Fakultät für Pädagogik und Psychologie

Achievement Related Cognitions and the Intention of Doctoral Graduates in Medicine and Life Sciences to Pursue an Academic Research Career

A Sociocognitive Perspective on the Development of Academic Career Aspirations

Inaugural-Dissertation zur Erlangung des Doktorgrades der Philosophie an der Ludwig-Maximilians-Universität München

vorgelegt von

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München, April 2016

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Datum der mündlichen Prüfung: 04.07.2016

Acknowledgements

I want to express my sincere gratitude to my supervisors Prof. Rudolf Tippelt and Prof. Martin Fischer for their continuous support and encouraging, constructive style of feedback throughout the doctorate. I also want to thank Prof. Hella von Unger for recommending me helpful literature with respect to the qualitative study. I also want to thank the whole "E-Prom"-team, without their support the conduct of the studies would not have been possible. Special thanks go to Mona Pfeiffer and Kathrin Redies, who were an indispensable support of the project at the institute. I also want to thank the BMBF (Bundesministerium für Bildung und Forschung) which funded the E-Prom project.

My sincere thanks also go to the native English speakers who were such a great and indispensable support: Heather Carpenter, Diana L. Oulette, and Christine Vinson. Not only your language editing was a big support, but your critical reading was at least as important and helped me a lot.

I also want to thank some attentive proofreaders, without whom the thesis would not have reached its final level: Julia Eberle, Mona Pfeiffer, Helen Panzer, Barbara Saravo, Clara Storm and Christian Strobel. Your suggestions, corrections and editing were a huge support.

I also want to thank Basim Aawais for final editing and emotional support throughout the whole "thesis episode".

Content

Deutsche Zusammenfassung

Das E-Prom-Projekt, Ethikvotum und Datenschutz

Die folgende Dissertation wurde im Rahmen des BMBF geförderten Projekts *„E-Prom: Einfluss der Promotionsphase von Nachwuchswissenschaftlerinnen und -wissenschaftlern in der Medizin und den Lebenswissenschaften“* (2013-2016) verfasst. Die Forschungsfragen der Dissertation wurden in die quantitativen Studien und die qualitative Studie des Projekts integriert. Die Studien wurden von der Ethikkommission und dem Datenschutzbeauftragten des Klinikums der Universität München genehmigt. Alle Studienteilnehmerinnen und -teilnehmer wurden über den Verlauf der Studien und deren Ziel informiert und unterzeichneten jeweils eine informierte Einwilligung.

Fragestellung und Hintergrund

Die folgende Arbeit untersucht die Intention von promovierten Nachwuchswissenschaftlerinnen und Nachwuchswissenschaftlern der Medizin und Lebenswissenschaften, eine wissenschaftliche Karriere anzustreben. Der Fokus der Arbeit liegt hierbei auf soziokognitiven Einflussfaktoren: der Selbstwirksamkeitserwartung (Bandura, 1977) und kausalen Attributionen (Weiner, 1985, 2010) bezüglich des Erfolgs oder Misserfolgs der Promotion.

Beide Konstrukte stehen nicht nur theoretisch, sondern auch empirisch mit motivationalen Aspekten in Zusammenhang (Bandura, 1977; Schunk, 1984; Schunk & Gunn, 1986), vor allem im akademischen Bereich. Ebenso wurden kausale Attributionen von Leistungen früh als Quelle von Selbstwirksamkeitserwartungen identifiziert (Bandura, 1977). Die *mastery experience*, die nach Bandura (1977) die wichtigste Quelle der Selbstwirksamkeitserwartung ist, ist demnach nicht mit einer „objektiven Performanz“ gleichzusetzen, sondern beinhaltet bereits deren subjektive Interpretationen und Beurteilungen: „*[P]eople can gain competence through authentic means but, because of faulty appraisals of the circumstances under which they improve, will credit their achievements to external factors rather than to their own capabilities. Here the problem is one of inaccurate ascription of personal competency to situational factors. Successes are more likely to enhance self-efficacy if performances are perceived as resulting from skill than from fortuitous or special external aids“* (Bandura, 1977, S. 148).

Relevanz und Forschungslücke

Aufgrund der Rahmenbedingungen einer wissenschaftlichen Karriere[1] in Deutschland, die sich durch eine sehr geringe Anzahl an Dauerstellen auszeichnet, die sich zudem fast ausschließlich auf die Professur beschränken (Fitzenberger & Schulze, 2014; Krempkow, Musselin, 2005; 2014; Tuttenuj, 2014), kann dieser Karriereweg als äußerst riskant beschrieben werden. Nach Fitzenberger und Schulze (2014) handelt es sich um ein System des „Up or Out“: Die Nachwuchswissenschaftlerin bzw. der Nachwuchswissenschaftler ergattert entweder eine der raren Professuren oder der wissenschaftliche Karrierepfad muss verlassen werden. Es ist ebenfalls anzumerken, dass obwohl diese Merkmale sich auch auf die wissenschaftliche Karriere im Ausland übertragen lassen, der Anteil an befristeten Stellen insbesondere in Deutschland hoch ist (Musselin, 2005).

Frisch Promovierte haben eine vergleichsweise kurze Zeit im Umfeld Wissenschaft verbracht. Während sie eventuell schon durch den Erfolg ihrer Promotion relevante Weichen gestellt haben – z.B. durch die positive Bewertung der Promotion und Publikationen – sind diese objektiv erreichten Leistungen kein ausreichender Prädiktor für den zukünftigen Erfolg in der Wissenschaft oder gar für das Erreichen einer Professur.

Dies gilt insbesondere unter Bedingungen der hohen Konkurrenz: einem hohen Anteil von Promotionen in lebenswissenschaftlichen Fächern und der Medizin (Hornbostel & Simon, 2010; Reimer & Falk, 2007; Jaksztat et al., 2010) sowie einem steigenden Anteil an Promotionen die mit Auszeichnung bestanden werden (Jaksztat, Preßler & Briedis, 2012). Während wenige promovierte Medizinabsolventinnen und -absolventen eine wissenschaftliche Laufbahn anstreben (Epstein, Pfeiffer, Eberle et al., 2016; Gensch & Waltenberger, 2006; Loos, Albrecht, Sander & Schliwen, 2014) und diese weiterhin sehr gute Arbeitsmarktaussichten außerhalb der Wissenschaft haben, sehen sie sich in der Wissenschaft mit ähnlichen Bedingungen konfrontiert: einem ebenso hohen Anteil befristeter Stellen (Loos et al., 2014) und Konkurrenz mit benachbarten Disziplinen (s. Kapitel 1.4. und Kapitel 4 zu disziplinspezifischen Unterschieden).

Unter diesen Bedingungen – hohe Konkurrenz, geringe Aussichten auf eine Professur und relativ kurze Berufserfahrung – sollten Interesse und promotionsbezogene Leistungen *alleine* nicht die Bereitschaft von Nachwuchswissenschaftlerinnen und -wissenschaftlern erklären, sich auf das „Leistungsturnier“ der wissenschaftlichen Karrierelaufbahn (Burk, Grund, Martin & Wiese, 2016, S. 120) einzulassen. Ebenso ist anzumerken, dass sich mit einer fortschreitenden wissenschaftlichen Karrierelaufbahn die Wechselmöglichkeiten in andere

[1] Unter einer wissenschaftlichen Karriere wird im Folgenden eine universitäre Laufbahn verstanden.

Berufsfelder verringern (Enders, 1996). Dies mag für Medizinerinnen und Mediziner jedoch ein geringeres Problem sein, wenn diese neben der Forschung auch klinischen Tätigkeiten nachgehen.

Die wahrgenommene Sicherheit bezüglich der eigenen wissenschaftsbezogenen Kompetenzen bzw. die wissenschaftsbezogene Selbstwirksamkeitserwartung sollte besonders unter dem Umstand der unsicheren Zukunftsperspektiven die Intention weiterhin eine wissenschaftliche Karriere zu verfolgen beeinflussen. Dieser Zusammenhang konnte bereits durch einige Studien belegt werden (Berweger & Keller, 2005; Bieschke, Bishop, & Garcia, 1996; Estrada, Woodcock, Hernandez, & Schultz, 2011). Einschränkend ist zu sagen, dass die vorliegenden Studien nicht für objektive Leistungsindikatoren kontrollieren. Diese können wahrscheinlich einen Teil der wissenschaftsbezogenen Selbstwirksamkeitserwartung erklären, vermutlich gibt es darüber hinaus jedoch weitere Quellen, die sich signifikant auf die wissenschaftsbezogene Selbstwirksamkeit auswirken. Jedoch gibt es bislang kaum Studien, die sich mit Quellen der wissenschaftsbezogenen Selbstwirksamkeitserwartung beschäftigen. Wie schon zuvor argumentiert, sind kausale Attributionen Bandura (1977) zufolge neben objektiven Leistungen ein wesentlicher Bestandteil der *mastery experience*. Die Zuschreibung von Erfolg und Misserfolg im Rahmen der Promotion zu kausalen Faktoren, wie z.B. den eigenen Fähigkeiten, Anstrengungen oder äußeren Rahmenbedingungen, könnte eine Möglichkeit für Nachwuchswissenschaftlerinnen und Nachwuchswissenschaftler sein, die Unsicherheit bezüglich der eigenen Karriereaspirationen zu verringern.

Kausale Attributionen werden zumeist unter Laborbedingungen untersucht, entweder in Bezug auf ein hypothetisches Ereignis oder auf eine kontrollierte Laboraufgabe (Vispoel & Austin, 1995). Die Ergebnisse solcher Laboruntersuchungen sind jedoch in ihrer Übertragbarkeit auf „echte“ Erfahrungen eingeschränkt (vgl. ebd.). Durch die Anwendung einer *critical incident*-Methode, d.h. durch die Erfassung von Attributionen bezogen auf ein natürlich auftretendes Lebensereignis (vgl. ebd.), wird in dieser Arbeit ein Beitrag zur Untersuchung der Relevanz kausaler Attributionen im „echten Leben“ geleistet.

Theoretischer Hintergrund

Kausale Leistungs-Attributionen: Weiners attributionale Theorie der Motivation und Emotion

Attributionale Theorien[2] nehmen an, dass vor allem individuelle Interpretationen von Erfolg und Misserfolg entscheidend sind für die anschließende Leistungsmotivation und Persistenz beim Verfolgen von Zielen (Eccles & Wigfield, 2002). Die attributions-theoretischen Überlegungen sind dabei eng mit dem Gedanken des Menschen als Laienwissenschaftler verbunden, der sich selbst und seine Umwelt verstehen möchte; zum einen aus reiner Neugierde, zum anderen um das eigene Verhalten zu optimieren (Heider, 1958; Weiner, 2000). Weiners attributionale Theorie, die sich mit den motivationalen und emotionalen Konsequenzen von Leistungsattributionen auseinandersetzt (Weiner 1986, 2000, 2010), geht dabei auf Heider (1958) zurück. Dieser äußerte bereits die Vermutung, dass Leistungen auf internale oder externale Faktoren zurückgeführt bzw. attribuiert werden können: *„In commonsense psychology (as in scientific psychology) the result of an action is felt to depend on two sets of conditions, namely factors within the person and factors within the environment"* (Heider, 1958, S. 82).

