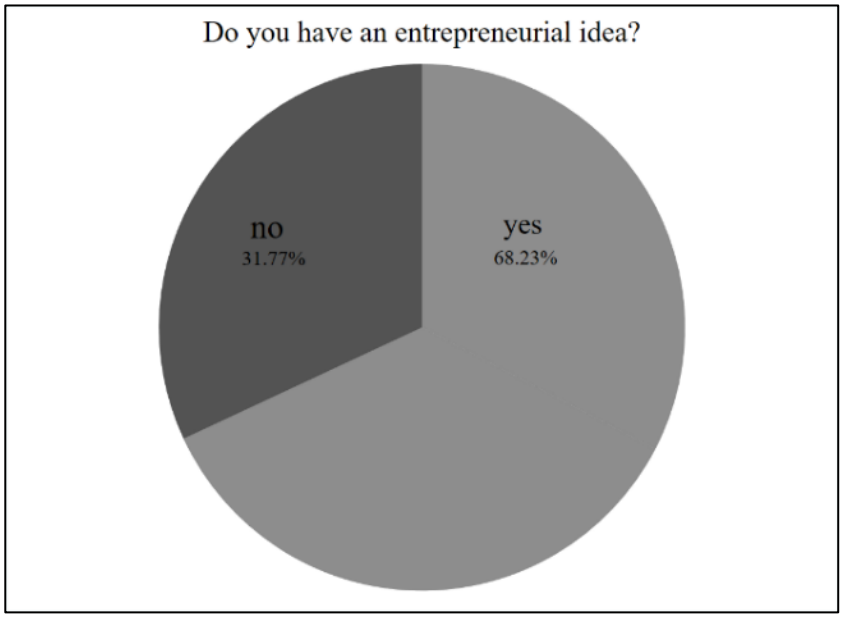
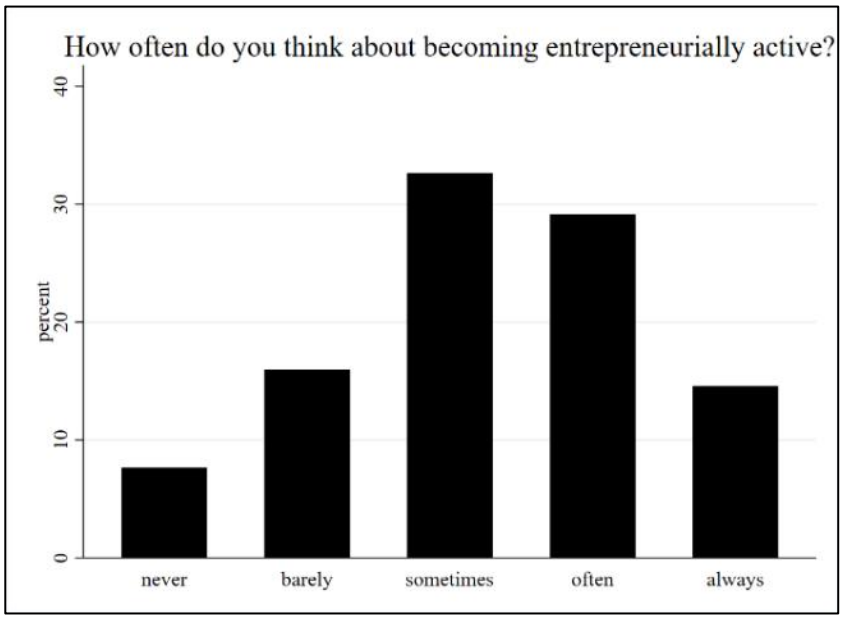


Figure 28: Entrepreneurial interest of academic makers



9.4.2 Results of conjoint analysis: Importance of opportunity attributes for makers

To address entrepreneurial opportunity evaluation by makers, we used our conjoint experiment data and conducted a linear (OLS) regression analysis with clustered standard errors to investigate the effects on entrepreneurial opportunity evaluation (see Table 44). The design of our experiment resulted in 1,626 total observations from 144 respondents.[17]

Reliability of conjoint decision-making is accounted for by test-retest checks (Shepherd & Zacharakis 1997). All respondents were significantly reliable in their responses ($p < 0.05$) with a mean test–retest correlation of .85, which is comparable to other studies (e.g. Shepherd & Zacharakis 1999).

[17] As part of our iterative development process, the conjoint design was slightly adjusted after the first makerspace had been surveyed and featured one task less per participant, resulting in N=1,626.

Table 44: Regression model on opportunity evaluation of academic makers

Model	**(1)**		**(2)**		**(3)**	
Mode	Control variables		Conjoint attributes		CV + attributes	
Statistic	**Coeff.**	**(Std. err.)**	**Coeff.**	**(Std. err.)**	**Coeff.**	**(Std. err.)**
Control variables						
Age	-0.012**	(0.006)				
Female	0.113	(0.094)			0.187*	(0.095)
Immigration backgr.	-0.021	(0.093)			-0.014	(0.091)
Children (no/yes)	0.012	(0.138)			0.121	(0.135)
Married	0.150*	(0.081)			0.110*	(0.081)
Occupation: student	0.059	(0.096)			0.039	(0.103)
Occupation: employed	0.117	(0.105)			0.115	(0.108)
Employed risk-taking	-0.018	(0.019)			-0.021	(0.019)
Financial risk-taking	0.028**	(0.014)			0.028**	(0.014)
Private risk-taking	-0.072	(0.017)			-0.056	(0.017)
Maker experience	0.006	(0.015)			0.005	(0.015)
Number of prototypes	0.030	(0.027)			0.031	(0.028)
Time in makerspace	0.004	(0.009)			0.001	(0.008)
High network quality	-0.148*	(0.077)			-0.126	(0.078)
Entrepr. interest	-0.025	(0.049)			-0.004	(0.051)
2 years founding prob.	0.029	(0.037)			0.016	(0.038)
Reason to use: hobby	0.284***	(0.085)			0.282***	(0.089)
Reason to use: job	-0.090	(0.093)			-0.074	(0.092)
Reason to use: entrepreneurial	-0.047	(0.120)			-0.032	(0.120)
Covid-19 impact	-0.016	(0.035)			-0.015	(0.036)
Big makerspace	0.048	(0.089)			0.025	(0.086)
Maker motiv. (9 var.)	p=0.015					
Fields of edu. (6 var.)	p=0.122					
Conjoint attributes						
Medium market pot.			0.754***	(0.058)	0.758***	(0.058)
High market pot.			1.246***	(0.071)	1.247***	(0.071)
(ref.: low mark. attr.)						
Medium IPR protection			0.356***	(0.050)	0.359***	(0.051)
High IPR protection			0.472***	(0.063)	0.476***	(0.063)
(ref.: low IPR prot.)						
Medium tech. challenge			0.025	(0.058)	0.026	(0.058)
High tech. challenge			-0.029	(0.077)	-0.027	(0.079)
(ref.: low tech. chall.)						

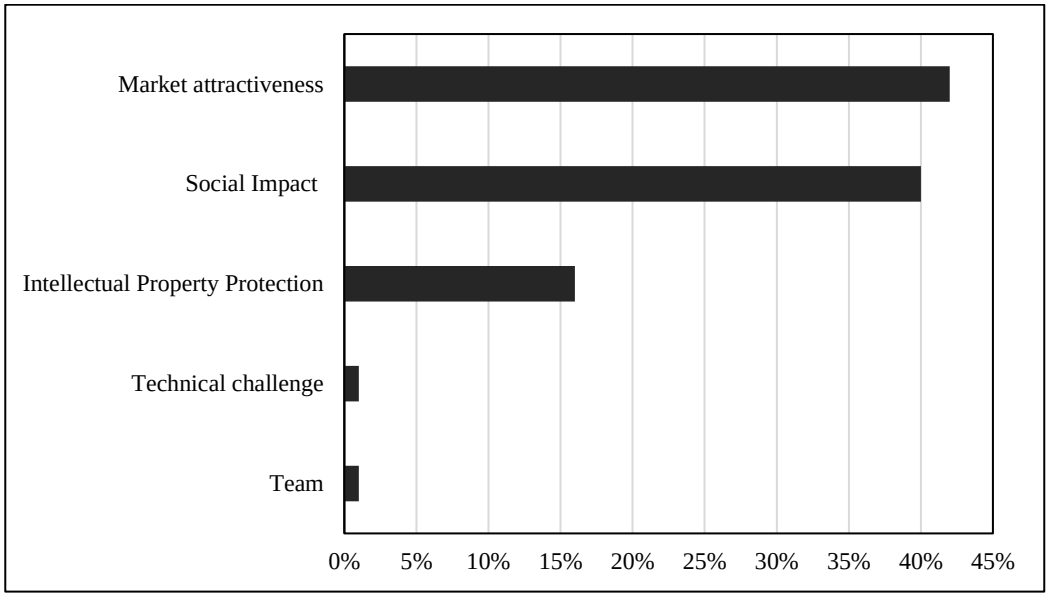
Table 45 (continued)

Medium social impact		0.543***	(0.059)	0.539***	(0.059)
High social impact		1.173***	(0.072)	1.175***	(0.072)
(ref. group: low)					
Team partner eco. background		-0.108	(0.076)	-0.111	(0.076)
Team partner tec.background		0.021	(0.061)	0.015	(0.062)
(ref.: no team partner)		0.754***	(0.058)	0.758***	(0.058)
Observations	1,626	1,626		1,626	
Respondents	144	144		144	
R^2	0.035	0.315		0.349	
adj. R^2	0.013	0.311		0.331	
F-value (Prob > F)	3.16 (0.000)	86.65 (0.000)		26.53 (0.000)	

To compare the attributes, we first zero-centered the values for each attribute of each respondent. Second, we measured the range (the distance between the lowest and highest value of each attribute level) to evaluate the effect of a change in an attribute's level on the total attractiveness of a specific opportunity. Third, the range of each attribute is divided by the sum of all ranges to calculate its relative importance.

Model 3 in Table 44 shows the results and Figure 29 shows the direct comparison of the attributes. The two most important attributes are market attractiveness and social impact, together explaining almost 85% of the decisions. Protection of intellectual property rights (IPR) does also have a significant positive impact on the evaluation, explaining more than 15% of the variance in decision-making. In contrast, we find that technical challenge and team constellation do not have a significant impact on the evaluation of an entrepreneurial opportunity (both are insignificant in the regressions in Table 44).

Figure 29 Relative importance of conjoint attributes (academic makers)



Note: Calculated based on the coefficients of the regression model (Model 3 in Table 44).

Source: Own illustration.

Regarding our control variables, we found effects for age, the reasons to use a makerspace, financial risk-taking ability, the field of education as well as the motivation to engage in making activities. Increased age leads to an overall more negative evaluation of the attractiveness of entrepreneurial opportunities. Interestingly, we find that participants using the makerspace as part of their hobby evaluate entrepreneurial opportunities better. In addition, we find that a higher financial risk-taking ability increases the overall attractiveness of opportunities. Participants with an educational background in craftsmanship tend to evaluate entrepreneurial opportunities to be more attractive than participants from other fields of education (such as STEM or IT). Regarding different motivation dimensions, the recognition motive increases overall opportunity evaluation while self-realization slightly decreases it. Overall, we find few and mostly weak effects of our control variables.

Next, we investigated the moderation of different forms of maker experience and entrepreneurial activities on the evaluation of entrepreneurial opportunity evaluation. Therefore, Table 45 shows the results of each attribute level interacting with maker experience, time invested with making, and entrepreneurial interest as well as experience as a founder.