Darüber hinaus ging Heider davon aus, dass die kausale Zuschreibung zu Faktoren, die vermutlich das Leistungsergebnis mitversursacht haben, wichtig für ein optimiertes Entscheidungsverhalten sei. Mithilfe kausaler Attributionen sei so die Möglichkeit gegeben, das Verhalten im Sinne der Misserfolgsvermeidung und Erfolgsoptimierung anzupassen: *„I make this inquiry not because of idle curiosity, but because only if I refer this relatively insignificant offshoot event to an underlying core event will I attain a stable environment and have the possibility of controlling it"* (Heider, 1958, S. 80). Auf diesen Überlegungen baut Weiners Theorie auf (Weiner, 2010). Zunächst fügt Weiner Heiders Liste kausaler Faktoren (Fähigkeiten, Anstrengung und Aufgabenschwierigkeit) den Ursachenfaktor Glück hinzu (Weiner 1992, 2010). Darüber hinaus nimmt Weiner an, dass bei kausalen Faktoren drei Dimensionen unterschieden werden können: Lokation *(locus of causality)* – mit den Ausprägungen internal oder external –, Kontrollierbarkeit *(controllability)* – kontrollierbar oder nicht kontrollierbar –, und Stabilität *(stability)* – stabil oder nicht stabil.[3]

[2] Attributionale Theorien beschäftigen sich mit den Konsequenzen von kausalen Attributionen (Motivation, Emotion, Leistungen), wohingegen Attributionstheorien, wie beispielsweise Kelleys Kovariationsprinzip (1971, 1972), sich mit dem Zustandekommen dieser beschäftigen (Stiensmeier-Pelster & Heckhausen, 2006).

[3] Heider (1958) spricht ebenfalls die Stabilität von Ursachen und deren Bedeutung für die Vorhersage zukünftiger Ereignisse an. So findet sich in seinem Werk die Aussage: „Instances of relatively unchanging structures are such object properties as color and size, such person properties as character and ability. We feel, for example, that John's good grades make sense when we refer his achievement, a relatively momentary

Dabei bedeutet eine internale Lokation, dass die Ursache im Akteur selbst liegt, beispielsweise die eigens aufgebrachte Anstrengung. Ein Beispiel für eine externale Lokation wäre Unterstützung durch das Umfeld. Die Kontrollierbarkeit bezieht sich auf die wahrgenommene Möglichkeit, die Ursache selbst zu beeinflussen. So kann man sich selbst dazu entscheiden, mehr oder weniger Anstrengung aufzubringen. Der Stabilität einer Ursache, also deren Fortbestehen, schreibt Weiner die bedeutendste Rolle in Bezug auf Veränderungen in der Erwartungshaltung zu (Weiner 1985, 2010).

In Bezug auf die Lokation ist zu bemerken, dass diese nicht mit dem Konzept des *locus of control* (Rotter, 1966) zu verwechseln ist. Im Gegensatz zu Rotter *unterscheidet* Weiner zwischen Lokation und Kontrollierbarkeit, denn er erkennt, dass eine internale Ursache, z.B. die Begabung, nicht unbedingt kontrollierbar sein muss (Weiner, 2010). Ein weiterer Unterschied besteht darin, dass Rotters *locus of control* ein Persönlichkeitsmerkmal ist, kausale Attributionen hingegen abhängig von der Situation sind (vgl. ebd.).

Von anderen Autoren wurden Globalität und Intentionalität als weitere kausale Dimensionen diskutiert: Die Globalität einer Ursache meint dabei, ob diese situationsspezifisch wahrgenommen wird oder auch als relevant in anderen Situationen (Abramson, Seligman, & Teasdale, 1978). Weiterhin wurde die Intentionalität, also das absichtsvolle Verhalten, als kausale Dimension vorgeschlagen. Jedoch argumentiert Weiner, dass das absichtsvolle Verhalten keine Eigenschaft einer Ursache ist, sondern eher den motivationalen Zustand einer Person wiederspiegelt [*„…describes an action, or a motivational state of an organism“* (Weiner, 1985, S. 554)]. So kann die Intentionalität eher als Ergebnis einer kausalen Zuschreibung verortet werden. Weiner sieht Lokation, Kontrollierbarkeit und Stabilität als die zentralen kausalen Dimensionen, gesteht jedoch zu, dass die Globalität einer Ursache ebenfalls von Bedeutung sein kann (Weiner, 2010). Dies wird jedoch nicht weiter ausgeführt (vgl. ebd.).

Zuschreibung von kausalen Faktoren zu kausalen Dimensionen. Während Weiner zunächst kausale Faktoren a priori kausalen Dimensionen zugeschrieben hatte, und somit insbesondere der Fähigkeit als vermeintlich stabile Ursache große Bedeutung beimaß, wurde diese Praxis der a priori Zuschreibung durch den Forschenden als *„fundamentaler Forscher-Attributionsfehler“*[4] kritisiert (Russel, 1982). Hier wurde argumentiert, dass die subjektive

event, to his high intelligence, *a more or less permanent property*, and we then believe we are safe in predicting a successful college career” (Heider, 1958, S. 80; Hervorhebung nicht im Original). Formal unterscheidet Heider jedoch nur die Lokation von Ursachen. Die systematische Unterscheidung auf den drei Dimensionen findet sich erst bei Weiner (1985, 2010).

[4] Freie Übersetzung der Autorin des Ausdrucks *„fundamental attribution researcher error”* (Russel, 1982).

Wahrnehmung der dimensionalen Eigenschaften von Faktoren direkt gemessen werden müsse, da Personen diese unterschiedlich auffassen könnten (Russel, 1982; Weiner, 1985; Dickhäuser & Stiensmeier-Pelster, 2000). So könnte beispielsweise eine Person der Ansicht sein, dass mathematische Fähigkeiten eine stabile und nicht kontrollierbare Eigenschaft sind, wohingegen eine andere meinen könnte, dass diese trainiert werden können und somit nicht stabil, aber kontrollierbar seien (Weiner, 1985). Jedoch konnte eine interkulturelle Studie unter Berücksichtigung des sozialen Status belegen, dass die Wahrnehmung kausaler Faktoren der „a priori-Klassifizierung" von Weiner nahe kommt (Schuster, Forsterlung & Weiner, 1989). Ebenfalls belegen eine Vielzahl an empirischen Studien, die kausale Faktoren messen, dass diese im postulierten Zusammenhang mit unterschiedlichen abhängigen Variablen stehen, wie z.B. der Selbstwirksamkeitserwartung (Schunk & Gunn, 1986, Schunk, 1984; Vasil, 1992), der Motivation und der Persistenz (Kiefer & Shih, 2006; Curdes, 2003) oder auch mit erbrachten Leistungen (Hsieh & Schallert, 2008).

Stabilität der Ursache oder Verhaltenswirksamkeit. Im Hinblick auf die kausalen Dimensionen kam eine weitere Kritik von Dickhäuser und Stiensmeier-Pelster (2002). Diese argumentieren, dass nicht die Stabilität einer Ursache für die zukünftigen Erwartungen entscheidend ist, sondern die Stabilität der Verhaltenswirksamkeit. Um sich dieses Argument im Kontext der Promotion zu veranschaulichen, könnte man sich vorstellen, dass der Promotionserfolg auf die stabile Ursache „unterstützende Betreuerpersönlichkeit" zurückgeführt wird. Wohingegen die Persönlichkeit des Betreuers stabil ist, mag diese irrelevant für das zukünftige Verhalten sein, wenn eine Weiterbeschäftigung an dem Lehrstuhl nicht möglich ist.

Diesen Umstand können Dickhäuser und Stiensmeier-Pelster (2002) zudem innerhalb eines Experiments demonstrieren: Hier werden Teilnehmerinnen und Teilnehmer mit der Situation konfrontiert eine auf einer Diskette gespeicherte Datei nicht öffnen zu können aus den Gründen A) defekte Diskette (stabil und nicht kontrollierbar) oder B) unzureichende Kenntnisse (nicht stabil und kontrollierbar). Die subjektive Erfolgswahrscheinlichkeit in Zukunft Dateien erfolgreich zu öffnen, war im Fall A, trotz stabiler Ursache für Misserfolg, höher. Denn die defekte Diskette wurde als irrelevant für zukünftiges Verhalten angesehen. Hingegen das Aneignen von fehlendem Wissen als ein viel aufwändigeres Unterfangen.

Selbstwirksamkeitserwartung

Mit Attributionen eng verbunden ist das Konzept der Selbstwirksamkeitserwartung (kurz: Selbstwirksamkeit) von Bandura (1977). Die Selbstwirksamkeit bezeichnet Erwartungen an die eigene Fähigkeit, eine zu einem erwünschten Ergebnis führende Handlung erfolgreich zu vollziehen (vgl. ebd.). Damit ist die Selbstwirksamkeit auch eine Art wahrgenommener Kontrolle über die eigenen Leistungen und Ziele (Ajzen, 2002). Zudem ist es wichtig zu erwähnen, dass die Selbstwirksamkeit bereichsspezifisch ist und es sich um keine Persönlichkeitseigenschaft handelt (Bandura, 1982, 2006; Betz & Hacket, 2006). Um es in den Worten von Betz und Hacket zu sagen (2006, S. 9)*: "[…] there is no such thing as "self-efficacy" or "career self-efficacy" […] without reference to specific domains of behavior"*.

Der Selbstwirksamkeit steht zum einen, wie auch kausale Attributionen, mit der Motivation und Zielsetzung in engem Zusammenhang, darüber hinaus aber auch mit motivationalem Handeln bzw. der *Selbstregulation* (Bandura, 1991). So würde eine Person sich bei höherer Selbstwirksamkeit wohl eher dazu entscheiden, Anstrengung für eine Aufgabe aufzuwenden als bei geringerer Selbstwirksamkeit (vgl. ebd.).

Um wieder auf die Verbindung zur attributionalen Theorie von Weiner zu kommen, ist es einleuchtend, dass die Erklärungen, die eine Person für ihre vergangenen Leistungen hat sich auf die wahrgenommen Handlungskompetenzen für zukünftige Aufgaben auswirken sollten, gerade wenn die zukünftigen Aufgaben den vergangenen gleichen. Wie bereits zuvor beschrieben, weist ebenfalls Bandura (1977) darauf hin, dass „objektiver" Erfolg und Misserfolg als Prädiktoren der Selbstwirksamkeitserwartung alleine nicht ausreichen. Die Interpretation des Erfolgs bzw. Misserfolgs – die Zuschreibung der Leistung zu kausalen Faktoren – muss berücksichtigt werden (vgl. ebd.). So können Attributionen im Zusammenhang mit erreichten Leistungen als Bestandteile der *mastery experience* gesehen werden, die nach Bandura die wichtigste Quelle der Selbstwirksamkeit ist.