Table 45: Moderation of opportunity attributes (academic makers)

Model	(1)	(2)	(3)	(4)
Moderator	Weekly time spent	Maker experience	Own entrepreneurial experience as a founder	Entrepreneurship intention
Opportunity attribute	Coeff. (SE)	Coeff. (SE)	Coeff. (SE)	Coeff. (SE)
High market pot.	-0.033 (0.036)	0.039 (0.021)*	0.078 (0.167)	0.114 (0.061)*
Medium market pot.	-0.002 (0.031)	-0.022 (0.017)	-0.050 (0.144)	0.110 (0.044)**
High IPR prot.	-0.070 (0.033)**	-0.052 (0.018)***	-0.156 (0.127)	0.006 (0.053)
Medium IPR prot.	0.009 (0.030)	-0.011 (0.015)	-0.207 (0.115)*	0.008 (0.043)
High tech. challg.	0.108 (0.039)***	0.039 (0.021)*	-0.460 (0.174)***	-0.028 (0.070)
Medium tech. challg.	0.086 (0.029)***	0.028 (0.016)*	-0.375 (0.150)**	-0.005 (0.051)
High social impact	0.032 (0.036)	-0.004 (0.021)	0.099 (0.194)	-0.078 (0.060)
Medium soc. impact	-0.017 (0.029	-0.027 (0.017)	0.207 (0.149)	-0.002 (0.051)
Economic team part.	-0.042 (0.036)	-0.042 (0.022)*	0.210 (0.138)	-0.046 (0.073)
Technical team part.	-0.059 (0.033)*	-0.051 (0.019)***	0.286 (0.149)*	0.017 (0.055)
Control variables	Yes	Yes	Yes	Yes
N (observations)	1,626	1,626	1,626	1,626
N (participants)	144	144	144	144

Notes: Regression type: OLS Regression Dependent variable: Opportunity attractiveness, evaluated by the decision maker. In Model 1-4 each attribute level interacts with another variable (e.g. motivation dimension). The main effects are included in the estimation but are omitted for reasons of brevity so that the coefficients displayed here only refer to interaction effects; Coeff.=Coefficient SE=Standard Error; *p < 0.10, ** p < 0.05, *** p < 0.01.

Observing the interaction effects enables us to explore the individual differences of the participants impacting their opportunity evaluation decisions. Models 1 and 2 show the results of the interaction effects between the weekly time investment for "making" and experience as a maker with each opportunity attribute, both variables can be seen as indicators for involvement in making and show consistent results. Participants that spend much time in the makerspace, as well as participants with high experience, rate opportunities with increased technical challenges more attractive. At the same time, this group is rather critical of the restrictions imposed by intellectual property rights. This reluctance may originate from open source ideology among experienced makers.

Regarding the entrepreneurial experience, we find that participants who approach the makerspace with a higher level of interest in entrepreneurship attribute higher importance to market potential (Model 4) and desire a technical challenge as less attractive for an entrepreneurial opportunity (Model 3).

9.5 Discussion

We used a survey and a conjoint experiment to provide insights into the characteristics and motivation of makers and their relationship to entrepreneurial opportunities. We point out the general importance of the opportunity attributes social impact, market potential, and intellectual property rights protection as conditions for an attractive entrepreneurial opportunity. We also show individual differences driven by makers' experience as makers and their entrepreneurial experience.

9.5.1 Contribution to the literature

Our study provides several theoretical contributions. First, with our large-scale study, we contribute insights to the small but growing Maker Movement literature (Halbinger 2018; Hausberg & Spaeth 2020) by providing quantitative evidence regarding maker characteristics, motivations, and entrepreneurial interests and activities. Specifically, we add to the literature by focusing on makers in academic makerspaces and indicate that here a high share of students is present and that makers are generally highly educated. We also link this literature to the entrepreneurship literature by shedding light on makers' motivations and their judgment of opportunity attractiveness.

Second, we contribute to accounts that conceptualize the importance of the Maker Movement for entrepreneurial activities (Browder et al. 2019). Our empirical insights show the differences in the importance of attributes. Specifically, we identify the most important drivers to be social impact and market potential as two inherently different attributes, one focusing on social impact, the other directly hinting at commercialization. Especially social impact is an overlooked driver of opportunity evaluation (Langley et al. 2017; Millard et al. 2018). Overall, our empirical insights draw a more comprehensive and nuanced picture of the relationship between "making" and entrepreneurship.

Third, next to contributing to the Maker Movement literature, our study also has implications for the broader literature on entrepreneurial opportunities (Archdichvilli et al. 2003; Shane 2000; Haynie 2009). We expand the literature on opportunity evaluation of different entrepreneurially relevant groups like nascent entrepreneurs (Dimov 2010), serial entrepreneurs (Ardichvilli et al. 2003), or social entrepreneurs (Robinson 2006) by providing insights into the cognitive processes in terms of entrepreneurial opportunity evaluation among an entrepreneurially relevant group: makers. Moreover, we add to research regarding the relevance of different attributes within opportunity evaluation. Thereby, we quantitively support the relevance of opportunity attributes such as market potential (Welpe et al. 2012) and intellectual property rights (Choi & Shepherd 2004). In addition, we empirically show that social impact is an important opportunity attribute for makers while we don't find significant effects of technical challenges or project partners.

Finally, we support the perspective that "making" can have non-commercial and commercial benefits that are related with each other and overlap (Browder et al. 2019; van Holm 2015). We find that intrinsic motivations—learning and autonomy—are main drivers for non-commercial "making". Thus, we mainly support prior research that emphasizes the importance of intrinsic motives like self-fulfillment and fun while also pointing out the relatively minor importance of monetary interest for non-commercial "making" (Mauroner 2017). However, we add to the research regarding the compatibility of non-commercial and commercial "making" by evaluating the potential of commercial project-outcome, makers do perceive financial attributes like market potential and intellectual property rights as important attributes for their decision, even though they are not considered as important for non-commercial "making" (Langley et al. 2017).

9.5.2 Practical and policy implications

Our findings provide several practical and policy implications for universities and policymakers. First and most important, our findings have direct implications for the implementation of makerspace strategies within universities. As makerspace promise great potential for academic entrepreneurship efforts, many universities are currently seeking to embed makerspaces as part of their entrepreneurship activities. A major challenge still lies in the transition of maker activities into entrepreneurial activities.

One way to tackle these challenges is by setting a stronger focus on potential societal impacts. We found that societal impact is a main driver (only second to market potential). Involving educators in particular from social entrepreneurship, in contrast to entrepreneurship in general, could help mobilize makerspaces' potential in producing startups.

We demonstrate that academic makers have heterogeneous motivations. University administrators should clearly define if their makers spaces and associated offers are rather focused on learning-oriented (non-commercial) or entrepreneurship-oriented (commercial) outcomes and individuals when designing makerspaces and related programs. Currently, most makerspaces are focused on STEM-related study programs and tech-savvy individuals and emphasize the technological potential and opportunities. Our research shows that this should be complemented with a communication of the (social) impact that makerspaces can help to generate. This way, makerspaces can realize their full potential as a tool to foster academic entrepreneurship.

9.5.3 Limitations and future research avenues

Our study has several limitations. One general limitation of conjoint experiments is that they may not accurately reflect the complexity of real-world decision-making, as they typically involve presenting consumers with simplified choice scenarios. However, compared to other methods, conjoint analysis still provides the best approximation due to its use of indirect interrogation. Nevertheless, future research could test further opportunity attributes in order to understand their impact on opportunity evaluation within the Maker Movement.

Another limitation of our study is the exclusive focus on the opportunity evaluation scenario. This allows us only to investigate a single step of the entrepreneurial opportunity process–opportunity evaluation–while not considering opportunity exploitation. This leaves open questions such as in which conditions makers (also, what kind of makers?) start a business and what kind of business do they start?

Following this, we provide future research avenues for scholars. First, while our study focused on the evaluation of entrepreneurial opportunities, we encourage future research to investigate the exploitation of entrepreneurial opportunities through

(academic) makers. As such, this is an important effort to map the entire process from entrepreneurial opportunity to entrepreneurial activity within the Maker Movement. Second, scholars should study the impact of influencing factors–like entrepreneurship policies and academic ecosystems–of universities on makerspaces. Finally, but most important, we emphasize the need of opening a new research agenda regarding academic makerspaces and their linkage with social entrepreneurship. Our empirical data point to an exciting relationship that is worth further exploration in the future.

10 Conclusion, discussion and limitation

10.1 Summary of results

Using a qualitative and quantitative empirical investigation of makerspaces in Germany, this thesis intended to provide a status quo overview of the Maker Movement, its characteristics and its relationship to entrepreneurship. Thereby, this dissertation identified several key results (see Table 46) in four areas: maker characteristics, decision criteria, maker identities and academic makers.

Table 46: Summary of the main findings

RQ	Summarized results
RQ1	• Makers are male, well-educated, full-time employees with an educational background in technical fields like STEM or information technology. On average they are active as a maker for 3-4 hours per week with an experience of three to four years as makers.
RQ2	• About one third of the makers did start a business. In addition, two thirds of respondents do have entrepreneurial ideas. The majority of makers produces four or more prototypes (mainly hardware and software) on average.
RQ3	• Learning, autonomy and problem-solving are the most important motivations for makers to engage in "making".
RQ4	• The most important opportunity attributes for makers are: (1) market potential (2) social impact and (3) protection of intellectual property rights. No significant effects were found for the attributes: team partner and technical challenge.
RQ5	• I find several interaction effects that have impact on the evaluation of the opportunity attributes (e.g. maker experience, gender, etc.). The strongest effect is apparent the image of entrepreneurship.
RQ6	• Identification of three maker identities: technical, social and economic. Technical makers, which represent the majority of makers, are mainly motivated by learning. Social makers value community and team partners. Economic makers value motivations with regard to financial and self-realization.
RQ7	• Technical makers perceive technically challenging opportunities as more attractive, while economic makers prefer high market potential. In addition, social makers rate opportunities with social impact and team partners as more attractive.
RQ8	• We find that academic makers are mostly from technical fields of education and are primarily motivated by learning, autonomy and innovation.
RQ9	• Both, market potential and social impact make an entrepreneurial opportunity attractive for academic makers. Exploring the heterogeneities of academic makers shows that highly involved and experienced makers prefer technically challenging opportunities and attribute a lower importance to intellectual property rights. In addition, entrepreneurial interest of makers increases the perceived attractiveness of opportunities with high market potential while founders avoid technical challenge.

10.1.1 Chapter 6: Maker characteristics

RQ1: *What are the demographic characteristics of makers?*

Chapter 6 investigates the characteristics of the individuals involved in the Maker Movement: makers. Regarding the demographic characteristics I find that the majority of makers are male, well-educated, full-time employees with an educational background in technical fields like STEM or information technology. Looking at the experience as a maker, most makers have been active for 3-4 years and are invest approximately four hours per week for their "making" activities. Thereby, most makers produced four or more prototypes. A majority identifies rather loosely with the Maker Movement, however, considers makerspaces to be a value-creating chance for participation.

RQ2: *Which entrepreneurial activities and interest are present among makers in makerspaces?*

Looking at the entrepreneurial experience of makers in the sample, I find that about one third already did start a business. In addition, two thirds of the respondents do possess entrepreneurial ideas. While makers on average stated that they think frequently about entrepreneurial activity, only a minority of makers can envision self-employment within the next two years. On average, a mainly positive image of entrepreneurship was observed. However, both very positive and very negative viewpoints are expressed. These disparities become clearly apparent within the assessment of entrepreneurial opportunities.

RQ3: *What are the main motives for makers to be active in makerspaces?*

Learning, autonomy and problem-solving are the most important motivations for makers to engage in "making". In contrary, financial and recognition are the least important motives for makers.

10.1.2 Chapter 7: Decision criteria

RQ4: *Which attributes matter to the makers when they evaluate the attractiveness of entrepreneurial opportunities?*

Chapter 7 investigates the opportunity evaluation behavior of makers regarding entrepreneurial opportunities they face within their activity as a maker. Based on findings from the literature and interviews conducted as part of this research project, five attributes were identified that best represent an entrepreneurial opportunity for makers. In a metric conjoint experiment, the relevance of the attributes market potential, protection of intellectual property rights, social impact, technical challenge and team partners was measured with regard to their impact on the perceived attractiveness of an entrepreneurial opportunity. As a result, I found that market potential and social impact are by far the most important attributes for the attractiveness of an entrepreneurial opportunity among makers. Followed by protection possibilities of intellectual property rights. In addition, technical challenge and project team were found to have no significant impact on the attractiveness rating of an entrepreneurial opportunity.

RQ5: *How do individual characteristics, motivations and affect the evaluation of entrepreneurial opportunities?*

Besides the described main effects, I could observe interaction effects with motivations, entrepreneurial experience and further maker characteristics that had impact on opportunity evaluation. For instance, I find that experienced makers prefer entrepreneurial opportunities that are highly technically challenging, whereas female makers perceive opportunities more attractive when they offer protection of intellectual property rights and potential team partners.

10.1.3 Chapter 8: Maker identities

RQ6: *Which maker identities can be derived from the different motivations and characteristics of makers?*

Within this dissertation I identified three maker identities: technical, social and economic. Thereby, the majority of makers identifies themselves strongest with the technical identity, followed by the social and financial identity. Moreover, I was able to show that the individuals associated with these identities are driven by different motivations in order to be a maker. Thereby, technical makers are mainly motivated by learning, innovation and user-innovation, whereas social makers are driven by being part of the maker community and desire to solve problems. In contrary, makers with a financial identity are rather self-focused and are motivated by self-realization and financial aspects.

RQ7: *How do the different maker identities affect the evaluation of entrepreneurial opportunities?*

Finally, I investigated the impact of the three maker identities on the evaluation of entrepreneurial opportunities. The results did show significant results regarding the opportunity attributes. For instance, makers with a technical identity rated opportunity more attractive when they were technical challenging, economic makers preferred high market potential and social makers put value on having team partners.

10.1.4 Chapter 9: Academic makers

RQ8: *What are the characteristics, entrepreneurial interest and motives of academic makers in university-based makerspaces?*

Academic makers are typically technically focused students or employees (likely employed within universities as well) who possess or aspire to a high level of education. In addition to a larger share of students in the university-based sample, differences to the overall data set can be observed, in particular, in the motivation to be active as a maker. The desire to actively participate in innovations and to become more autonomous and the intention to realize themselves is stronger among academic makers.

RQ9: *Which attributes matter to the academic makers when they evaluate the attractiveness of entrepreneurial opportunities?*

Regarding the evaluation of entrepreneurial opportunities, only minor differences were found for makers in university-based makerspaces. The prioritization of attributes is the same as for the overall data set: Market potential, social impact, protection of intellectual property rights, team partner and technical challenge (see Chapter 10.1.2 and Chapter 7 for detailed information).

10.2 Implications for theory

This dissertation provides several theoretical implications. First, with this large-scale study, it contributes empirically to the broader Maker Movement literature by providing quantitative evidence regarding maker characteristics, motivations and their entrepreneurial interest and activities. (Halbinger 2018; Hausberg & Spaeth 2020) Moreover, this thesis introduces a first approach to clustering the broad heterogeneity within the Maker Movement by identifying different identities (Maker Media Inc. & Intel Inc. 2012).

Second, by providing empirical evidence for the conceptual model by Browder et al. (2019) regarding the linkage of the Maker Movement and entrepreneurship, this dissertation contributes to the existing understanding of the relationship between non-commercial and commercial (resp. entrepreneurial) project outcomes. By

identifying social impact and market potential as central aspects for the evaluation of entrepreneurial opportunities within the Maker Movement, this study expands this conceptual model by adding important aspects for the transition between non-commercial and commercial outcomes. Consequently, it draws a more comprehensive and nuanced picture of the relation of "making" and entrepreneurship by providing empirical evidence for the importance of different attributes, adding to the conceptual model. In addition, I quantitatively support first indications within research that the Maker Movement contributes to sustainability and social entrepreneurship, by showing the importance of social impact for makers when evaluating entrepreneurial opportunities (Millard et al. 2018).

This dissertation supports the perspective by prior research that "making" has non-commercial and commercial outcomes that are related (van Holm 2015; Browder et al. 2019a) but based on the results I argue that, in addition, the motivations and relevant aspects for non-commercial and commercial outcomes have to be considered separately and, in more detail. For instance, I find that intrinsic motivations – learning, autonomy, and the aim to actively engage in innovation – are main drivers for non-commercial "making", whereas learning is not considered less important for commercial projects. In addition, we support prior research that emphasizes the importance of intrinsic motives like self-fulfillment and fun while also pointing out the relatively minor importance of monetary interest for non-commercial "making (Mauroner 2017; Mersand 2021). However, the study adds to research regarding the compatibility of non-commercial and commercial "making" by evaluating the potential of commercial project-outcomes, makers do perceive financial attributes like market potential and intellectual property rights as important attributes for their decision, even though they are not considered as important for non-commercial "making" (Langley et al. 2017).

Next to contributing to the Maker Movement literature, this thesis also has implications for the broader literature on entrepreneurial opportunities (Ardichvili et al. 2003; Shane 2000; Haynie et al. 2009). It expands the literature regarding opportunity evaluation of different entrepreneurially relevant subgroups like nascent entrepreneurs (Dimov 2010), serial entrepreneurs (Ardichvili et al. 2003) or social entrepreneurs (Robinson et al. 2006) by providing insights into the cognitive

processes in terms of entrepreneurial opportunity evaluation among an entrepreneurially relevant group: makers. Moreover, the study contributes to research regarding the relevance of different attributes within opportunity evaluation. Thereby, it quantitively supports the relevance of opportunity attributes such as market potential (Welpe et al. 2012) and intellectual property rights (Choi & Shepherd 2004).In addition, the results empirically show that social impact is an important opportunity attribute for makers, while we don't find significant effects of technical challenge or project partners.

10.3 Implications for practice

Overall, the findings in this dissertation provide several practical and policy implications for practitioners in universities, makerspace-environments and policy makers within entrepreneurship and innovation-related disciplines.

Most important, the findings have direct implications for the implementation of makerspace strategies. A major challenge remains the transition of maker activities into entrepreneurial and innovation-oriented activities. One way to tackle these challenges is by setting a stronger focus on potential societal and social impacts. The results show that societal impact is a main driver (only second to market potential). Involving experts in particular from social entrepreneurship, in contrast to entrepreneurship in general, could help mobilize makerspaces' potential in producing businesses.

Another key insight that Maker Movement practitioners should be aware of is the heterogeneity of the makers themselves, but also in terms of the different affiliations of the makerspaces. For instance, the results of the study demonstrate that, on average, makers in academic makerspaces exhibit a higher level of entrepreneurial interest (see Chapter 9). Consequently, those responsible in academic makerspaces might develop their individual strategy for entrepreneurship, while those responsible in other makerspaces should get a sense of which entrepreneurial ambitions prevail in order to promote specific projects and encourage specializations, if applicable.

In this regard, those responsible can draw on the developed maker identities, to get a grasp of the composition of their community. Furthermore, engaging in dialogue with

individuals and obtaining their opinions (e.g., through surveys and feedback opportunities) and taking them into account in an iterative manner is important when building valuable, strong and innovation-oriented communities. However, to look beyond the community and encourage new perspectives, outside input should be facilitated on a regular basis. For instance, this could be a way to create a perspective in which entrepreneurship and the Maker Movement fit together (e.g. through presentations by maker-entrepreneurs) better than this seems to be the case with many makers at this point.

There are also important implications for policymakers who operate outside of makerspaces. For instance, makerspaces should not be equated with incubators or accelerators for tech startups. These expectations of structured entrepreneurship promotion are unlikely to be matched directly by makerspaces. Instead, makerspaces possess different strengths and can unleash innovation potential if they are properly targeted and intensified. Thus, the findings on motivations and entrepreneurial ambitions can contribute to this process as well. Furthermore, bureaucratic burdens on technical projects should be reduced in order to facilitate the entry of makers into entrepreneurial activities.

In addition, the results provide an opportunity for makers themselves to reflect on their own motivations and identities, as well as their involvement in the Maker Movement and its community. In this way, new perspectives on entrepreneurship and innovation may emerge, as well as opportunities to become active in it.

Furthermore, this work is intended to motivate makers to express and present themselves to the outside world more powerfully, in order not to be further defined by external factors - i.e. by political decision-makers or marketing brand campaigns, in order to be perceived as the strong movement and community, the Maker Movement really is.

10.4 Limitations

As with any work of scholarship, this thesis has some limitations. Some of these are due to the novelty of the Maker Movement phenomenon. As with other emerging phenomena, the field of the Maker Movement is still undergoing various changes that reduce the long-term transferability of the findings and encourage future replication research and in-depth studies. For example, in German-speaking countries, the term Maker Movement is still not well known among people involved in the field of entrepreneurship and even sometimes within makerspaces. Furthermore, the German language contains many terms in the context of the Maker Movement, some of which have different meanings and create boundaries that do not or only partially exist in the sense of the Maker Movement. However, new terms are slowly becoming established, at least as synonyms. However, these changes and challenges offer many opportunities for further research in the future. In the following sections, the limitations in different areas of the thesis are discussed in detail.

The sample consisted of individuals active in German makerspaces. Due to the different terminologies used, as well as the lack of public awareness of makerspaces, no reliable information can be provided on how many makerspaces and initiatives were not identified. Nevertheless, the creation of a new list of makerspaces based on established criteria was an important contribution to the literature and the most comprehensive list available. In addition to active makers, there are many other people in the Maker Movement environment. These include policy makers, educators, and the institutions themselves. While these could not be addressed within the scope of this dissertation, they offer exciting opportunities for further research. Additionally, regarding the sample, it is important to note that the relatively large number of cases (n=307) is faced with a high degree of heterogeneity. This can sometimes lead to significant differences in the representation of different types of makerspaces within the sample. Different makerspaces and their members may differ significantly from each other, which is important when considering the representativeness of the results. This may also be a limitation for possible further comparative analysis. At the same time, it must be considered that the German-

speaking Maker Movement sector as a whole is probably still comparatively small, measured in terms of the number of people working and engaging in this field.

These results however, only indicate tendencies and no general statements may be derived regarding the fact that all makers of a certain type decide in a certain way or possess the respective characteristics. Although the chosen methodology of a quantitative study with a conjoint experiment and a questionnaire made it possible to attain a high number of respondents, it was not possible to conduct more detailed investigations of individual components. Moreover, in providing the theoretical foundation of the dissertation, the main focus was given to the Maker Movement. Complementary subjects like entrepreneurial opportunities or social identities, which are indeed important for the skeleton of the work, but not required in detail, were considered at a somewhat superior level.

In keeping with the objective stated above, the level of in-depth analysis of the makerspaces and their thematic focus was likewise limited. Thus, no precise conclusions can be drawn about which tools and facilities are available to the makers on site, or whether there is a thematic focus of the makerspace, or not. This is a matter for future research, which may, for example, aim to identify existing differences or patterns. Another limitation consists in the concentration on German makerspaces, only. However, this was chosen intentionally due to the different development of the Maker Movement in Anglo-Saxon and German-speaking countries as well as the comparatively scarce research on German-speaking Maker Movement research. To date, there is little evidence on whether and to what extent findings from the Anglo-Saxon area can be transferred to the German-speaking area. Consequently, the explorative character of the work contributes towards this aspect as well. Even though the geographical and cultural context was not directly addressed within this analysis, the systematic and empirical research of this dissertation is nevertheless based on the conviction that makerspaces and the people involved as a phenomenon cannot be generalized. Moreover, van Holm (2017) argues that makerspaces emerged as a local phenomenon and do mainly have their strengths within local communities. Thus, it is necessary to consider the interrelationships between local characteristics and prerequisites. Further research in this regard can add important contributions to

the understanding of different micro- and macrogeographic ecosystems in relation to the Maker Movement.

Since conjoint experiments confront respondents with hypothetical decision tasks, they are critiqued for suffering from reality-based decision scenarios. However, the evaluation of profiles has advantages compared to studies and interviews asking for their preferences directly because they minimize biases like “tendency to the top bias” ,“recall bias” and “self-reporting bias” (van den Brink et al. 2001). The construct validity is another limitation that frequently arises when conducting conjoint experiments, because criteria are predefined and not selected or determined by the participants in the questionnaire.

In order to reduce this possible limitation, the criteria were determined through the comprehensive (qualitative) preliminary study prior to the experiment. In other addition, the results of other conjoint studies show that real decisions strongly correlate with the estimated behavior, reducing the external validity problems.

Looking at the selected decision criteria, another limitation may be found in the selected number of five attributes without considering other criteria, for instance worst-case-scenario. However, in order to reduce this possible limitation, we selected the attributes via a combined approach of literature review and interviews. In addition, too many attributes may lead to an overwhelming decision task. Furthermore, a similar understanding of the attributes was regarded as given, supported by short descriptions for each attribute. However, the possibility that respondents had different interpretations of attributes or the dependent variable cannot be fully excluded. The limited scope of the dissertation did not allow to provide extensive descriptions for each attribute and level. Nevertheless, a number of pretests with other researchers and makers was performed to ensure that participants had a similar understanding of the decision scenario and respective tasks.