Weitere Quellen der Selbstwirksamkeit sind nach Bandura stellvertretende Erfahrungen *(vicarious experience)*, also Erfahrungen anderer Personen, verbale Beeinflussung und physiologische Zustände, so z.B. das Empfinden von Stress. Die verbale Beeinflussung kann zudem auch in Zusammenhang mit Attributionen gesehen werden, denn Feedback kann ebenfalls für den Empfänger kausale Ursachen implizieren. Hier sind Interventionsstudien zu Reattributionstrainings zu nennen, in denen Teilnehmerinnen und Teilnehmer über Feedback lernen, Misserfolge auf kontrollierbare Ursachen zu attribuieren und Erfolge den eigenen Fähigkeiten zuzuschreiben (z.B. Relich, Debus, & Walker, 1986; Ziegler & Heller, 2000).

Attribution und Selbstwirksamkeit: Empirische Ergebnisse

Im Folgenden sollen einige relevante Forschungsergebnisse in Bezug auf kausale Attributionen und die Selbstwirksamkeitserwartung erläutert werden (vgl. Kapitel 2). Die Forschungsergebnisse bezüglich der kausalen Attributionen werden im Folgenden so dargestellt, dass zunächst Befunde zu Ursachenfaktoren und anschließend Befunde zu Ursachendimensionen betrachtet werden.

Attribution auf kausale Ursachen. Auch wenn die empirischen Ergebnisse auf diesem Themengebiet nicht immer konsistent sind, so zeigt sich, dass Fähigkeitsattributionen bei guter Leistung zu höheren Erfolgserwartungen/Selbstwirksamkeitserwartungen führen (z.B. Schunk, 1984; Schunk & Gunn, 1986; Vasil, 1992) und die Motivation bzw. die Ausdauer beim Bearbeiten von Aufgaben steigern (Curdes et al., 2003; Kiefer & Shih, 2006; Schunk, 1984). Umgekehrt verhält es sich bei Misserfolgen: Werden diese auf fehlende Bemühung oder auf nicht-stabile externe Faktoren attribuiert, so steigt die Motivation (Andrews & Debus, 1978). Bezüglich der externen Faktoren gibt es jedoch Ausnahmen. So führt die Attribution von Misserfolg auf Diskriminierung zu einer geringeren Motivation (van Laar, 2000).

Einige Studien können zudem direkte Effekte von Attributionen auf spätere Leistungen finden (z.B. Ziegler & Heller 2000, Schunk, 1984; Schunk & Gunn, 1986). Schunk und Gunn (1986) fanden in diesem Zusammenhang, dass bei guten Leistungen Attributionen auf den externen Faktor Glück oder auf die geringe Aufgabenschwierigkeit einen negativen Einfluss auf die spätere Leistung haben. Fähigkeitsattributionen hingegen hatten im Rahmen der Studie einen positiven Effekt auf die Leistungen.

Darüber hinaus zeigen Interventionsstudien einen positiven Einfluss von Reattributionstrainings auf spätere Leistungen (zusammenfassend Weiner, 2010; Relich et al. 1986; Ziegler & Heller, 2000). In einer Studie von Ziegler und Heller (2000), in der Mädchen ein solches Training im Fach Physik durchliefen, hatten diese am Ende des Schuljahres signifikant bessere Schulnoten als die Kontrollgruppe ohne ein solches Training. Die Effekte solcher Interventionen sind sehr wahrscheinlich auf Änderungen in der Motivation zurückzuführen (Weiner, 2010). Somit ist auch zu verstehen, dass andere Studien keinen direkten Effekt von Attributionen auf Leistungen feststellen (z.B. Erkut, 1983).

In Bezug auf die wissenschaftliche Karriere konnten Curdes und Kollegen (2003) belegen, dass die Attribution von Erfolg auf die eigenen Fähigkeiten bei Mathematikstudentinnen und -studenten in signifikant positivem Zusammenhang mit der Promotionsintention stand. Unter

Kontrolle der Attributionen nivellierten sich zudem zuvor signifikante Geschlechterunterschiede bzw. die geringe Ausprägung der Promotionsintention bei weiblichen Studienteilnehmerinnen.

Attribution auf kausale Dimensionen. Studien, die kausale Dimensionen messen, kommen zu ähnlichen Ergebnissen. Dickhäuser und Stiensmeier-Pelster (2000) fanden beispielsweise, dass die Attribution von Erfolg auf stabile, globale und kontrollierbare Ursachen mit einem höheren Fähigkeitsselbstkonzept verbunden war. Thomas und Mathieu (1994) zeigten, dass die Attribution von Erfolg auf stabile Ursachen bei Schülerinnen und Schülern mit einer höheren Selbstwirksamkeitserwartung einherging.

Im Einklang damit stehen die Ergebnisse einer Studie von Stajkovic und Sommer (2000), die zeigen, dass die Attribution von Erfolg auf interne Faktoren mit höheren Selbstwirksamkeitserwartungen verbunden war. Darüber hinaus wurde empirisch belegt, dass die Attribution von Misserfolg auf stabile Faktoren mit einer Absenkung von Aspirationen einhergeht (Donovan & Williams, 2003), wohingegen die Attribution von Misserfolg auf kontrollierbare Faktoren mit höheren Aspirationen zusammenhängt (Williams, Donovan, & Dodge, 2003).

Selten werden in Studien sowohl kausale Ursachenfaktoren als auch kausale Dimensionen gemessen. Hsieh und Schallert (2008) fanden zwar einen Zusammenhang zwischen Fähigkeitsattributionen auf die Selbstwirksamkeitserwartung, jedoch keinen Effekt der Stabilitätsdimension. Hsieh und Kang (2010) konnten mit beiden methodischen Herangehensweisen – der Messung von kausalen Faktoren und der Messung kausaler Dimensionen – zeigen, dass Personen dazu tendieren, selbstwertdienlich zu attribuieren, also Erfolge eher der eigenen Person zuschreiben und Misserfolge eher externen Faktoren. Die Tendenz zu selbstwertdienlichen Attributionen wird häufig auch als Indiz für die Konstruktvalidität von Instrumenten, die Attributionen messen sollen, herangezogen (Russel, 1987).

Selbstwirksamkeit. Selbstwirksamkeitserwartungen wurden in unterschiedlichsten Kontexten untersucht und Studien können die Relevanz des Konstrukts gut unterstützen (Eccles & Wigfield, 2002). Insbesondere im akademischen und beruflichen Umfeld wird das Konzept der Selbstwirksamkeit häufig herangezogen. Positive Effekte der Selbstwirksamkeit wurden zum Beispiel auf den beruflichen Erfolg festgestellt (z.B. Abele-Brehm & Stief, 2004) sowie auch auf die Intention zu promovieren (Spies & Schute, 1999) bzw. eine wissenschaftliche

Laufbahn anzustreben (Berweger & Keller, 2005; Bieschke et al., 1996; Estrada et al., 2011). Bei Estrada et al. (2011) ist jedoch der Zusammenhang zwischen Selbstwirksamkeit und wissenschaftliche Karriereaspiration unter Berücksichtigung der intrinsischen Motivation nicht signifikant. Weiterhin zeigen sich Unterschiede in Bezug auf das Geschlecht, sodass Nachwuchswissenschaftlerinnen in vielen Studien scheinbar eine geringere wissenschaftsbezogene Selbstwirksamkeit aufweisen als ihre männlichen Kollegen (Berweger & Keller, 2005; Bakken et al., 2003; Jöstl, Bergsmann, Lüftenegger, Schober & Spiel, 2012; Spies & Schute, 1999). Diese Ergebnisse sind jedoch nicht immer konsistent (Bieschke et al., 1996). Voneinander abweichende Ergebnisse könnten zum einen an der Untersuchung unterschiedlicher Fachbereiche liegen (die sich beispielsweise in der Geschlechterzusammensetzung unterscheiden), an der gemeinsamen Analyse verschiedener Fächer oder auch an der fehlenden Kontrolle für Indikatoren der objektiven Leistung.

Attribution und Selbstwirksamkeit. Studien können vielfach den Zusammenhang von Attributionen und Selbstwirksamkeitserwartungen unterstützen. So zeigt beispielsweise Schunk (1984) einen signifikanten Zusammenhang von Fähigkeits- und Anstrengungsattributionen auf die Selbstwirksamkeitserwartung bei Schülerinnen und Schülern. Bei einem weiteren Experiment von Schunk und Gunn (1986) zeigte sich bei guter Leistung ein positiv signifikanter Effekte von Fähigkeits-Attributionen auf die Selbstwirksamkeitserwartung. Weiterhin schien die Attribution auf Anstrengung, Glück und Leichtigkeit der Aufgabe in negativem Zusammenhang mit der Selbstwirksamkeitserwartung zu stehen. In Bezug auf den eher unerwarteten negativen Zusammenhang der Anstrengungsattributionen interpretieren die Autoren der Studie, dass mit steigendem Alter dem Konzept der Fähigkeit als Ursache für Leistungen eine immer bedeutendere Rolle zukommt. Ebenso ist anzumerken, dass es eine gängige Auffassung ist, dass Fähigkeiten eine Leistungsverbesserung durch Anstrengung einschränken (Nicholls, 1978). So kann eine starke Attribuierung des Erfolgs auf Anstrengung die Wahrnehmung der eigenen Fähigkeiten nach unten korrigieren.

Die bereits erwähnte Studie von Vasil (1992) kann zeigen, dass Forscher, die die Annahme eines Artikels in einer wissenschaftlichen Zeitschrift auf Fähigkeiten attribuierten, eine höhere Selbstwirksamkeitserwartung aufwiesen, hingegen die Attribution einer Ablehnung auf die eigenen Fähigkeiten mit einer geringeren Selbstwirksamkeitserwartung einhergingen. In der bereits erwähnten Studie von Thomas und Mathieu (1994) konnte gezeigt werden, dass Schülerinnen und Schüler, die ihre Examenserfolge auf stabile Faktoren attribuierten, den

größten Zuwachs in der Selbstwirksamkeitserwartung hatten – auch im Vergleich mit ebenso erfolgreichen Mitschülerinnen und Mitschülern, die ihre Erfolge weniger stabilen Ursachen zuschrieben. In Übereinstimmung damit fanden Hsieh und Kang (2010), dass Schülerinnen und Schüler, die Erfolge internal attribuierten, ebenfalls höhere Selbstwirksamkeitserwartungen äußerten. Ebenso hatten Schülerinnen und Schüler, die ihre Misserfolge auf kontrollierbare Faktoren attribuierten, höhere Selbstwirksamkeitserwartungen.