For the conjoint analysis, a full-profile method was not applied. This decision was made primarily with regard to the possible overwhelming of participants. Furthermore, full-profile methods lead to significantly higher dropout rates, especially with a higher number of scenarios. For the analysis of the data, a choice-based conjoint may provide unambiguous results in some cases. Using a rating-based conjoint on the basis of a Likert scale, deviations in a certain direction and decisions

with regard to attributes may be less noticeable or may become indistinct. In retrospect, a more fine-grained Likert scale might have allowed refined interpretations of the results. Still, the decision to use a metric scale was made intentionally in order to capture the general attitude towards entrepreneurial opportunities. Thus, in reality, there are individuals who generally rate entrepreneurial opportunities higher, or on the other hand, have no interest in entrepreneurial opportunities at all. This option of "rejecting" entrepreneurial opportunities by rating them very unattractive is familiar with a "no-option" which is frequently used in CBC.

10.5 Future research opportunities

This thesis provides several avenues for future research. Chapter 2 provides a comprehensive characterization of the Maker Movement. As part of the Maker Movement, makerspaces play an important role in providing the physical component of the Maker Movement. However, makerspaces have not been studied in detail and have tended to be generalized. Because research on makerspaces is still in its infancy, there are many areas for further research. For example, research needs to understand the differences between makerspaces with different focus areas (e.g., commercial, university-based), numbers of participants, and geographic locations.

Chapter 3 provides a brief overview of current research on entrepreneurial opportunities and empirically applies the evaluation of such opportunities within the metric conjoint experiment. It shows that the characteristics of entrepreneurial opportunities in quantitative studies, especially conjoint experiments, are very diverse. Future research needs to continue to better understand which attributes of entrepreneurial opportunities are important for different types of individuals in different situations. Furthermore, future research should explore the next step, the exploitation of entrepreneurial opportunities by makers.

Chapter 4 draws attention to the motivations of makers to engage in making activities. While this is an important foundation for the empirical analysis that follows, it is not the main focus of this dissertation. While maker motives have been analyzed in many qualitative studies, future research could assess maker motives using quantitative approaches. In addition, scholars should aim to develop a sophisticated scale to measure maker motivation. Although this dissertation

contributes to the body of literature on the Maker Movement and its linkage to entrepreneurship, it became apparent that makerspaces include individuals with several different motivations and goals. However, it may be very interesting to gain a deeper understanding of makers involved in entrepreneurial activities. For this reason, quantitative research on maker-entrepreneurs and their entrepreneurial activities can provide important insights about makers and the entrepreneurial process beyond the evaluation of opportunities. As policymakers and educators put a lot of effort and hope into this phenomenon, this is an important question that needs to be answered.

When makers think about engaging in entrepreneurial activities, open source ideology is an important moderator. This emerged from the literature review and interviews with makers and experts in the field. Therefore, new research should extend the field by investigating the role of open source culture within the Maker Movement.

Chapter 7 examined the assessment of entrepreneurial opportunities by makers. As this is the first study of its kind within the Maker Movement, replication studies are particularly important to increase the validity of the findings. In addition, the importance of additional attributes and the effects in different geographic locations and makerspace settings (e.g., commercial vs. entrepreneurial) need to be explored to gain a deeper understanding of the underlying mechanisms.

Chapter 8 characterized and identified three distinct maker identities. In doing so, future research could use other methodologies to extend the external validity of the study, develop sophisticated scales to access large-scale and longitudinal empirical studies, and ultimately expand the research agenda on maker identities. (See Chapter 8.5.3 for more information).

In addition, the findings derived from Chapter 9 provide areas for future research, including encouraging future research to examine the exploitation of entrepreneurial opportunities by (academic) makers, taking a closer look at the influence of university policies on academic makerspaces, and reemphasizing the research agenda towards linking the Maker Movement and social entrepreneurship.

10.6 Final remarks

This dissertation used an exploratory research approach, through qualitative and quantitative methods, to contribute empirically to theory building in the field of Maker Movement research. Indeed, little was previously known about causes and contexts in the Maker Movement and entrepreneurship landscape. The results presented provide insight and structure for this field of research. Finally, this work offers a foundation for the generation of hypothesis. Specifically, this applies to fostering innovation and entrepreneurship from the Maker Movement environment and promoting these efforts in the public and academic sector.

Overall, this work opens up a broad overview of the Maker Movement and its relationship to entrepreneurship and (social) innovation in Germany, expands the understanding of the different makers, their behaviors, identities and motivations, as well as demonstrates the dynamic development of this movement. While it has certain limitations at various levels, it offers great potential and new directions for future research and practitioners. For people involved in and around the Maker Movement, this project offers an opportunity to take a closer look at what they are currently dealing with. In addition, it offers an opportunity for future approaches to use the synergies of the Maker Movement and (social) entrepreneurship and innovation in several dimensions.

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Appendix

Table 47: Interview guide (german)

Version 1: Makers

Anmerkung:

Ort, Datum, Name und Einverständnis zur Aufnahme werden vom Interviewenden dokumentiert

0.) Eigene Vorstellung und Beschreibung des Forschungsprojekts

Hallo und vielen Dank, dass Sie sich Zeit für ein Gespräch und damit auch für unser Forschungsprojekt nehmen. Mein Name ist Christian Brandstetter, ich bin 27 Jahre alt und ich bin akademischer Mitarbeiter im Team von Prof. Dr. Jeanine von Stehlik an der Dualen Hochschule Baden-Württemberg in Karlsruhe. Gemeinsam mit meinem Doktorvater Herrn Prof. Dr. Block forsche ich in Kooperation mit der Universität Trier im Bereich Macher*innen. Das Forschungsprojekt untersucht dabei die Motivation von Menschen, die etwas schaffen und wie Machen, Innovation und unternehmerische Selbstständigkeit eventuell miteinander zusammenhängen. Um ein besseres Verständnis für die Praxis zu bekommen führen wir viele Gespräche. Sie sind heute aktiver Teil unserer Forschung. Die Ergebnisse der Forschung haben volkswirtschaftliche Relevanz für unser ganzes Land. Wir möchten vorhandene Potentiale besser nutzen und Menschen mit Talenten und Motivation fördern. Vielen Dank, dass Sie dieses Vorhaben mit Ihrer Teilnahme unterstützen.

Haben Sie noch Fragen zum Forschungsprojekt oder zu mir persönlich?

Ansonsten steigen wir direkt ein. Wenn es für Sie in Ordnung ist würde ich Ihnen gerne einige Fragen stellen. Ich bitte Sie, jederzeit offen zu antworten. Es gibt keine falschen Antworten

1.) Eigenschaften als Person

a) Wenn ich Sie als Macher*in anspreche. Was macht das mit Ihnen?

b) Was sind Macher*innen für Sie?

Wie definieren Sie diese?

c) Was hat dazu geführt, dass Sie Macher*in werden konnten?

Gab es ein besonderes Erlebnis, welches dazu geführt hat?

Gab es in Ihrer Familie weitere Menschen, die Dinge geschaffen haben?

2.) Projekte

d) Was machen Sie aktuell? Könnten Sie bitte kurz Ihr momentanes Projekt beschreiben.

e) Was haben Sie früher schon gemacht? Welche Projekte haben Sie bereits durchgeführt?

f) Wo arbeiten Sie (örtlich) an diesen Projekten?

g) Ist Ihnen das Maker Movement bekannt?

(1) Nein: Erklärung dann zu 2.

(2) Ja: Was denken Sie über das Maker Movement?

Welche Rolle haben Sie persönlich, ihrer Meinung nach, im Maker Movement?

3.) Motivation

h) Was motiviert Sie, an ihren Projekten/Projektideen zu arbeiten?

Welche Rolle spielt _____hinsichtlich Ihrer persönlichen Motivation des Machens?

1. Machen an sich	8. Neue Technologien nutzen
2. Möglichkeit etwas zu lernen	9. Eigennutzung von Produkten
3. Gesellschaftliche Attraktivität (Impact)	10. Teil einer Community zu sein
4. Beliebtheit in einer Community	11. IPR (Patente kreieren)
5. Ökonomische Faktoren (Geld verdienen/sparen)	12. Etwas für andere herstellen
6. Ein bestehendes Produkt optimieren	13. Etwas erschaffen
7. Wissen weiterzugeben, anderen bereitzustellen (open source)	

Was fehlt Ihnen noch, wenn wir über Ihre Motivation sprechen?

4.Unternehmertum/Entrepreneurship

i) Wie denken Sie über unternehmerische Selbstständigkeit?

Falls Gründer*in: Wie kamen Sie zu Ihrer Selbstständigkeit?

Was hält Sie ggf. davon ab sich selbstständig zu machen?

Wie müsst eine Selbstständigkeit für Sie persönlich gestaltet sein, um reizvoll zu sein?

j) Wie beurteilen Sie Ihre Projekte im Hinblick auf eine mögliche unternehmerische Selbstständigkeit?

k) Was macht eine Projektidee für Sie unternehmerisch interessant? (ggf. erklären)

Welchen Einfluss hat/haben die _____ im Hinblick auf die Attraktivität einer Projektidee für Sie persönlich, im Kontext der unternehmerischen Selbstständigkeit?

1. Ökonomische Attraktivität	5. Technische Neuartigkeit
2. Möglichkeit etwas zu lernen	6. Zielgruppen/Eigennutzung
3. Gesellschaftliche Attraktivität (Impact)	7. Sichtbarkeit in der Community
4. Kosten der Selbstständigkeit (Geld + Zeit)	8. IPR (Möglichkeiten ihre Idee schützen)

l) Welche weiteren Faktoren würden eine unternehmerische Selbstständigkeit für Sie attraktiv bzw. attraktiver machen?

m) Wenn über Nacht, all das was Ihnen im Bereich des Machertum fehlt, heute Nacht gelöst werden würde, wo wären Veränderungen eingetreten? [Wunderfrage nach Lumann]

Fehlt Ihnen Unterstützung (in einem speziellen Bereich)?

5.) Zum Schluss

n) Was könnte Ihrer Meinung nach für dieses Forschungsprojekt noch relevant sein?

o) Welche Fragen und Anregungen haben Sie abschließend?

Version 2: Experts

Anmerkung:

Ort, Datum, Name und Einverständnis zur Aufnahme werden vom Interviewenden dokumentiert

0.) Eigene Vorstellung und Beschreibung des Forschungsprojekts

Hallo und vielen Dank, dass Sie sich Zeit für ein Gespräch und damit auch für unser Forschungsprojekt nehmen. Mein Name ist Christian Brandstetter, ich bin 27 Jahre alt und ich bin akademischer Mitarbeiter im Team von Prof. Dr. Jeanine von Stehlik an der Dualen Hochschule Baden-Württemberg in Karlsruhe. Gemeinsam mit meinem Doktorvater Herrn Prof. Dr. Block forsche ich in Kooperation mit der Universität Trier im Bereich Macher*innen. Das Forschungsprojekt untersucht dabei die Motivation von Menschen, die etwas schaffen und wie Machen, Innovation und unternehmerische Selbstständigkeit eventuell miteinander zusammenhängen. Um ein besseres Verständnis für die Praxis zu bekommen führen wir viele Gespräche. Sie sind heute aktiver Teil unserer Forschung. Die Ergebnisse der Forschung haben volkswirtschaftliche Relevanz für unser ganzes Land. Wir möchten vorhandene Potentiale besser nutzen und Menschen mit Talenten und Motivation fördern. Vielen Dank, dass Sie dieses Vorhaben mit Ihrer Teilnahme unterstützen.

Haben Sie noch Fragen zum Forschungsprojekt oder zu mir persönlich?

Ansonsten steigen wir direkt ein. Wenn es für Sie in Ordnung ist würde ich Ihnen gerne einige Fragen stellen. Ich bitte Sie, jederzeit offen zu antworten. Es gibt keine falschen Antworten

1.) Eigenschaften als Person

a) Was bedeutet das Maker Movement für Sie?