Tolli und Schmidt (2008) können mit ihrer Studie weitere Evidenz für den mediierenden Effekt der Selbstwirksamkeitserwartung zwischen Attributionen und Aspirationen liefern: Personen, die in dem Experiment positives Feedback erhielten und dieses internal attribuierten, steigerten ihre Selbstwirksamkeitserwartung, was dazu führte, dass sie ihre Ziele nach oben korrigierten .

Darüber hinaus unterstützen die Studien von Silver, Mitchell und Gist (1995) und Stajkovic und Sommer (2000) die postulierte wechselseitige Beeinflussung von Attributionen und Selbstwirksamkeitserwartungen. Silver et al. (1995) konnten innerhalb zweier Experimente zeigen, dass erstens Personen mit höherer „Baseline“-Selbstwirksamkeitserwartungen (gemessen vor der Intervention) zu selbstwertdienlicheren Attributionen tendierten und zweitens, dass die Performanz in der Laboraufgabe als auch Attributionen in Bezug auf diese, in signifikantem Zusammenhang mit anschließenden Selbstwirksamkeitserwartungen standen. Stajkovic und Sommer (2000) führten ebenfalls ein Experiment durch, in dem Probanden die Aufgabe hatten, eine Brainstorming-Aufgabe zu bearbeiten. Hier zeigte sich, dass die „Baseline“-Selbstwirksamkeit mit Attributionen in Zusammenhang stand, die sich auf die anschließende Selbstwirksamkeitserwartung nach dem Performanz-Feedback weiter auswirkten.

Heuristisches Modell und allgemeine Hypothesen

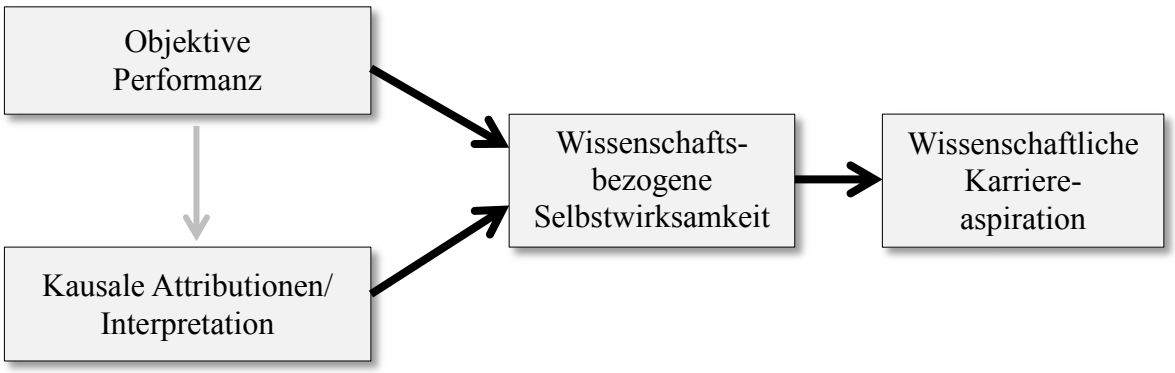
Auf Basis der vorgestellten theoretischen und empirischen Grundlage werden folgende Hypothesen aufgestellt, die zur Veranschaulichung in einem Pfadmodell (s. Abbildung 1) dargestellt werden. Die hier vorgestellten Hypothesen und das graphische Modell dienen der Zusammenfassung der erwarteten Zusammenhänge. Weiterhin werden spezifische und gerichtete Hypothesen in den jeweiligen Studien aufgestellt (vgl. Kapitel 8 und 9).

Hypothese 1 – Attributionen und wissenschaftsbezogene Selbstwirksamkeitserwartung: Kausale Attributionen in Bezug auf die Promotionsleistung sind signifikant mit der wissenschaftlichen Selbstwirksamkeitserwartung verbunden.

Hypothese 2 – Wissenschaftsbezogene Selbstwirksamkeitserwartung und wissenschaftliche Karriereaspirationen: Höhere wissenschaftliche Selbstwirksamkeitserwartungen gehen mit signifikant höheren wissenschaftlichen Karriereaspirationen einher.

Hypothese 3 – Attributionen und wissenschaftliche Karriereaspirationen:
Kausale Attributionen in Bezug auf die Promotionsleistung stehen in einem signifikanten Zusammenhang mit wissenschaftlichen Karriereaspirationen. Dieser Zusammenhang ist indirekt und wird über Selbstwirksamkeitserwartungen vermittelt.

Abbildung 1: Graphische Illustration des theoretischen Modells[5]



[5] Aus Gründen der Übersichtlichkeit werden die Kontrollvariablen nicht abgebildet.

Methodisches Vorgehen

Um die postulierten Zusammenhänge zu untersuchen, wurden zwei quantitative und eine qualitative Studie durchgeführt. Die beiden quantitativen Studien unterschieden sich dabei in der Erfassung der Attributionen: in Studie 1 (Kapitel 8) wurden diese als kausale Faktoren gemessen, in Studie 2 (Kapitel 9) als Ursachendimensionen. In der qualitativen Studie wurde eine Teilgruppe der Teilnehmerinnen und Teilnehmer aus Studie 1 tiefergehend in Bezug auf ihre Promotionsphase befragt. Die qualitative Studie sollte insbesondere motivationale Prozesse während der Promotion beleuchten, da in den quantitativen Studien kausale Attributionen lediglich in Bezug auf das Gesamtergebnis der Promotion bezogen waren, die Promotion jedoch wahrscheinlich immer aus vielen Erfolgs- und Misserfolgserlebnissen besteht.

Die Methodentriangulation, *within-methods* und *between-methods* (Denzin, 1978), wurde somit auch als Werkzeug der Kreuzvalidierung eingesetzt (Jick, 1979). So ist im Fall, dass mehrerer Methoden die postulierten Zusammenhänge unterstützen, die Wahrscheinlichkeit eines methodischen Artefakts minimiert (vgl. ebd.). Insbesondere kann die spontane Äußerung von Attributionen bei den Teilnehmerinnen und Teilnehmern der qualitativen Studie die Ergebnisse der quantitativen Studie untermauern. Die Triangulation sollte außerdem die qualitativen Daten im Sinne des *„Vertiefungsmodells“* (Mayring, 2001), stützen und zu einem besseren Verständnis und einer besseren Interpretation der quantitativen Ergebnisse beitragen. In der qualitativen Studie konnten zudem zusätzliche Themen und Einflussfaktoren, wie beispielsweise die Betreuungssituation, in Zusammenhang mit den zentralen Konstrukten der Arbeit gesetzt werden.

Methoden und Ergebnisse der quantitativen Studien (vgl. Kapitel 8 und 9)

Methoden

In Studie 1 und 2 wurden Promovierte medizinischer und biologischer Fakultäten online befragt. Die angewandten Fragebögen unterschieden sich lediglich in Bezug auf die Erfassung der Attributionen (kausale Faktoren in Studie 1 und kausale Dimensionen in Studie 2), weshalb die Ergebnisse und das methodische Vorgehen an dieser Stelle zusammenfassend dargestellt werden. Methodische Unterschiede der beiden Studien werden dabei hervorgehoben. Detailliertere Beschreibungen der Stichprobe und methodische Einzelheiten sind in den Beschreibungen der jeweiligen Studien zu finden (Kapitel 8 und 9). Alle Teilnehmerinnen und Teilnehmer wurden über ihre Fakultät zur Studienteilnahme eingeladen,

über die Ziele der Studie aufgeklärt und unterzeichneten eine elektronische informierte Einwilligung. Als Dankeschön erhielten die Teilnehmerinnen und Teilnehmer einen Einkaufsgutschein über fünf Euro.

Stichprobe Studie 1

Die Stichprobe der ersten Studie setzte sich aus Promovierten medizinischer und biologischer Fakultäten zusammen, die ihren Abschluss zwischen April 2013 und April 2014 erhielten.[6] Die untersuchte Stichprobe bestand aus 285 Promovierten der Lebenswissenschaften und 407 Promovierten der Humanmedizin. In beiden Fächergruppen lag der Anteil weiblicher Promovierter bei knapp über 60 Prozent. Dies scheint zudem der Geschlechterverteilung in diesen Fächern deutschlandweit nahezukommen (Hauss et al., 2015; Statistisches Bundesamt, 2014, 2015).

Stichprobe Studie 2

Die Stichprobe der zweiten Studie setzte sich ebenfalls aus Promovierten medizinischer und biologischer Fakultäten zusammen, die ihren Abschluss zwischen April 2014 und April 2015 erhielten. Einige Universitäten, die in Studie 1 teilgenommen hatten nahmen an Studie 2 nicht teil, was zu einer geringeren Fallzahl führte.[7] Die untersuchte Stichprobe bestand aus 223 Promovierten der Lebenswissenschaften und 107 Promovierten der Humanmedizin. In beiden Fächergruppen lag der Anteil weiblicher Promovierter, ähnlich wie in Studie 1, bei knapp 60 Prozent.

Operationalisierung

Übersetzung. Die Umfragen aus beiden Studien wurden professionell ins Englische übersetzt. Jedoch muss angemerkt werden, dass die Skalen nicht rückübersetzt wurden. Aufgrund der geringen Anzahl englischsprachig ausgefüllter Fragebögen (in beiden Studien insgesamt 36), wurden diese aus Analysen nicht ausgeschlossen. Es gab zudem keine Hinweise darauf, dass diese die Skalengüte beeinträchtigen.

[6] Teilnehmende Universitäten waren: Ludwigs-Maximilians-Universität München, Technische Universität München, Universität Würzburg, Friedrichs-Alexander-Universität Erlangen-Nürnberg, Universität Regensburg, Universität Witten-Herdecke, Rheinische Friedrich-Wilhelms-Universität Bonn, Universität zu Köln, RWTH Aachen, Ruhr-Universität Bochum, Heinrich-Heine-Universität Düsseldorf, Technische Universität Dresden, Universität Duisburg-Essen, Ruhr-Universität Bochum, Technische Universität Dresden, Universität Duisburg-Essen.

[7] Teilnehmende Universitäten waren: Ludwigs-Maximilians-Universität München, RWTH Aachen, Ruhr-Universität Bochum, Technische Universität München, Friedrichs-Alexander-Universität Erlangen-Nürnberg, Universität zu Köln, Universität Witten-Herdecke; Universität Würzburg.