Welche Rolle haben Sie dabei?

b) Was sind Macher*innen für Sie?

Wie definieren Sie diese?

c) Wie kamen Sie mit dem Maker Movement in Berührung?

2.) Projekte

d) Was machen Sie aktuell? Könnten Sie bitte kurz Ihre momentanes Tätigkeit beschreiben.

e) Welche Kontakte/Beziehungen haben Sie zu Macher*innen?

f) Ist Ihnen das Maker Movement bekannt?

(1) Nein: Erklärung dann zu 2.

(2) Ja: Was denken Sie über das Maker Movement?

Welche Rolle haben Sie persönlich, ihrer Meinung nach, im Maker Movement?

3.) Motivation

g) Was motiviert Ihrer Meinung nach, Macher*innen, an ihren Projekten/Projektideen zu arbeiten?

Welche Rolle spielt _____hinsichtlich der Motivation des Machens?

1. Machen an sich	8. Neue Technologien nutzen
2. Möglichkeit etwas zu lernen	9. Eigennutzung von Produkten
3. Gesellschaftliche Attraktivität (Impact)	10. Teil einer Community zu sein
4. Beliebtheit in einer Community	11. IPR (Patente kreieren)
5. Ökonomische Faktoren (Geld verdienen/sparen)	12. Etwas für andere herstellen
6. Ein bestehendes Produkt optimieren	13. Etwas erschaffen
7. Wissen weiterzugeben, anderen bereitzustellen (open source)	

Was fehlt Ihnen noch, wenn wir über Motivation sprechen?

4.Unternehmertum/Entrepreneurship

h) Wie denken Sie über unternehmerische Selbstständigkeit von Macher*innen?

Was hält Macher*innen ggf. davon ab sich selbstständig zu machen?

Wie müsst eine optimale untern. Selbstständigkeit für Macher*innen gestaltet sein?

i) Wie beurteilen Sie Ihnen bekannte Projekte von Macher*innen im Hinblick auf eine mögliche unternehmerische Selbstständigkeit?

j) Was macht eine Projektidee für Macher*innen, Ihrer Meinung nach, unternehmerisch interessant? (ggf. erklären)

Welchen Einfluss hat/haben die _____ im Hinblick auf die Attraktivität einer Projektidee für Macher*innen, im Kontext der unternehmerischen Selbstständigkeit?

1. Ökonomische Attraktivität	5. Technische Neuartigkeit
2. Möglichkeit etwas zu lernen	6. Zielgruppen/Eigennutzung
3. Gesellschaftliche Attraktivität (Impact)	7. Sichtbarkeit in der Community
4. Kosten der Selbstständigkeit (Geld + Zeit)	8. IPR (Möglichkeiten ihre Idee schützen)

k) Welche weiteren Faktoren würden eine unternehmerische Selbstständigkeit für Macher*innen attraktiv bzw. attraktiver machen?

l) Wenn über Nacht, all das was Ihnen im Bereich des Machertum fehlt, heute Nacht gelöst werden würde, wo wären Veränderungen eingetreten? [Wunderfrage nach Lumann]

Fehlt Ihnen Unterstützung (in einem speziellen Bereich)?

5.) Zum Schluss

m) Was könnte Ihrer Meinung nach für dieses Forschungsprojekt noch relevant sein?

n) Welche Fragen und Anregungen haben Sie abschließend?

Table 48: Interview guide (english)

Research Project: Motivation of makers

Dear participant,

thank you very much for taking the time for an interview and thus also for our research project. The research project investigates the motivation of people who create something. We want to explore how making, innovation and entrepreneurial activities are related to each other. You are now an active part of our research. The results of the research have economic relevance for all of us. We want to make better use of existing potentials and support people with talents and motivation.

All data collected is used exclusively anonymously and for research purposes.

Thank you for supporting this research project with your participation.

We have prepared the following guiding questions for our discussion with you. But: We deliberately want to have an open and interactive conversation with you in order to learn and experience as much as possible. We therefore encourage you to contribute examples, suggestions and questions openly to the conversation at any time.

Leading questions:

Theme 1: Motivation

What motivates makers to work on their projects/project ideas?

In your opinion, what are makers?

What is the value of the Maker Movement?

What are misconceptions about makers?

Theme 2: Entrepreneurial Activity

What do you think about entrepreneurial activity among makers?

Which factors do you think attract makers to become entrepreneurs with a project or project idea?

What obstacles to entrepreneurial activity do you see for makers?

How can makers be supported in entrepreneurial activities?

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Table 49: Coding schema

Coding schema

A Motivation

- Self realization and ideology
  - Learning
  - Curiosity and understanding
  - Creating (new things)
  - Rewarding
  - Self-empowerment
  - Challenging yourself
- Community
  - being party of a community
  - share knowledge & learn from others
  - community recognition
- Ideology
  - tinkering & making itself
  - democratization of tools and innovation
  - process attributes (autonomy, flexibility, autonomy, control, speed)
- Problem focus
  - problem solving
  - improve world & society
  - improve existing things
- Technical newness

B Entrepreneurial Motivation

- **Economic attractiveness**
  - **commercialize an idea**
  - **patenting and licensing**
- **Support and investments**
  - ecosystem (spaces, co-ops, crowdfunding, grants)
  - personal support (exchange, coaching, IPR support, etc.)

- **Entrepreneurial Problem focus**
  - improve world & society
  - identify gaps
  - problem solving
  - improve existing things
- **Feedback**
  - from the community
  - from others

C Inhibitors

- **Scaling**
  - IPR
  - opportunity cost & missing resources
  - entrepreneurial support fails to address makers
  - missing production capabilities/missing speed
  - rules and restrictions
  - missing platforms and support
- **Personal Inhibitors**
  - losing flexibility
  - no interest in founding/commercialization
  - fear and pressure
  - refuse responsibility
  - missing knowledge
  - working alone
- **Ideological Inhibitors**
  - open source vs. commercialization
  - rejection of capitalism

Source: Own illustration

Table 50: Variables and operationalization

Variable	Description	Source
Maker experience		
Number of prototypes	Number of physical prototypes or products the respondent created during their maker activities (*0,1,2,3,4 or more*)	Halbinger (2018)
Prototyping areas	Areas the respondent created prototypes and products in	de Jong et al. (2015)
Making time per week	Number of hours spent for making-related activities per week	Halbinger (2018)
Share of time in makerspace	Share of making time per week spent in a makerspace (*0%, 25%, 50%, 75%, 100%)*	
Covid-19 impact	degree of impact on making-related activities of the respondent ranging from very negative to very positive	Prochazka et al. 2021
Maker movement identification	degree of identification with the Maker Movement 1=not at all 5=completely	Hausberg & Spaeth (2020)
Makerspace impact	degree of perceived advantage the respondent gained by using a makerspace, ranging from 1=not at all to 5=completely	Hausberg & Spaeth (2020)
Reasons to use makerspace	*Hobby, employment, education, self-employment, no makerspace usage*	
Cooperation intensity (community)	degree of cooperation with other makers during making-related projects, ranging from 1=not at all to 5=always	de Jong et al. (2015)
Motivation		
Maker motivation	26 items regarding the individual motivation to engage in maker activities, ranging from 1=not important at all to 5=very important	Carter et al. (2013)
Identity		
maker identities	three items regarding the identification with three different identity descriptions (vignettes), ranging from 1=no identification at all to 5=complete identification	Postmes (2013)
Entrepreneurship		Halbinger 2018
Founding status	binary variable whether the respondent has started a business or not	
Company description	optional short description of the company regarding area and duration of operation, number of employees, etc.	Halbinger (2018)
Company making-related	binary variable whether the company is/was making-related or not	
Company founded with team	binary variable whether the company was founded alone or with a team	
Entrepreneurial interest	degree of entrepreneurial interest and thinking, ranging from 1=never to 5=always	Wilson et al. (2007)
Founding within next two years	degree of probability for founding a company within the next two years, ranging from 1=not likely at all 5=very likely	
Personal network	available personal network in case of starting a business	
Entrepreneurial idea	binary variable whether the respondent has an entrepreneurial idea in mind or not	Linan & Chen (2009)
Idea duration	number of years the respondent has the idea, ranging from 1=less than one year to 7=more than 10 years	

(continued)

Idea origin	binary variable whether the idea is making-related or not	
Risk	three items regarding the degree of risk-taking, ranging from 1=not at all to 11=very risk-taking	Dohmen et al. (2011)
Image of entrepreneurship	six items regarding the entrepreneurial image of the respondent's personal and social environments (three items each) image of entrepreneurship, ranging from 1= to 5=	

Table 51: Physical makerspace posting

Figure 30: Sawtooth study design

Studie: Maker und unternehmerische Gelegenheiten

Liebe Maker, herzlich willkommen zu unserem Forschungsprojekt.

Vielen Dank, dass Sie an unserer Studie teilnehmen und uns dabei unterstützen, das Maker Movement und seine Verbindung zum Unternehmertum zu erforschen! Die Umfrage nimmt ca. 20-25 Minuten in Anspruch.

Mit Ihrer Teilnahme unterstützen Sie die Maker-Bewegung. Weiterhin werden die **Ergebnisse gemeinsam mit dem Make Magazin veröffentlicht**. Unter allen Teilnehmer*innen werden zudem **tolle Preise** wie z.B. ein Raspberry Pi Set oder ein Conrad-Gutschein (50€) **verlost**. Mehr Informationen zur Teilnahme am Gewinnspiel finden Sie am Ende der Umfrage.

Die **Befragung ist anonym** und die gewonnenen Daten werden streng vertraulich und nur zu Forschungszwecken im Rahmen der Datenschutz-Grundverordnung (**DSGVO**) verwendet.

Bitte zögern Sie nicht, sich bei Fragen und Anregungen jederzeit gerne per E-Mail an christian.brandstetter@dhbw-karlsruhe.de zu wenden.

Herzlichst,
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Hinweis für Nutzer*innen von Mobilgeräten: Wir empfehlen das Gerät für eine optimale und vollständige Darstellung horizontal/quer auszurichten.

Bitte bestätigen Sie, dass Sie die oben genannten Bedingungen gelesen und verstanden haben und mit der Teilnahme an dieser Studie einverstanden sind.

◯ Ja

weiter

UNIVERSITÄT TRIER

DHBW Duale Hochschule Baden-Württemberg

Bitte lesen Sie sich folgendes Szenario sorgfältig durch und versetzen sich in die folgende Situation:

Sie arbeiten im Rahmen Ihres Hobbys als Maker an einem Projekt und haben einen **Prototypen** für ein mögliches Produkt entwickelt. Ihr direktes Umfeld reagiert positiv auf den Prototypen. Daraus ergibt sich für Sie möglicherweise eine unternehmerische Gelegenheit. Das finanzielle Risiko für Sie ist gering. Die unternehmerischen Gelegenheiten unterscheiden sich in Bezug auf folgende 5 Merkmale.

Hinweis: Wenn Sie die Maus über die unterstrichenen Begriffe bewegen, erhalten Sie zusätzliche Informationen.

Merkmal	Ausprägungen
Attraktivität des Marktes	niedrig mittel hoch
Anwendbarkeit formeller Schutzrechte	nicht möglich ggf. möglich sicher möglich
Technischer Anspruch	niedrig mittel hoch
Gesellschaftlicher Impact	gering mittel hoch
Projektteam	Sie arbeiten alleine Projektpartner*in BWL Projektpartner*in technisch

Im Folgenden werden Ihnen **16 verschiedene unternehmerische Gelegenheiten** präsentiert. Bitte **bewerten Sie** nun für sich ganz persönlich **die Attraktivität** dieser unternehmerischen Gelegenheiten. Bitte bewerten Sie dabei jede dieser unternehmerischen Gelegenheiten für sich alleine und unabhängig von den anderen.

Wie attraktiv ist diese unternehmerische Gelegenheit für Sie persönlich?

Gesellschaftlicher Impact:	mittel
Projektteam:	Projektpartner*in BWL
Technischer Anspruch:	hoch
Formelle Schutzrechte:	sicher möglich
Attraktivität des Marktes:	niedrig

Überhaupt nicht attraktiv	Eher nicht attraktiv	Weder noch	Eher attraktiv	Sehr attraktiv
○	○	○	○	○

Vielen Dank für Ihre Einschätzungen.

Im zweiten Teil der Studie möchten wir mehr über Sie und Ihre Maker-Motivation erfahren.

zurück weiter

Seit wie vielen Jahren sind Sie als Maker aktiv?

Bitte wählen Sie..

Wieviele Produkte (funktionierende Prototypen o.ä.) haben Sie im Rahmen Ihrer Tätigkeit als Maker entwickelt?

0	1	2	3	4 oder mehr
○	○	○	○	○

In welchen Bereichen haben Sie bereits Produkte oder Dienstleistungen (auch Prototypen) im Rahmen Ihrer Tätigkeit als Maker entwickelt?

(Mehrfachnennung möglich)

- ☐ Hardware
- ☐ Software
- ☐ Haushaltsgeräte oder -mobiliar
- ☐ Transport & Fahrzeug
- ☐ Werkzeuge
- ☐ Messgeräte & Sensoren
- ☐ Ersatzteile
- ☐ Modellbau
- ☐ Sport & Fitness
- ☐ Unterhaltung & Hobby
- ☐ Pflege, Medizin & Gesundheit
- ☐ Kinder & Spielzeug
- ☐ Kunst & Design
- ☐ andere: ____
- ☐ keine

Wie viel Zeit verbringen Sie durchschnittlich pro Woche ca. mit all Ihren aktuellen Maker-Projekten?

Bitte wählen Sie..

Welchen Anteil davon verbringen Sie schätzungsweise in einem Makerspace?

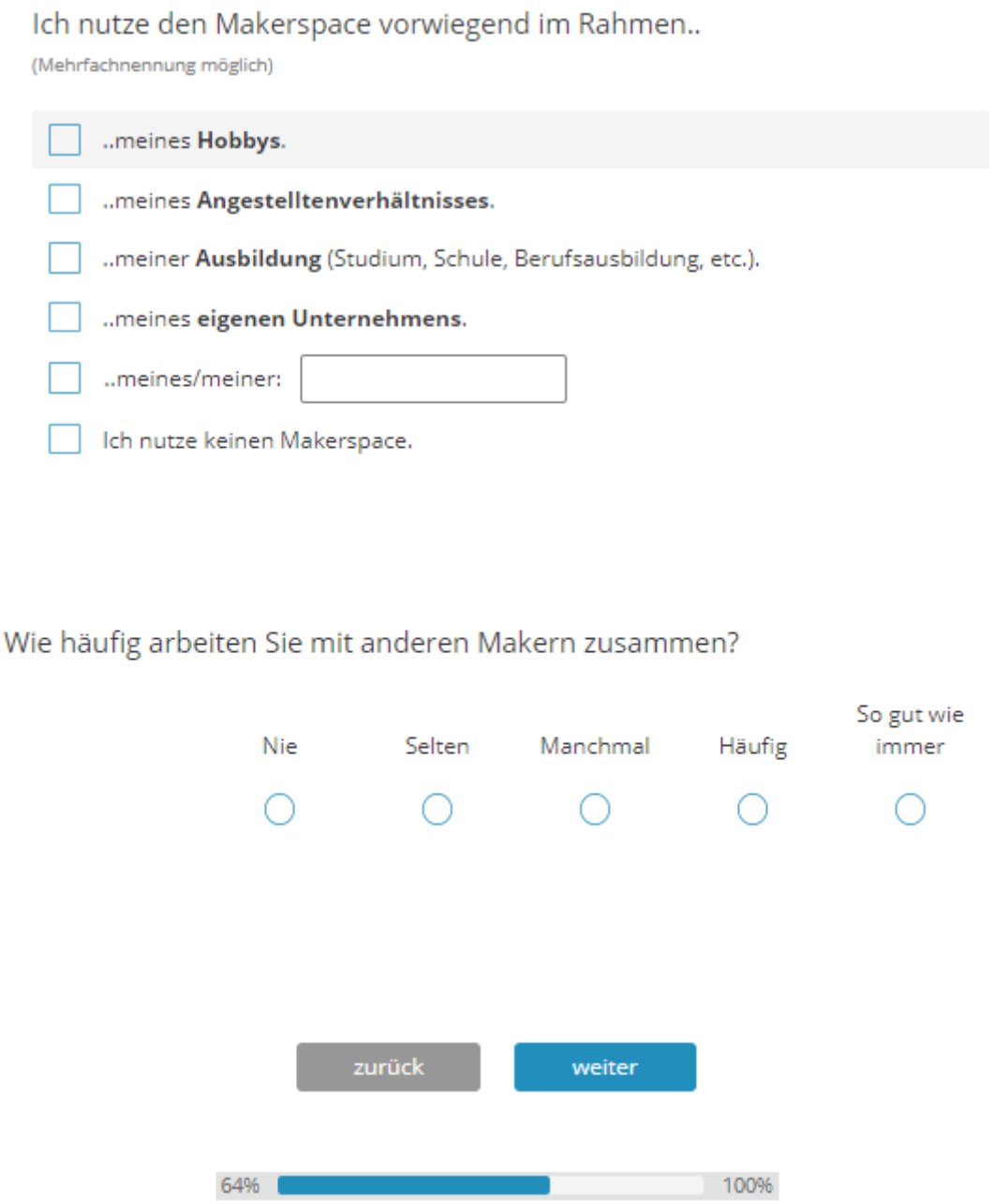
0%	25%	50%	75%	100%
○	○	○	○	○

Wie wurde Ihre Tätigkeit als Maker infolge der Corona-Pandemie insgesamt beeinflusst?

Sehr negativ	Eher negativ	Weder noch	Eher positiv	Sehr positiv
○	○	○	○	○

Inwiefern treffen die folgenden Aussagen auf Sie zu?

Ich fühle mich **stark verbunden mit dem Maker Movement** bzw. der Maker-Bewegung.	○	○	○	○	○
Ich habe bisher bei meinen Projekten **von** einem bzw. mehreren **Makerspaces profitiert**.	○	○	○	○	○


Ich nutze den Makerspace vorwiegend im Rahmen..
(Mehrfachnennung möglich)
..meines **Hobbys**.
..meines **Angestelltenverhältnisses**.
..meiner **Ausbildung** (Studium, Schule, Berufsausbildung, etc.).
..meines **eigenen Unternehmens**.
..meines/meiner:
Ich nutze keinen Makerspace.
Wie häufig arbeiten Sie mit anderen Makern zusammen?
Nie
Selten
Manchmal
Häufig
So gut wie immer
zurück
weiter
64%
100%

Nun möchten wir noch etwas mehr über Ihre Maker-Motivation erfahren.

Bitte beurteilen Sie die folgenden Aussagen im Hinblick auf Ihre **Aktivitäten als Maker**.

	Stimme überhaupt nicht zu	Stimme eher nicht zu	Weder noch	Stimme eher zu	Stimme voll zu
Ich **fordere mich gerne selbst heraus**.	○	○	○	○	○
Ich möchte mich **für potenzielle Arbeitgeber interessanter machen**.	○	○	○	○	○
Ich möchte **als Person dazulernen und wachsen**.	○	○	○	○	○
Finanzielle Sicherheit ist mir wichtig.	○	○	○	○	○
Ich strebe ein **höheres persönliches Einkommen** an.	○	○	○	○	○
Ich strebe **großen Wohlstand und ein hohes Einkommen** an.	○	○	○	○	○
Ich möchte **etwas erreichen und dafür wahrgenommen werden**.	○	○	○	○	○
Ich möchte **eine höhere gesellschaftliche Stellung** erreichen.	○	○	○	○	○
Ich strebe nach **Anerkennung in meiner Community**.	○	○	○	○	○

	Stimme überhaupt nicht zu	Stimme eher nicht zu	Weder noch	Stimme eher zu	Stimme voll zu
Ich möchte eine größere **persönliche Flexibilität für mein Leben**.	○	○	○	○	○
Ich möchte meinen **eigenen Ansatz in Bezug auf meine Arbeit** ausleben.	○	○	○	○	○
Ich möchte **Teil einer Community** sein.	○	○	○	○	○
Ich möchte **mein Wissen mit anderen teilen**.	○	○	○	○	○
Ich möchte **Projekte gemeinsam** mit anderen bearbeiten.	○	○	○	○	○
Ich möchte **innovativ sein** und **mit der neuesten Technologie arbeiten**.	○	○	○	○	○
Ich möchte eine **Idee für ein Produkt entwickeln**.	○	○	○	○	○
Ich möchte **Dinge durch meine Innovationen beeinflussen**.	○	○	○	○	○
Ich möchte **wichtiges Know-how erwerben**.	○	○	○	○	○

	Stimme	Stimme

	Stimme überhaupt nicht zu	Stimme eher nicht zu	Weder noch	Stimme eher zu	Stimme voll zu
Ich möchte **lernen, Technologien und Werkzeuge anzuwenden.**	○	○	○	○	○
Ich möchte mich **selbst befähigen, Dinge zu tun**, die ich vorher nicht konnte.	○	○	○	○	○
Ich möchte **ungelöste Herausforderungen bearbeiten.**	○	○	○	○	○
Ich möchte ein **soziales/gesellschaftliches Problem lösen.**	○	○	○	○	○
Ich möchte **Probleme selbst angehen.**	○	○	○	○	○
Ich möchte **bestehende Dinge** (Produkte, Programme, etc.) **verbessern.**	○	○	○	○	○
Ich möchte **bestehende Dinge** (Produkte, Programme, etc.) verändern und **auf meine eigenen Bedürfnisse anpassen.**	○	○	○	○	○
Ich möchte Dinge **selbst erschaffen, statt zu kaufen.**	○	○	○	○	○

zurück weiter

Bitte geben Sie an, inwiefern Sie sich persönlich mit den folgenden drei Aussagen identifzieren können.

Diese Aussage beschreibt mich als Maker..

"Meine **Motivation** als Maker ist **wirtschaftlicher Natur**. Die Interaktion mit Kunden und Märkten ist es, was mich motiviert. Ich sehe meine Aktivität als Maker als **Mittel zum Zweck** und suche den **Markterfolg**. Ich **orientiere** mich dabei an anderen wirtschaftlich erfolgreichen **Unternehmer*innen**."	○	○	○	○	○
"Meine **Motivation** als Maker ist **sozialer Natur**. Der Austausch mit anderen Mitgliedern der Community und die Arbeit an der gemeinsamen Sache ist es, was mich motiviert. Ich sehe meine Aktivität als Maker als Plattform zum **sozialen Austausch** und suche den **Kontakt** mit anderen Mitgliedern der **Community**. Ich **orientiere mich** dabei an anderen, sichtbaren und geschätzten **Mitgliedern der Community**."	○	○	○	○	○
"Meine **Motivation** als Maker ist **technischer Natur**. Der Umgang mit spannenden Technologien und neuer Technik ist es, was mich motiviert. Ich sehe meine Aktivität als Maker als Möglichkeit zu **experimentieren** und zu lernen und suche den **technischen Erfolg**. Ich **orientiere** mich dabei an anderen herausragenden **Erfinder*innen**."	○	○	○	○	○

Wie stehen Sie zum Thema Unternehmertum?

Haben Sie bereits ein Unternehmen gegründet?

- ○ Ja
- ○ Nein

Bitte beschreiben Sie das Unternehmen kurz.
(z.B. angebotenes Produkt/Dienstleistung, Mitarbeiterzahl, Gründungsjahr, etc.)

Ist das Unternehmen noch aktiv?

- ◯ Ja
- ◯ Nein

Ist das Unternehmen aus Ihrer Tätigkeit als Maker enstanden?

- ◯ Ja
- ◯ Nein

Haben Sie das Unternehmen alleine gegründet?

- ◯ Ja
- ◯ Nein, im Team

Haben Sie je darüber nachgedacht, (wieder) ein eigenes Unternehmen zu gründen?

Nie	Selten	Manchmal	Häufig	So gut wie immer
○	○	○	○	○

Wie wahrscheinlich ist es, dass Sie sich innerhalb der nächsten zwei Jahren ein Unternehmen gründen?

Sehr unwahrscheinlich	Eher unwahrscheinlich	Unentschieden	Eher wahrscheinlich	Sehr wahrscheinlich
○	○	○	○	○

Verfügen Sie bereits über Kontakte, die für die Realisierung einer potentiellen Gründungsidee hilfreich wären?