Attributionen wurden in Bezug auf die subjektive Einschätzung des Promotionserfolgs erfasst. Dies ist eine gängige Praxis in Studien die Attributionen untersuchen, da persönliche Standards in Bezug auf Erfolg und Misserfolg unterschiedlich sind (Arkin & Maruyama, 1979). Hier zeigte sich aber auch, dass objektive Leistungsindikatoren der Promotion, wie Publikationen und Promotionsnote, in signifikantem Zusammenhang mit der persönlichen Einschätzung lagen (s. Kapitel 8, Tabelle 1 und Kapitel 9, Tabelle 13)

In Studie 1 wurden Attributionen als Zustimmung zu unterschiedlichen *kausalen Faktoren* gemessen: Fähigkeiten, Anstrengung, (fehlende) Unterstützung durch das Umfeld, z.B. Betreuende, eine gute/schlechte Beziehung zu Betreuenden, eine wohlwollende/strenge Bewertung und hohe/niedrige promotionsfremde Arbeitsbelastung. Die gängigen externen Faktoren „Glück" und „Aufgabenschwierigkeit" wurden für den Rahmen der Promotion als unpassend erachtet und daher nicht erhoben.

In Studie 2 wurde die Bewertung des vermeintlich wichtigsten Faktors hinsichtlich seiner kausalen Dimensionen erfasst: Lokalität (Cronbachs Alpha, Erfolg=0.81; Misserfolg=0.82), Kontrollierbarkeit (Cronbachs Alpha, Erfolg=0.79, Misserfolg=0.89), Stabilität der Verhaltenswirksamkeit (kurz: Stabilität) (Cronbachs Alpha, Erfolg=0.90; Misserfolg=0.82) und Globalität (Cronbachs Alpha=0.82, Misserfolg=0.83). Die Skala wurde auf Grundlage des Attributionsstilfragebogens für Erwachsene (ASF-E) (Poppe, Pelster, & Stiensmeier-Pelster, 2005) entwickelt. Die Items wurden dabei an den Kontext der Promotion angepasst. Während konfirmatorische Faktorenanalysen die besten Passungen für ein vierdimensionales Konstrukt zeigten, mussten die Kontrollierbarkeit und Globalität aufgrund von Multikollinearität aus den multivariaten Analysen herausgenommen werden.

Wissenschaftsbezogene Selbstwirksamkeitserwartung. Die Skala zur Erfassung der wissenschaftsbezogenen Selbstwirksamkeitserwartung wurde auf Grundlage der Skala von Berweger (2008) entwickelt, zudem wurde auch der Artikel von Kyvik (2013), der die zentralen Tätigkeiten in der Wissenschaft empirisch untersucht, miteinbezogen. Die wissenschaftsbezogene Selbstwirksamkeitserwartung wurde zudem als wahrgenommene Sicherheit erfasst, bestimmte Tätigkeiten, die im Rahmen einer wissenschaftlichen Karriere wichtig sind, erfolgreich zu meistern. Diese umfassten: 1) Projektmanagement, 2) das Durchführen von Forschung, 3) regelmäßiges Publizieren in peer-reviewten Journals, 4) das Verfassen einer (Sammel-)Habilitation, 5) das Einwerben von Drittmitteln, 6) Anerkennung in der wissenschaftlichen Community erlangen und 7) Kooperationen mit anderen Wissenschaftlerinnen und Wissenschaftlern aufzubauen. Die Skala wies eine sehr gute

Reliabilität auf (Cronbachs Alpha=0.93). Methoden der explorativen Faktorenanalyse – Eigenwertkriterium (Eigenwert größer eins), Scree-Test und Velicers Minimum Average Partial Correlation test (MAP-test) (O'Connor, 2000; Velicer, 1976; Velicer, Eaton, & Fava, 2000) – wiesen auf ein eindimensionales Konstrukt hin.

Wissenschaftliche Karriereaspirationen wurden durch zwei Items erfasst: 1) Die Intention, auf lange Sicht einer wissenschaftlichen Karriere nachzugehen und 2) Die Intention, langfristig eine Professur anzustreben (Cronbachs Alpha=0.92).

Zudem wurden binäre Variablen für das ***Studienfach*** (Medizin oder Lebenswissenschaften) und ***Geschlecht*** erstellt.

Kontrollvariablen. Berücksichtigt wurden zudem Kontrollvariablen, die sich ebenso auf die wissenschaftsbezogene Selbstwirksamkeitserwartung und die Intention, eine wissenschaftliche Karriere zu verfolgen, auswirken könnten. Dies waren zunächst objektive *Leistungsindikatoren der Promotion*: die Note der Promotion, Publikationen als Erst- und Co-Autor/in sowie Konferenzbeiträge. Ebenso wurde die *intrinsische Forschungsmotivation* (kurz: intrinsische Motivation) vor der Promotion bzw. als Grund für die Aufnahme einer Promotion berücksichtigt. Die Skala zur Erfassung der intrinsischen Motivation beinhaltete die Gründe 1) später allgemein forschen zu wollen, 2) fachlich dazu lernen, 3) während der Promotion forschen und 4) sich intensiver mit dem speziellen Thema der Promotion zu beschäftigen (Cronbachs Alpha=0.81). Methoden der explorativen Faktorenanalyse – Eigenwertkriterium (Eigenwert größer eins), Scree-Test und Velicers Minimum Average Partial Correlation test (MAP-test) (O'Connor, 2000; Velicer, 1976; Velicer, Eaton, & Fava, 2000) – wiesen auf ein eindimensionales Konstrukt hin.
Des Weiteren wurde kontrolliert, ob Personen während und nach ihrer Promotion als wissenschaftliche Mitarbeiterin bzw. wissenschaftlicher Mitarbeiter angestellt waren. Da 28 Prozent der promovierten Lebenswissenschaftlerinnen und Lebenswissenschaftler jedoch nach der Promotion einige weitere Monate auf ihrer Promotionsstelle beschäftigt wurden und der Großteil der in der Medizin Promovierten ihre Facharztweiterbildung begonnen hatte, wurde diese Position nicht als aussagekräftiger Indikator für langfristige berufliche Ziele gesehen. Dieser Faktor konnte zudem in Studie 2 aufgrund eines technischen Fehlers und einem sehr hohen Anteil fehlender Werte nicht berücksichtigt werden. Letztlich wurde das Alter der Personen als Kontrollvariable aufgenommen.

Analysemethoden

Alle Analysen wurden mit Stata, Version 12, durchgeführt. Multivariate Regressionsanalysen wurden durchgeführt, um fach- und geschlechtsspezifische Unterschiede zu identifizieren. Die postulierten Zusammenhänge zwischen Attributionen, wissenschaftlichen Selbstwirksamkeitserwartungen und wissenschaftlicher Karriereaspiration wurden in multivariaten Pfadmodellen berechnet. Aufgrund der reduzierten Fallzahl in den Pfadmodellen, durch die Aufteilung der Stichproben in erfolgreiche und weniger erfolgreiche Promotionen, wurden diese Zusammenhänge zusätzlich zur *Complete Case Analysis* auch mit imputierten Daten berechnet. Zum einen wurden Pfadmodelle mit der *Full Information Maximum-Likelihood* (FIML)-Methode berechnet, die für Pfadmodelle in Stata 12 implementiert ist. Zum anderen wurden fehlende Wert mit der MICE-Methode *(Multiple Imputations via Chained Equations)* imputiert, da die FIML-Methode bei nicht-kontinuierlichen und nicht normalverteilten Daten zu verzerrten Schätzern führen kann (Lee & Carlin, 2010; von Hippel, 2012). Da die mit MICE imputierten Daten in Stata 12 nicht in Pfadmodellen analysiert werden können, wurde in diesem Fall auf einfache Regressionsanalysen ausgewichen. Hierdurch war jedoch die Möglichkeit der Berechnung indirekter Effekte eingeschränkt (Rucker, Preacher, Tormala, & Petty, 2011). Um die Wahrscheinlichkeit eines zufälligen Effekts zu minimieren, wurde eine Hypothese nur angenommen, wenn mindestens zwei der drei Methoden – Complete Case, FIML, MICE – signifikant waren.

Ergebnisse

Pfadmodelle – Attributionen, Selbstwirksamkeitserwartung und wissenschaftliche Karriereintention

Zunächst werden die Ergebnisse der Pfadmodelle aus beiden Studien berichtet. Die zentralen Ergebnisse der Pfadmodelle sind zudem grafisch in den Abbildungen 2 bis 5 dargestellt. Die tabellarisch dargestellten Ergebnisse sind zudem in den jeweiligen Studien zu finden (Kapitel 8 und 9).

Wissenschaftsbezogene Selbstwirksamkeitserwartung und wissenschaftliche Karriereaspirationen. Zunächst zeigte sich sowohl in Studie 1 als auch in Studie 2 ein signifikanter Zusammenhang zwischen der wissenschaftsbezogenen Selbstwirksamkeitserwartung und der Intention, eine Karriere in der Wissenschaft anzustreben.

Attributionen und Wissenschaftsbezogene Selbstwirksamkeitserwartung. In den gerechneten Pfadmodellen zeigten sich signifikante Zusammenhänge zwischen Attributionen und der wissenschaftlichen Selbstwirksamkeitserwartung. So waren in Studie 1 die Attribution des Promotionserfolgs auf die eigenen Fähigkeiten und Anstrengung positiv mit der Selbstwirksamkeit verbunden (vgl. Abbildung 2). Im Fall der Misserfolgsattribution war die Attribution auf die eigenen Fähigkeiten negativ mit der wissenschaftlichen Selbstwirksamkeitserwartung assoziiert. Ebenfalls in Einklang mit der Hypothese war der positive Zusammenhang zwischen der Attribution des Misserfolgs auf eine mangelnde Unterstützung und der Selbstwirksamkeit. Die Misserfolgsattribution auf eine schlechte Beziehung mit dem Betreuer hingegen stand in einem negativen Zusammenhang (vgl. Abbildung 4).

In Studie 2 war die Attribution des Promotionserfolgs auf einen kausalen Faktor, der als stabil in Bezug auf seine Wirksamkeit im Fall einer fortgeführten wissenschaftlichen Karriere wahrgenommen wurde, positiv mit der wissenschaftsbezogenen Selbstwirksamkeit assoziiert (vgl. Abbildung 5). Umgekehrt verhielt es sich bei der Attribution auf Misserfolg (vgl. Abbildung 6).

Die Effektstärken waren im Fall der Misserfolgsattribution größer als im Fall der Erfolgsattribution. Bezüglich der Misserfolgsattribution waren in Studie 1 die standardisierten Koeffizienten der einzelnen kausalen Faktoren vergleichbar mit denen der objektiven Leistungsindikatoren der Erstautorenschaften und Konferenzbeiträge, die im signifikanten Zusammenhang mit der Selbstwirksamkeit standen. Anzumerken ist, dass insbesondere der Vergleich mit dem Effekt der Erstautorenschaften relevant ist, da sich diese in besonderem Maße auf den Erfolg in der Wissenschaft bzw. das Erreichen einer Professur auswirken (Baethge, 2008; Lutter & Schröder, 2014; Plümper & Schimmelfennig, 2007). Im Fall der erfolgreichen Promotion war der gemeinsame Effekt der Ursachenfaktoren vergleichbar mit den Leistungsindikatoren der Erstautorenschaften und der Konferenzbeiträge.

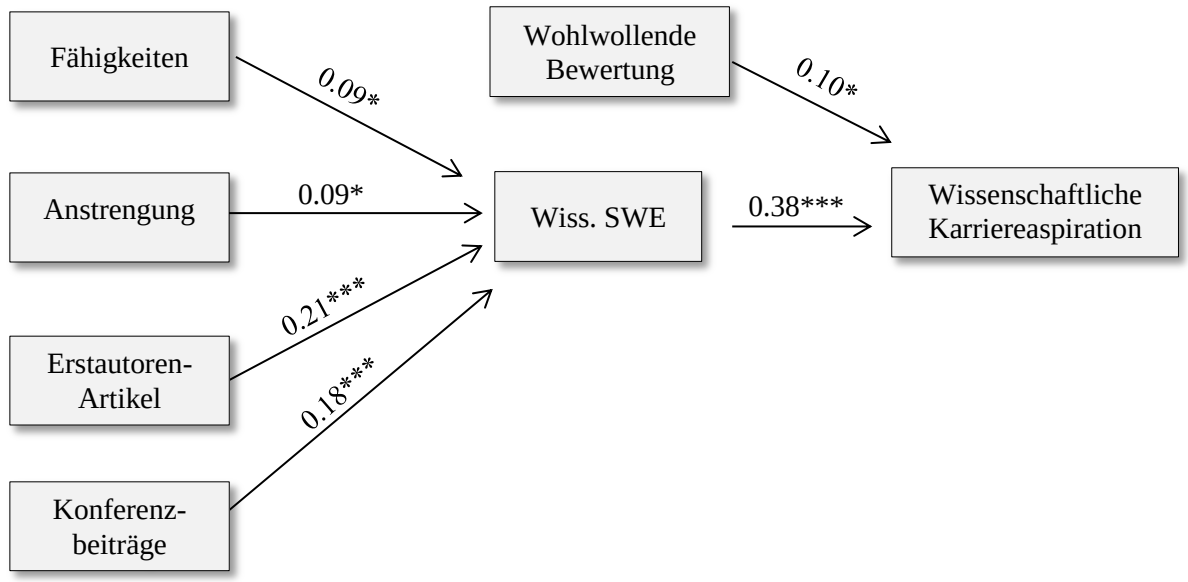
Auch in Studie 2 war im Erfolgsfall der Effekt der Attribution auf einen stabilen Faktor auf die Selbstwirksamkeit vergleichbar groß wie der Effekt der Erstautorenschaften. Im Rahmen von Studie 2 war ebenfalls die Effektstärke der Attribution von Misserfolg auf einen stabilen Faktor (ß= -0.41, $p<0.01$) größer als im Erfolgsfall (ß=0.17, $p<0.05$) (vgl. Abbildungen 3 und 5) und sogar vergleichbar mit der Effektstärke der intrinsischen Forschungsmotivation (ß=0.31, $p<0.10$), die in den meisten Pfadmodellen am stärksten mit der Selbstwirksamkeit verbunden war.

Indirekter Effekt von Attributionen auf die wissenschaftliche Karriereaspiration. In den Pfadmodellen aus Studie 1 und 2 zeigten sich signifikante Effekte der Attributionen, die über die Selbstwirksamkeitserwartung vermittelt wurden. Jedoch war der Großteil dieser indirekten Effekte minimal. Ausnahmen bildeten jedoch die Attribution des Misserfolgs auf einen stabilen Faktor (ß= -0.12, $p<0.05$) sowie die Attribution des Misserfolgs auf eine schlechte Beziehung mit der Betreuerin/dem Betreuer (ß= -0.23, $p<0.05$). Diese hatten einen relativ großen negativen, indirekten Effekt auf die wissenschaftliche Karriereaspiration.[8]

Direkte Effekte von Attributionen auf die wissenschaftliche Karriereaspiration. In Studie 1 zeigten sich direkte Zusammenhänge zwischen Attributionen und der Intention, eine wissenschaftliche Karriere anzustreben, die nicht über die Selbstwirksamkeitserwartung vermittelt wurden. Hier war im Fall der erfolgreichen Promotion die Attribution auf eine wohlwollende Bewertung positiv – und nicht wie angenommen negativ – mit der Intention, eine wissenschaftliche Karriere anzustreben, verbunden (vgl. Abbildung 2). Im Fall des Misserfolgs war die Attribution auf eine strenge Bewertung ebenfalls direkt und positiv mit der wissenschaftlichen Karriereaspiration assoziiert (vgl. Abbildung 4).

[8] In Pfadmodellen berechnen sich die indirekten Effekte über die Multiplikation der Koeffizienten der unabhängigen Variable auf die Mediatorvariable und der Koeffizienten der Mediatorvariablen auf die abhängige Variable (vgl. auch Sobel, 1982).

Abbildung 2: Pfadmodell Erfolgsattribution, Studie 1 – kausale Faktoren

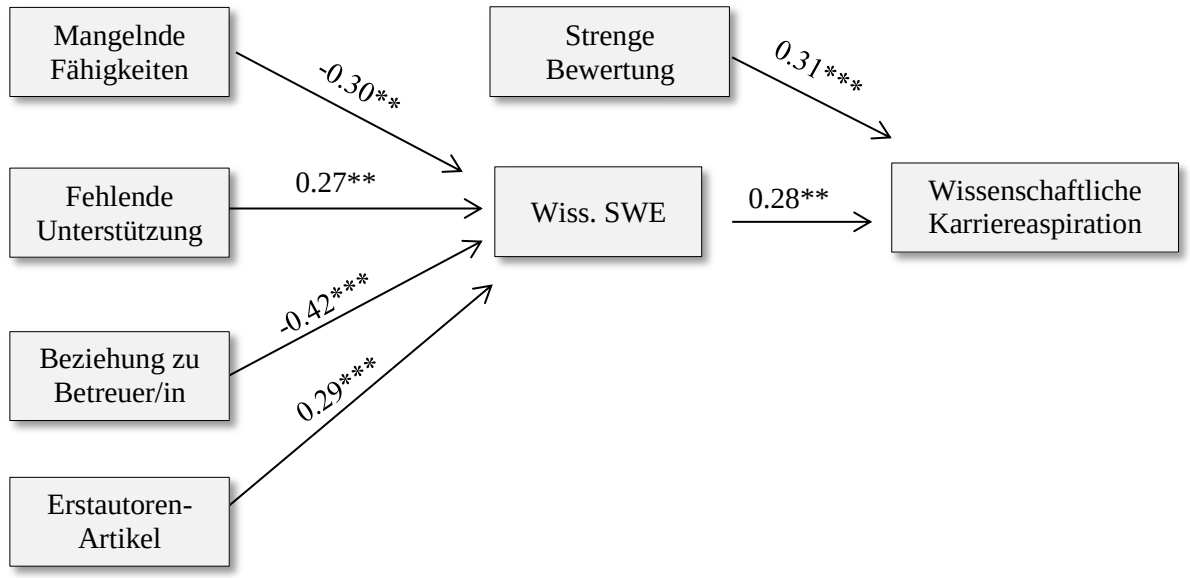


Legende: Ergebnisse multivariater Pfadanalysen (Complete Case Analysis, N=272). Analyse mit allen Kontrollvariablen in Kapitel 8, Tabelle 6. Abkürzung Wiss. SWE = wissenschaftsbezogene Selbstwirksamkeitserwartung. Standardisierte Koeffizienten auf die zweite Nachkommastelle gerundet. $^{+}$p<0.10; *p<0.05; **p<0.01; ***p<0.001

Abbildung 3: Pfadmodell Erfolgsattribution, Studie 2 – kausale Dimensionen

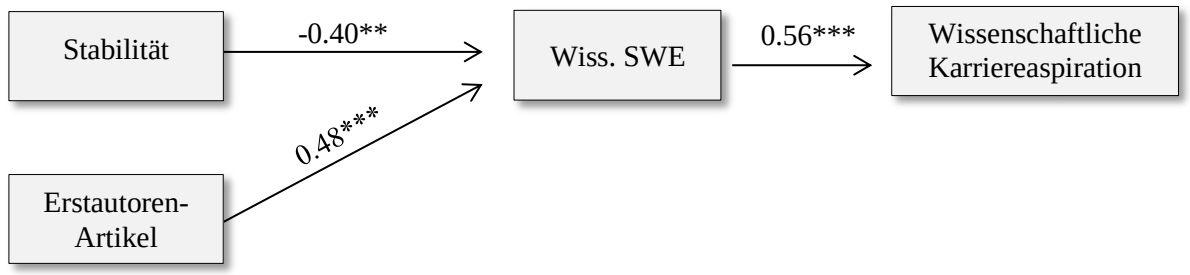
Legende: Ergebnisse multivariater Pfadanalysen (Complete Case Analysis, N=171). Analyse mit allen Kontrollvariablen in Kapitel 9, Tabelle 19. Abkürzung Wiss. SWE = wissenschaftsbezogene Selbstwirksamkeitserwartung. Standardisierte Koeffizienten auf die zweite Nachkommastelle gerundet. $^{+}$p<0.10; *p<0.05; **p< 0.01; ***p<0.001

Abbildung 4: Pfadmodell Misserfolgsattribution, Studie 1 – kausale Faktoren



Legende: Ergebnisse multivariater Pfadanalysen (Complete Case Analysis, N=85). Analyse mit allen Kontrollvariablen in Kapitel 8, Tabelle 7. Abkürzung Wiss. SWE = wissenschaftsbezogene Selbstwirksamkeitserwartung. Standardisierte Koeffizienten auf die zweite Nachkommastelle gerundet. $^{+}$p<0.10; *p<0.05; **p<0.01; ***p<0.001

Abbildung 5: Pfadmodell Misserfolgsattribution, Studie 2 – kausale Dimensionen



Legende: Ergebnisse multivariater Pfadanalysen (Complete Case Analysis, N=33). Analyse mit allen Kontrollvariablen in Kapitel 9, Tabelle 20. Abkürzung Wiss. SWE = wissenschaftsbezogene Selbstwirksamkeitserwartung. Standardisierte Koeffizienten auf die zweite Nachkommastelle gerundet. $^{+}$p<0.10; *p< 0.05; **p<0.01; ***p<0.001

Fach- und geschlechtsspezifische Unterschiede

In Bezug auf das Studienfach konnte gezeigt werden, dass promovierte Medizinerinnen und Mediziner zum einen eine signifikant niedrigere intrinsische Forschungsmotivation aufwiesen und zum anderen – in Übereinstimmung mit den Hypothesen – auch unter Kontrolle von Publikationen, der Note und Konferenzbeiträgen signifikant geringere wissenschaftsbezogene Selbstwirksamkeitserwartungen hatten. Ebenfalls wiesen die Medizinerinnen und Mediziner im Vergleich zu den befragten Lebenswissenschaftlerinnen und -wissenschaftlern signifikant geringere wissenschaftliche Karriereaspirationen auf. Diese waren jedoch insgesamt sehr niedrig ausgeprägt. Unter Kontrolle der wissenschaftlichen Selbstwirksamkeitserwartung wiesen die Medizinerinnen und Mediziner sogar eine höhere Intention auf, einer wissenschaftlichen Karriere nachzugehen.