(Mehrfachnennung möglich)

- ☐ Meine **Eltern** haben ein eigenes Unternehmen
- ☐ **Andere Familienmitglieder** haben ihr eigenes Unternehmen
- ☐ Mein*e **Partner*in** hat ein eigenes Unternehmen
- ☐ **Enge Freund*innen** von mir haben ihr eigenes Unternehmen
- ☐ **Nachbar*innen** von mir haben ihr eigenes Unternehmen
- ☐ Ich verfüge über Kontakte zu **potenziellen Kund*innen**
- ☐ Ich verfüge über Kontakte zu **potenziellen Geschäftspartner*innen**
- ☐ Ich verfüge über Kontakte zu **Kapitalgeber*innen**
- ☐ Nein, gar nicht.

Haben Sie eine Gründungsidee?

- ◯ Ja, sogar eine konkrete
- ◯ Ja, aber unkonkret
- ◯ Nein, gar nicht

Seit wie vielen Jahren haben Sie diese Gründungsidee?

Bitte wählen Sie..

Hängt die Idee mit Ihrer Tätigkeit als Maker zusammen?

- ◯ Ja
- ◯ Nein

Sind Sie im Hinblick auf **folgende Bereiche Ihres Lebens** generell ein Mensch, der bereit ist, Risiken einzugehen, oder versuchen Sie, Risiken zu vermeiden?

	0 - Überhaupt nicht risikobereit	1	2	3	4	5	6	7	8	9	10 - Sehr risikobereit
Berufsleben	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Privatleben	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Finanzen	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

Wie beurteilen Sie Ihr **soziales Umfeld** in Bezug auf Unternehmertum?

	Stimme überhaupt nicht zu	Stimme eher nicht zu	Weder noch	Stimme eher zu	Stimme voll zu
Die **Verwirklichung neuer Ideen** zu einem Unternehmen ist in meinem sozialen Umfeld ein **geschätzter Berufsweg**.	○	○	○	○	○
In meinem sozialen Umfeld gilt **innovatives und kreatives Denken** als der **Weg zum Erfolg**.	○	○	○	○	○
Unternehmer*innen werden in meinem sozialen Umfeld **geschätzt**.	○	○	○	○	○

Bitte teilen Sie uns mit, wie Sie **persönlich** zu folgenden Aussagen stehen.

	Stimme überhaupt nicht zu	Stimme eher nicht zu	Weder noch	Stimme eher zu	Stimme voll zu
Ich schätze die **Verwirklichung neuer Ideen zu einem Unternehmen**.	○	○	○	○	○
Ich denke, **innovatives und kreatives Denken** ist der **Weg zum Erfolg**.	○	○	○	○	○
Ich **schätze Unternehmer*innen**.	○	○	○	○	○

Wie alt sind Sie?

Bitte wählen Sie..

Bitte geben Sie Ihr Geschlecht an:

Bitte wählen Sie..

itte machen Sie Angaben zu Ihrer persönlichen Lebenssituation.

	Ja	Nein	keine Angabe
Eigene Kinder	○	○	○
Verheiratet/verpartnert	○	○	○
Allein lebend	○	○	○
In Deutschland geboren	○	○	○
Migrationshintergrund der Eltern	○	○	○

Was ist Ihr höchster Bildungsabschluss?

Bitte wählen Sie..

In welchem bzw. welchen der folgenden Bereiche liegt Ihre fachliche Ausbildung bzw. Ihr Studium?
(Mehrfachnennung möglich)

- ☐ Wirtschaftswissenschaften
- ☐ Ingenieurwissenschaften/Technik
- ☐ Informatik
- ☐ Produktdesign & Architektur
- ☐ Mathematik & Naturwissenschaften
- ☐ Medizin & Gesundheitswissenschaften
- ☐ Landwirtschaft & Forstwirtschaft
- ☐ Sportwissenschaften & Ernährungswissenschaften
- ☐ Jura
- ☐ Pädagogik & Bildungswissenschaften
- ☐ Sprachen & Kulturwissenschaften
- ☐ Kunst & Musik
- ☐ Handwerk
- ☐ Öffentliche Verwaltung
- ☐ Medien & Kommunikation
- ☐ Psychologie
- ☐ Sozialwissenschaften
- ☐ Lehramtsstudien
- ☐ Andere, und zwar: [ ]
- ☐ keine Angabe

Wie ist Ihr aktuelles Beschäftigungsverhältnis?

Bitte wählen Sie.. ▼

Wie würden Sie Ihre Kenntnisse in den folgenden Bereichen einschätzen?

Finanzen, Rechnungswesen & Controlling	○	○	○	○	○
Management & Leadership	○	○	○	○	○
Marketing & Vertrieb	○	○	○	○	○
Recht	○	○	○	○	○
Produktion & Logistik	○	○	○	○	○
Forschung & Entwicklung	○	○	○	○	○
Ingenieurtechnik & Konstruktion	○	○	○	○	○
IT & Digitalisierung	○	○	○	○	○
Kommerzialisierung von Erfindungen	○	○	○	○	○

Über welche Expertise verfügen Sie hinsichtlich dieser (gewerblichen) Schutzrechte?

Hinweis: Wenn sie mit der Maus über die einzelnen Begriffe fahren, erhalten Sie eine kurze Beschreibung.

	Gar keine	Wenig	Mittel	Gute	Sehr gute
Patente	○	○	○	○	○
Gebrauchsmuster	○	○	○	○	○
Marken	○	○	○	○	○
eingetragene Designs/Geschmacksmuster	○	○	○	○	○
Topografien	○	○	○	○	○
Geheimhaltungsvereinbarung (NDA)	○	○	○	○	○

Gewinnspiel (optional)

Möchten Sie am Gewinnspiel teilnehmen?

Hinweis: Hierfür ist die Angabe einer Email-Adresse erforderlich. Diese wird getrennt vom restlichen Datensatz gespeichert und nur zu Zwecken des Gewinnspiels genutzt.

- ◯ Ja
- ◯ Nein

Optional:

Falls Sie teilnehmen möchten, wählen Sie bitte Ihren Wunschpreis aus.

- ◯ 1x Mini-Abo Make Magazin (3 Monate)
- ◯ 1x Rasperry Pi 400 DE Set
- ◯ 1x 50€ Conrad Gutschein

Bitte geben Sie Ihre Email-Adresse für die Teilnahme am Gewinnspiel an.

zurück weiter

96% 100%

Figure 31: Maker motivation in detail

Table 52: Hybrid identity matrix: social x economic

Social Id. from 1 to 5	Economic identity from 1 to 5					Total
	1	2	3	4	5	
1	8	6	6	3	5	28
2	19	16	13	11	4	63
3	37	13	16	12	2	80
4	41	30	12	6	2	91
5	31	2	3	5	4	45
Total	136	67	50	37	17	307

Table 53: Hybrid identity matrix: social x technical

Social Id. from 1 to 5	Technical identity from 1 to 5					Total
	1	2	3	4	5	
1	2	0	1	14	11	28
2	0	6	8	24	25	63
3	3	2	6	25	44	80
4	1	10	8	30	42	91
5	1	2	8	14	20	45
Total	7	20	31	107	142	307

Table 54: Hybrid identity matrix: economic x technical

Eco. Id. from 1 to 5	Technical identity from 1 to 5					Total
	1	2	3	4	5	
1	3	8	13	45	67	136
2	0	1	7	29	30	67
3	2	5	7	15	21	50
4	2	5	2	15	13	37
5	0	1	2	3	11	17
Total	7	20	31	107	142	307

Table 55: Summary statistics

Variable	N	Mean	S.D.	Min	Max	Description
Demographics						
Gender	307	1.26	0.57	1	4	Gender of the respondent (1= male 2=female 3 =divers 4=ns)
Age	307	3.02	1.26	1	8	Age of the respondent (1=
Partnership	307	1.53	0.57	1	3	Respondent married or living in a partnership
Children	307	1.73	0.49	1	3	Respondent with children
Living alone	307	1.72	0.50	1	3	Respondent living alone
Imm. backgr.	307	1.88	0.41	1	3	Respondent with immigration background
Maker experience						
Experience	307	3.70	1.96	1	7	Experience as maker of the respondent
Products/Prototypes	307	3.64	1.43	1	5	Number of Products/Prototypes developed as maker of the respondent
Areas of Products						Areas of the products developed
Time per week	307	4.12	2.58	1	9	Time per week used for maker projects in hours (1=
Time in space	307	2.51	1.29	1	5	Percentage of these hours spent in the makerspace
Covid-19	307	2.75	1.07	1	5	Influence of the covid-19 pandemic on individual maker projects
Maker movement id.	307	3.50	1.21	1	5	Personal connection to the Maker Movement
Makerspace value	307	3.93	1.23	1	5	Individual opinion regarding the value of a makerspace
Reason Hobby	307	0.71	0.46	0	1	(dummy; 1=yes; 0=no)
Reason Job	307	0.19	0.39	0	1	(dummy; 1=yes; 0=no)
Reason Education	307	0.24	0.43	0	1	(dummy; 1=yes; 0=no)
Reason Entrepr.	307	0.20	0.40	0	1	(dummy; 1=yes; 0=no)
Reason other	307	0.04	0.19	0	1	(dummy; 1=yes; 0=no)

Teamwork	307	2.95	1.03	1	5	
Motivation						
Motivation 1	307	4.30	0.73	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 2	307	2.63	1.31	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 3	307	4.64	0.60	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 4	307	3.53	1.11	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 5	307	3.20	1.29	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 6	307	2.64	1.31	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 7	307	3.64	1.13	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 8	307	2.69	1.13	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 9	307	3.07	1.14	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 10	307	4.18	0.87	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 11	307	4.03	1.91	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 12	307	3.59	1.13	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 13	307	4.28	0.84	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 14	307	3.96	0.95	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 15	307	4.09	0.98	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 16	307	3.83	1.14	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 17	307	3.98	1.05	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 18	307	4.46	0.69	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 19	307	4.54	0.67	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 20	307	4.59	0.65	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 21	307	4.12	0.91	1	5	(Likert; 1=fully disagree; 5=fully agree)

Motivation 22	307	3.71	1.12	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 23	307	4.22	0.81	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 24	307	3.89	0.98	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 25	307	3.91	1.01	1	5	(Likert; 1=fully disagree; 5=fully agree)
Motivation 26	307	4.06	1.06	1	5	(Likert; 1=fully disagree; 5=fully agree)
Identity						
Identity Economic	307	3.20	1.19	1	5	(Likert; 1=completely identify; 5=identify not at all)
Identity Technical	307	2.13	1.26	1	5	(Likert; 1=completely identify; 5=identify not at all)
Identity Social	307	4.16	1.00	1	5	(Likert; 1=completely identify; 5=identify not at all)
Entrepreneurship						
Founder (Y/N)	307	0.31	0.46	0	1	Founder (dummy; 1= yes; 0=no)
Operating Company	95	0.23	0.42	0	1	Company still operating (dummy; 1= yes; 0=no)
Making related Company	95	0.13	0.33	0	1	Making-related background of the company (dummy; 1= yes; 0=no)
Team Founding	95	0.17	0.38	0	1	Company founded with other people as team (dummy; 1= yes; 0=no)
Entr. Intent	307	3.10	1.18	1	5	Individual degree of thinking about self-employment
2 years Founding	307	2.56	1.34	1	5	Individual estimated probability of founding a company within 2 years
Personal Network						
Network: Parents	307	0.14	0.35	0	1	Personal entrepreneurial network through parents (dummy; 1=yes; 0=no)
Network: Family	307	0.12	0.33	0	1	Personal entrepreneurial network through family (dummy; 1=yes; 0=no)
Network: Partner	307	0.05	0.21	0	1	Personal entrepreneurial network through partner (dummy; 1=yes; 0=no)
Network: Friends	307	0.34	0.47	0	1	Personal entrepreneurial network through friends (dummy; 1=yes; 0=no)
Network: Neighbors	307	0.06	0.23	0	1	Personal entrepreneurial network through