Geschlechterunterschiede waren lediglich in der Medizin ersichtlich. Hier berichteten die weiblichen Promovierten signifikant geringere Selbstwirksamkeitserwartungen und eine geringere Intention, einer wissenschaftlichen Karriere nachzugehen. Letztere Unterschiede waren nicht mehr signifikant, wenn die wissenschaftsbezogene Selbstwirksamkeitserwartung kontrolliert wurde. In Bezug auf die Attributionen konnten keine Unterschiede zwischen den Geschlechtern festgestellt werden. Hier muss jedoch beachtet werden, dass die Fallzahl bei Misserfolgsattribution womöglich nicht hoch genug war.

Methoden und Ergebnisse der qualitativen Studie (vgl. Kapitel 10)

Methoden

Stichprobe. Im Rahmen der qualitativen Studie wurden 28 Teilnehmerinnen und Teilnehmer aus Studie 1 – 10 Promovierte der Medizin, 14 Promovierte der Lebenswissenschaften und vier fortgeschrittene Promovierende der Medizin befragt. Die Interviews mit fortgeschrittenen Promovierenden der Medizin wurden zunächst als Probeinterviews geplant, dann aber in die Analyse mit einbezogen, da sich zum einen der Leitfaden nach der Durchführung der Interviews nicht mehr verändert hatte und zum anderen die Promovierenden, im Gegensatz zu den bereits Promovierten, nicht nur retrospektiv über die Promotionserfahrung sprechen konnten.

Die Auswahl der Teilnehmerinnen und Teilnehmer erfolgte im weiteren Verlauf anhand der Antworten im Rahmen der quantitativen Studie. Es wurden Personen mit hohen und niedrigen Ausprägungen in Bezug auf intrinsisches Forschungsinteresse, wissenschaftsbezogene

Selbstwirksamkeitserwartung und die Intention, einer wissenschaftlichen Karriere nachzugehen, ausgewählt. Um die Ergebnisse der quantitativen Studie kritisch zu beleuchten, wurden zudem auch gezielt Personen ausgewählt, die der Annahme, dass Personen mit einer hohen Selbstwirksamkeitserwartung und intrinsischen Forschungsmotivation nach der Promotion forschend tätig sind, in der Befragung widersprachen.

Datenerhebung. Personen wurden zwischen Oktober 2014 und November 2015 telefonisch, anhand strukturierter Leitfäden befragt. Das Leitfadengespräch wurde als Instrument gewählt, da das Ziel der qualitativen Befragung insbesondere auch dem vertieften Verständnis der Angaben aus Studie 1 dienen sollte. Die Gestaltung des Leitfadens richtete sich nach den Empfehlungen von Helfferich (2005).

Datenauswertung. Die aufgezeichneten Interviews wurden wörtlich transkribiert. Bei der Transkription wurden Orte und Namen anonymisiert und durch Oberbegriffe ersetzt (z.B. „deutsche Stadt“ anstelle von München). Die Interviews wurden mithilfe eines überwiegend deduktiv entwickelten Kodierschemas (einige wenige Kategorien wurden induktiv während des Probekodierens gewonnen) mit der qualitativen Inhaltsanalyse nach Mayring (2010) ausgewertet. Zur Erfassung der Interrater-Übereinstimmung wurden 25 Prozent der Interviews doppelt kodiert und Cohens Kappa (Cohen, 1968) berechnet. Ein Wert von 0.73 wies auf eine gute Reliabilität des Kodierschemas hin (Lombard, Snyder-Duch, & Brakken, 2002; Landis & Koch, 1977).

Ergebnisse

In der qualitativen Studie wurde ersichtlich, dass die Teilnehmerinnen und Teilnehmer auch spontan Attributionen äußerten. So wurde beispielsweise im Fall von schlechtem Feedback des Betreuenden geäußert, dass dies an der Persönlichkeit des Betreuenden lag und nicht am Befragten selbst. Weiterhin wiesen die Ergebnisse darauf hin, dass selbstwertdienliche Attributionen positiv im Zusammenhang mit der Motivation während der Promotion standen, insbesondere dann, wenn Personen ein schwieriges Verhältnis zu Betreuenden hatten. Dies galt ebenso für die Motivation, auch nach der Promotion weiterhin zu forschen.

Ein schwieriges Verhältnis zu Betreuenden bzw. zur Doktormutter/zum Doktorvater war vor allem durch die Art des Feedbacks und den Kommunikationsstil gekennzeichnet. In den negativen Fällen vermittelten die betreuenden Personen den Promovierenden, wissenschaftlich inkompetent zu sein, kommunizierten nicht auf Augenhöhe und gaben diesen

nicht das Gefühl, ein Teil der wissenschaftlichen Gemeinschaft zu sein, bzw. Nachwuchswissenschaftlerin oder Nachwuchswissenschaftler.

Darüber hinaus gab es Hinweise darauf, dass die stellvertretende Erfahrung *(vicarious experience)* (Bandura, 1977) ebenfalls eine Quelle der wissenschaftsbezogenen Selbstwirksamkeit sein kann. So wurde von Teilnehmerinnen und Teilenehmern berichtet, dass die Schwierigkeiten von begabten Postdoktorandinnen und Postdoktoranden im eigenen Arbeitsumfeld, bezüglich einer Weiterbeschäftigung in der Wissenschaft, demotivierend seien und an dem Verfolgen einer wissenschaftlichen Karriere zweifeln ließen.

Ein weiteres Ergebnis der qualitativen Untersuchung bezieht sich auf die Fokussierung auf *einen* Karriereweg. Hier wurde ersichtlich, dass Personen die eine wissenschaftliche Karriere verfolgten oder in Betracht zogen, dennoch anmerkten, dass sie weiterhin offen seien für andere berufliche Möglichkeiten: beispielsweise, wenn sich herausstellen sollte, dass die wissenschaftliche Karriere nicht mit dem Privatleben zu vereinbaren sei oder sich andere attraktive Optionen ergäben. Zudem zeigte sich insbesondere für die Promovierten der Lebenswissenschaften, dass die Beschäftigung nach der Promotion nicht immer mit dem Karrierewunsch übereinstimmte und somit Opportunitäten letztendlich das „Ausleben“ von beruflichen Vorstellungen einschränkten.

Zusammenfassung und Diskussion

Attributionen, Selbstwirksamkeit und Motivation. Die Ergebnisse der zwei quantitativen Studien zeigten, dass Attributionen signifikant mit der geäußerten wissenschaftlichen Selbstwirksamkeitserwartung assoziiert waren, sodass davon ausgegangen werden kann, dass nicht nur die objektive Performanz, sondern auch deren interpretative Zuschreibung zu kausalen Faktoren ein wichtiger Bestandteil der *„mastery experience“* von Nachwuchswissenschaftlerinnen und -wissenschaftlern ist. Diese Deutung der quantitativen Ergebnisse wurde zudem durch die qualitativen Daten gestützt. Ebenso weisen die Studienergebnisse darauf hin, dass die wissenschaftsbezogene Selbstwirksamkeitserwartung in starkem Zusammenhang mit der Intention, eine universitäre Laufbahn zu verfolgen, steht. Selbstwirksamkeitserwartung und intrinsische Motivation wiesen zudem die größten Effektstärken auf. Die indirekten, über die Selbstwirksamkeitserwartung vermittelten Effekte der Attributionen auf die Intention, einer wissenschaftlichen Karriere nachzugehen, waren hingegen mit Ausnahme der Misserfolgsattribution nur minimal.

Unerwarteterweise war die Attribution des Misserfolgs auf eine schlechte Beziehung mit der betreuenden Person negativ mit der Selbstwirksamkeitserwartung und der wissenschaftlichen Karriereaspiration verbunden. Dies könnte, wie auch die Ergebnisse der qualitativen Studie, darauf hindeuten, dass eine negative Beziehung zur betreuenden Person durch negatives Feedback gekennzeichnet ist, das sich darüber hinaus negativ auf die Kompetenzwahrnehmung von Promovierenden auswirkt. Ebenfalls ist es denkbar, dass ein negatives Erleben des wissenschaftlichen Umfelds mit negativen Emotionen verbunden ist. Im Einklang mit dieser Argumentation zeigte sich auch die Attribution des Promotionserfolgs auf eine wohlwollende Bewertung positiv und direkt mit der wissenschaftlichen Karriereintention verbunden. Diesbezüglich ist es naheliegend, dass der Effekt durch positive Emotionen vermittelt wird. Nach Weiner ist die externe Attribution von Erfolg mit Dankbarkeit verbunden (Weiner, 1985). Dankbarkeit sowie das allgemeine positive Erleben eines wohlwollenden Umfelds könnten somit den positiven Effekt der Variable „wohlwollende Bewertung“ auf die wissenschaftliche Karriereintention erklären. Diese Interpretation steht ebenfalls in Einklang mit den qualitativen Ergebnissen, in denen sich eine positive Beziehung zur betreuenden Person, insbesondere zur Doktormutter oder zum Doktorvater, positiv auf die Haltung zur wissenschaftlichen Karriere auswirkte.

Insgesamt schienen sich Attributionen im Fall des Misserfolgs stärker auf die Selbstwirksamkeit und die Intention eine wissenschaftliche Karriere zu verfolgen auszuwirken. Dies ist einleuchtend, denn das Risiko des Scheiterns sollte nach einem Misserfolg generell als größer wahrgenommen werden. Nach einem Erfolg ist womöglich das wahrgenommene Risiko in der Zukunft zu scheitern, ungeachtet der Attributionen, geringer. Ebenso ist die korrekte kausale Zuschreibung nach einem Misserfolgserlebnis wichtig, um das Verhalten so anzupassen, dass zukünftiger Misserfolg vermieden werden kann (Taylor, 1991). Dieses Ergebnis stimmt weiterhin mit einer Reihe von Forschungsergebnissen überein, die darauf hinweisen, dass negative Ereignisse mit stärkeren physiologischen, affektiven und kognitiven Reaktionen einhergehen. Ebenso gehen negative Ereignisse mit stärkeren kausalen Attributionen einher (vgl. ebd.).

Das Nachdenken über kausale Ursachen nach einer erfolgten Zuschreibung wird zudem vor allem nach Misserfolg beobachtet (s. Kapitel 2.2). So könnten kausale Attributionen bei Promovierten, die weniger zufrieden mit dem Ergebnis der Dissertation waren, gegenwärtiger gewesen sein als bei zufriedenen Promovierten.