						neighbors(dummy; 1=yes; 0=no)
Network: Customers	307	0.38	0.49	0	1	Personal entrepreneurial network of potential customers (dummy; 1=yes; 0=no)
Network: Business Partners	307	0.44	0.50	0	1	Personal entrepreneurial network of business partners (dummy; 1=yes; 0=no)
Network: Investors	307	0.23	0.42	0	1	Personal entrepreneurial network of investors (dummy; 1=yes; 0=no)
Network: not available	307	0.30	0.46	0	1	Personal entrepreneurial network not available (dummy; 1=yes; 0=no)
Business idea (Y/N)	307	2.03	0.93	1	3	Business idea available (1=yes, 2=yes, but roughly; 3=no)
Idea since	197	2.48	1.44	1	7	Idea since (in years) (1=<1; 2=1-2;3=3-4;4=5-6;5=7-8;6=9-10;7=>10)
Making related idea	197	0.42	0.49	1	2	Idea with Making-related background (dummy; 1=yes;0=no)
Risk tolerance						
Risk Employment	307	6.77	2.42	1	11	Risk tolerance regarding the individual employment situation (1=not risk tolerant at all; 11= very risk tolerant)
Risk Private	307	6.39	2.34	1	11	Risk tolerance regarding the individual living situation (1=not risk tolerant at all; 11= very risk tolerant)
Risk Finance	307	5.50	2.54	1	11	Risk tolerance regarding the individual financial situation (1=not risk tolerant at all; 11= very risk tolerant)
Image of Entrepreneurship						
Image of Entrpr.1:	307	3.36	1.02	1	5	individual's opinion of others in its social group regarding turning inventions into businesses
Image of Entrpr.2:	307	3.69	0.98	1	5	individual's opinion of others in its social group regarding innovation as the way to success
Image of Entrpr.3:	307	3.46	0.99	1	5	individual's opinion of others in its social group regarding Entrepreneurs
Personal Image of Entrepr. 1	307	3.96	0.95	1	5	personal image of turning inventions into businesses
Personal Image of Entrepr. 2	307	4.32	0.75	1	5	Personal image of innovation as the way to success
Personal Image of Entrepr. 3	307	3.79	1.05	1	5	Personal Image of Entrepreneurs

Education	307					
Formal education	307	7.21	2.21	2	12	Highest formal education (1=
Ed. Economic	307	0.13	0.33	0	1	(dummy; 1=yes;0=no)
Ed. Engineering	307	0.50	0.50	0	1	(dummy; 1=yes;0=no)
Ed. Information Sc.	307	0.34	0.48	0	1	(dummy; 1=yes;0=no)
Ed. Product Design/Architecture	307	0.07	0.26	0	1	(dummy; 1=yes;0=no)
Ed. Math/Science	307	0.14	0.34	0	1	(dummy; 1=yes;0=no)
Ed. Medicine/Health	307	0.02	0.13	0	1	(dummy; 1=yes;0=no)
Ed. Agriculture	307	0.01	0.08	0	1	(dummy; 1=yes;0=no)
Ed. Sport/Nutrition	307	0.01	0.10	0	1	(dummy; 1=yes;0=no)
Ed. Law	307	0.01	0.06	0	1	(dummy; 1=yes;0=no)
Ed. Educational Sc.	307	0.04	0.20	0	1	(dummy; 1=yes;0=no)
Ed. Languages/Culture	307	0.02	0.15	0	1	(dummy; 1=yes;0=no)
Ed. Art/Music	307	0.02	0.14	0	1	(dummy; 1=yes;0=no)
Ed. Craft	307	0.12	0.33	0	1	(dummy; 1=yes;0=no)
Ed. Public Services	307	0.01	0.08	0	1	(dummy; 1=yes;0=no)
Ed. Media/Comm.	307	0.08	0.27	0	1	(dummy; 1=yes;0=no)
Ed. Psychology	307	0.02	0.14	0	1	(dummy; 1=yes;0=no)
Ed. Social Science	307	0.33	0.18	0	1	(dummy; 1=yes;0=no)
Ed. Teaching	307	0.16	0.13	0	1	(dummy; 1=yes;0=no)
Ed. Other	307	0.62	0.24	0	1	(dummy; 1=yes;0=no)
Ed. Not specified	307	0.26	0.16	0	1	(dummy; 1=yes;0=no)

Employment and skills						
Employment situation	307	3.07	2.65	1	13	Current employment status of the respondent
Individual knowledge						
Knowledge: Finance/Controlling	307	2.58	1.06	1	5	(Likert; 1=no knowledge 5=very good knowledge)
Knowledge: Management/ Leadership	307	3.07	1.10	1	5	(Likert; 1=no knowledge 5=very good knowledge)
Knowledge: Marketing/Sales	307	2.50	1.06	1	5	(Likert; 1=no knowledge 5=very good knowledge)
Knowledge: Law	307	2.13	0.88	1	5	(Likert; 1=no knowledge 5=very good knowledge)
Knowledge: Production/Logistics	307	2.91	1.20	1	5	(Likert; 1=no knowledge 5=very good knowledge)
Knowledge: Research & Development	307	3.64	1.12	1	5	(Likert; 1=no knowledge 5=very good knowledge)
Knowledge: Engineering & Construction	307	3.58	1.26	1	5	(Likert; 1=no knowledge 5=very good knowledge)
Knowledge: IT & digitization	307	3.81	1.03	1	5	(Likert; 1=no knowledge 5=very good knowledge)
Knowledge: Commercialization of inventions	307	2.45	1.09	1	5	(Likert; 1=no knowledge 5=very good knowledge)
IPR knowledge						
IPR: Patents	307	2.23	1.15	1	5	(Likert; 1=no knowledge 5=very good knowledge)
IPR: Reg. Design	307	1.97	1.08	1	5	(Likert; 1=no knowledge 5=very good knowledge)
IPR: Trademarks	307	2.18	1.11	1	5	(Likert; 1=no knowledge 5=very good knowledge)
IPR: Designs	307	1.97	1.04	1	5	(Likert; 1=no knowledge 5=very good knowledge)
IPR: Topography	307	1.43	0.78	1	5	(Likert; 1=no knowledge 5=very good knowledge)
IPR: NDA	307	2.41	1.22	1	5	(Likert; 1=no knowledge 5=very good knowledge)

Table 56: Conjoint scenario description

Scenario
In the context of your hobby, you work on a project as a maker and have developed a prototype of a possible product. Your immediate environment shows a positive reaction to the prototype. This leads to the possibility of an entrepreneurial opportunity. The financial risk is low. The entrepreneurial opportunities differ with regard to the following 5 characteristics:

Table 57: Questionnaire items for the academic maker survey

Variable	Operationalization
Demographics	
Gender	Gender of the respondent (0=male 1=female)
Age	Age of the respondent
Married/Partnership	Binary variable; respondent is married or living in a partnership (0=no, 1=yes)
Children	Binary variable; respondent has children or not (0=no, 1=yes)
Migration background	Binary variable; respondent has an immigration background or not (0=no, 1=yes)
Occupation	Occupation of the respondent (e.g. full-time or part-time employee, student, etc.)
Formal education	Highest formal education of the respondent (e.g. A-level, Bachelor, Master's degree, etc.)
Field of education	Field of education of the respondent (e.g. Business, STEM, IT, etc.)
Maker experience	
Number of prototypes	Number of physical prototypes or products the respondent had created during their maker activities, ranging from 1=0 to 5= 4 or more (Halbinger 2018)
Making time per week	Number of hours spent for making-related activities per week, ranging from 1= less than 1 hour to 9=more than 14 hours (Hausberg & Spaeth 2020)
Identification with Maker Movement	Degree of identification with the Maker Movement, ranging from 1=not at all 5=completely (Hausberg & Spaeth 2020)
Cooperation intensity	Degree of cooperation with other makers during making-related projects, ranging from 1=not at all to 5=always (Hausberg & Spaeth 2020)
Covid-19 impact	Degree of covid-19 impact on making-related activities of the respondent ranging from 1=very negative to 5=very positive
Maker Motivation	27 items regarding the individual motivation to engage in maker activities, ranging from 1=not important at all to 5=very important (adapted from Carter 2013)
Entrepreneurship	
Entrepreneurial experience	Binary variable; respondent has started a business or not (0=no, 1=yes) (Halbinger 2018)
Founding status	Free text; short description of the founded company regarding area and duration of operation, number of employees, etc.
Company description	Binary variable; if the company founded by the participant is based on a "making" project (e.g. discovered during a project in the makerspace) or not (0=no 1=yes)

Company founded with team	Binary variable; participant's founded company was founded alone or with a team (0=no 1=yes)
Entrepreneurial interest	Degree of entrepreneurial interest and thinking, ranging from 1=never to 5=always(Wilson et al. 2017)
Estimate of founding within next two years	Estimated probability for founding a company within the next two years, ranging from 1=not likely at all to 5=very likely
Personal network	Availability of a supportive personal network for starting a business (0=no, 1=yes)
Entrepreneurial idea	Binary variable; respondent has an entrepreneurial idea in mind or not (0=no, 1=yes) (Linan & Chen 2009)
Duration of idea existence	Number of years the respondent has the idea, ranging from 1=less than one year to 7= more than 10 years
Relevance of making for idea	Binary variable; idea is making-related or not (0=no, 1=yes)
Risk-tolerance	Three items regarding the degree of risk-taking within financial, private and employment related dimensions, ranging from 1=not at all to 11=very risk-taking (Dohmen et al. 2011)

Table 58: Demographics of academic makers

Variable	**Mean**	**Variable**	**Mean**
Demographics		Formal education	
Female	19%	Secondary schools	3%
Age (years)	21-30	A-level	26%
Married	41%	Apprenticeship	13%
Children (no/yes)	15%	Bachelor degree	28%
Migration background	18%	Masters (or higher)	29%
Positions		Field of Education	
Student	50%	STEM	61%
Employed (full-time)	27%	IT	38%
Employed (part-time)	10%	Business	16%
Entrepreneur	10%	Craftmanship	9%
Other	3%	Design/Architecture	9%
		Social sciences	4%
		Other	18%

Table 59: Academic makers entrepreneurial experience

Variable	**Mean**
Founding experience (yes/no)	22%
of founders: active comp.	75%
of founders: team founded	50%
of founders: making-related	34%
Entrepreneurial idea	68%
of those: making-related	68%
Entrepr. interest (1-5)	3.27
Likelihood of founding (1-5)	2.76

Table 60: Pairwise correlations of conjoint attributes (academic makers)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Opp. attractiveness															
(2) Low market potential	**-.35**														
(3) Medium market potential	.04	**-.53**													
(4) High market potential	**.30**	**-.53**	**-.44**												
(5) Low IPR protection	**-.17**	.01	**.05**	**-.04**											
(6) Medium IPR protection	.01	**-.07**	**.07**	.01	**-.46**										
(7) High IPR protection	**.16**	**.07**	**-.11**	.03	**-.51**	**-.53**									
(8) Low technical challenge	.03	**-.05**	-.01	**.06**	-.03	**.07**	-.04								
(9) Medium technical challenge	-.01	**-.08**	**.06**	.03	**.10**	-.02	**-.07**	**-.46**							
(10) High technical challenge	-.02	**.13**	**-.05**	**-.08**	**-.06**	**-.04**	**.10**	**-.52**	**-.53**						
(11) Low social impact	**-.30**	**-.10**	.01	**.10**	**.08**	.03	**-.10**	.03	**.11**	**-.14**					
(12) Medium social impact	-.01	**.04**	-.02	-.03	**-.05**	-.01	**.05**	-.04	**-.14**	**.17**	**-.53**				
(13) High social impact	**.30**	**.06**	.01	**-.07**	-.03	-.02	**.05**	.01	.03	-.03	**-.47**	**-.50**			
(14) No team partner	**.05**	**-.13**	-.02	**.16**	**-.07**	.04	.02	.03	-.04	.01	.01	**-.08**	**.08**		
(15) Partner economic background	**-.07**	**.08**	.01	**-.08**	.01	**-.12**	**.11**	**-.05**	**-.06**	**.11**	**-.05**	**.15**	**-.11**	**-.51**	
(16) Partner technical background	.02	**.05**	.02	**-.07**	**.06**	**.08**	**-.14**	.02	**.10**	**-.12**	**.04**	**-.07**	.03	**-.47**	**-.51**

Notes: Bold correlation coefficients are significant at $p < 0.05$.