Zusammenfassend kann gesagt werden, dass die zu anfangs aufgestellten Hypothesen, dass 1) kausale Attributionen in Zusammenhang mit der wissenschaftlichen

Selbstwirksamkeitserwartung stehen *(Hypothese 1)*, dass 2) wissenschaftliche Selbstwirksamkeitserwartungen positiv mit der wissenschaftlichen Karriereaspiration assoziiert sind *(Hypothese 2)* und, dass 3) kausale Leistungsattributionen indirekt, über die Selbstwirksamkeit, mit akademischen Karriereaspirationen verbunden sind *(Hypothese 3)*, gestützt werden (vgl. Allgemeine Hypothesen und heuristisches Modell/Kapitel 5).
Bei Hypothese 3 sind jedoch einschränkend die geringen Effektstärken im Fall der Attribution von Erfolg zu nennen. Zusätzlich müssen direkte Zusammenhänge einiger kausaler Faktoren mit den wissenschaftlichen Karriereaspirationen genannt werden, die vermutlich über affektive Reaktionen vermittelt wurden.

Feedback, Attributionen und Emotionen. Die Ergebnisse der qualitativen Studie weisen darauf hin, dass die betreuenden Personen über das Geben von Feedback einen Einfluss auf die wissenschaftliche Selbstwirksamkeitserwartung ihrer Promovierenden haben können, worauf bereits einige Ergebnisse der quantitativen Studie hinwiesen (z.B. der negative Effekt der Misserfolgsattribution auf die Beziehung zum Betreuer/zur Betreuerin auf die Selbstwirksamkeitserwartung).
Weiterhin war die internale Attribution von Erfolg mit positiven Gefühlen verbunden, die zudem positiv im Hinblick auf die Motivation zu sein scheinen. Jedoch ist hier einschränkend zu sagen, dass im Zuge der qualitativen Studie nicht zwischen ergebnisbezogenen und attributionsbezogenen Emotionen (Weiner, 1985) unterschieden werden konnte. Wie schon angemerkt, war ein weiteres zentrales Ergebnis, dass sich selbstwertdienliche Attributionen im Fall einer schwierigen Promotionssituation, die sich im Weiteren insbesondere über die Beziehung zur Doktormutter/zum Doktorvater äußerte, sowohl positiv auf den Erhalt der Motivation während der Promotion als auch auf die Motivation, nach Abschluss weiterhin forschend tätig zu sein, auswirkten.

Geschlechterunterschiede. Signifikante Geschlechterunterschiede in der wissenschaftlichen Selbstwirksamkeit und der Intention, eine wissenschaftliche Karriere anzustreben, wurden lediglich in der Medizin festgestellt. Die Ergebnisse könnten zum einen durch unbeobachtete Heterogenität zustande kommen: Obgleich für mehrere Erfolgsindikatoren kontrolliert wurde, wurden beispielsweise die Qualität der Journals, in denen veröffentlicht wurde, oder die Anzahl der Koautoren nicht gemessen. Ebenfalls könnten bestehende Unterschiede in der Forschungserfahrung vor der Promotion die Unterschiede zwischen Medizinerinnen und Medizinern womöglich erklären. Abgesehen davon wäre es denkbar, dass insbesondere in der

Hochschulmedizin die Dreifachbelastung von Klinik, Forschung und Lehre aufgrund der schwierigen Vereinbarkeit von Beruf und Familie gerade für Frauen eine Barriere darstellt.
Da in Deutschland weit über die Hälfte der Medizinstudierenden weiblich sind, ist dieses Ergebnis zudem hoch relevant im Hinblick auf die Rekrutierung des ärztlichen Forschernachwuchses (Epstein et al, 2016). Dem Phänomen der geringeren Selbstwirksamkeitserwartungen von Medizinerinnen sollte auch aus diesem Grund durch weitere Forschung nachgegangen werden.
Die Ergebnisse weisen darauf hin, dass Geschlechterunterschiede im Rahmen der wissenschaftlichen Karriere fächerspezifisch analysiert werden sollten. Dies ist in früheren Studien nicht immer der Fall gewesen (z.B. Berweger & Keller, 2005; Jöstl, et al., 2012).

Fächerunterschiede. Die Ergebnisse in Bezug auf die Unterschiede in Medizin und anderen Lebenswissenschaften stehen im Einklang mit der Literatur, in der ein medizinischer Forschermangel beklagt wird (zusammenfassend Epstein et al., 2016). In den hier durchgeführten Studien hatten promovierte Medizinerinnen und Mediziner sowohl geringere Ausprägungen in den Selbstwirksamkeitserwartungen als auch in Bezug auf die wissenschaftlichen Karriereaspirationen. Die Selbstwirksamkeitserwartungen zeigten sich hier auch unter Kontrolle von Leistungsindikatoren als signifikante Prädiktoren.
Naheliegend ist, dass die beobachteten Unterschiede auf die verschiedenen Schwerpunkte in der Ausbildung zurückgeführt werden können. Während in der Medizin der Fokus im Studium auf der klinischen Ausbildung liegt, wird in den lebenswissenschaftlichen „Basiswissenschaften“ größeren Wert auf die wissenschaftliche Ausbildung gelegt. Ebenfalls sind nicht erfasste Unterschiede in der Qualität der Promotionsprojekte denkbar. Dass Promovierte der Medizin unter Kontrolle der Selbstwirksamkeit sogar höhere wissenschaftliche Karriereaspirationen äußerten, könnte an einer nicht beobachteten vorgeschalteten Variable liegen: Aufgrund ihres hohen Forschungsinteresses haben diese womöglich qualitativ anspruchsvollere Doktorarbeiten gewählt und sich verstärkt Forschungskompetenzen angeeignet. Zwar wurde versucht, diesen Einfluss über die Variable des intrinsischen Forschungsinteresses zu kontrollieren, es ist jedoch möglich, dass die neu entwickelte Skala nicht alle wichtigen Aspekte beinhaltete.

Stellvertretende Erfahrungen. In der qualitativen Studie gab es weiterhin einen Hinweis auf den Einfluss stellvertretender Erfahrungen auf die Selbstwirksamkeitserwartung. Hier äußerten manche Befragte, dass das Beobachten von Postdoktorandinnen und

Postdoktoranden im eigenen Arbeitsumfeld, die trotz hoher Fähigkeiten schließlich Probleme mit der Weiterbeschäftigung bekamen, ein entscheidender Faktor sei: Das Erfahren dieser Schwierigkeiten im eigenen Arbeitsumfeld schien, zusätzlich zu den bekannten fehlenden langfristigen Perspektiven, demotivierend zu sein.

Karriereintentionen der Teilnehmerinnen und Teilnehmer. Insgesamt ist anzumerken, dass die Intention, in der Wissenschaft zu verbleiben, bei allen Befragtengruppen niedrig ausgeprägt war. Eine hohe Zustimmung hingegen bekam die Aussage, eine Karriere außerhalb der Wissenschaft anzustreben. Bei Ärztinnen und Ärzten war – wenig überraschend – die Intention, einer Tätigkeit mit Patientenkontakt nachzugehen, am höchsten ausgeprägt. In den qualitativen Interviews kam ebenfalls zum Vorschein, dass die meisten Promovierten, die weiterhin in der Wissenschaft tätig waren, sich auch andere Karrierewege vorstellen konnten und sich nicht auf eine Universitätskarriere versteift hatten. Der Einbezug möglicher alternativer Karrierewege war ebenfalls mit den Rahmenbedingungen einer wissenschaftlichen Karriere verbunden. Daraus lässt sich schließen, dass ein motivierendes Arbeitsumfeld und die Förderung der wissenschaftlichen Selbstwirksamkeitserwartung durchaus wichtig sind. Jedoch werden talentierte Nachwuchswissenschaftlerinnen und Nachwuchswissenschaftler möglicherweise alternative Karrierewege bevorzugen, wenn die Rahmenbedingungen einer wissenschaftlichen Karriere deutlich unattraktiver sind.

Limitationen und Ausblick

***Zeithorizont und Opportunitätsstrukturen*.** Im Zuge der hier durchgeführten Studien wurden Karriereintentionen kurz nach der Promotion erfasst. Damit ist die Vorhersagekraft der unabhängigen Variablen in Bezug auf Karriereentscheidungen und Karriereaspirationen zu späteren Zeitpunkten eingeschränkt. Während die Aspirationen nach der Promotion eine erste Richtung vorgeben, limitieren Opportunitätsstrukturen das Verfolgen dieser Idealvorstellungen. So können aufgrund mangelnder Möglichkeiten auch wissenschaftlich hoch motivierte Nachwuchsforscherinnen und -forscher zu früheren oder späteren Zeitpunkten gezwungenermaßen aus der wissenschaftlichen Laufbahn aussteigen. Die fehlende Übereinstimmung von Wunsch und Wirklichkeit wurde insbesondere im Fall der Lebenswissenschaftlerinnen und -wissenschaftler in den qualitativen Interviews ersichtlich.

Methoden und Kausalität. Die quantitativen Ergebnisse beziehen sich auf Querschnittsdaten, sodass die Interpretation der Ergebnisse hinsichtlich kausaler Zusammenhänge eingeschränkt ist. Dies steht in direktem Zusammenhang mit der Unsicherheit bezüglich der Richtung der Zusammenhänge. So wäre es ebenso möglich, dass Personen mit höheren Aspirationen zur Reduzierung der kognitiven Dissonanz in Befragungen entsprechende Attributionen und Selbstwirksamkeitserwartungen äußern. Als Gegenargument zu diesem Einwand können jedoch auch experimentelle Studien genannt werden, die einen Einfluss von Attributionen auf die Selbstwirksamkeit belegen (z.B. Tolli & Schmidt, 2008; Schunk, 1984; Schunk & Gunn, 1986; Silver et al., 1995; Stajkovic & Sommer, 2000).
Darüber hinaus ist anzumerken, dass die Hinweise, die in der qualitativen Studie gegeben wurden, z.B. in Bezug auf die stellvertretende Erfahrung und die Rolle der Betreuerin/des Betreuers, zukünftig in weiteren Studien untersucht werden müssten.

Ausblick. Weitere Studien sollten insbesondere die Rolle der betreuenden Person und ihren Einfluss auf die Motivation und das Forschungsinteresse bzw. das Interesse an einer wissenschaftlichen Karriere der Promovierenden untersuchen. Eng damit verbunden ist der potentielle Effekt des Feedbacks auf Attributionen, Emotionen und die Selbstwirksamkeit. In diesem Zusammenhang wäre auch eine Interventionsstudie denkbar, in der entweder Betreuende hinsichtlich des attributionalen Feedbacks instruiert werden könnten oder Promovierende direkt an einem Reattributionstraining teilnehmen könnten.
In Bezug auf einen möglichen Zusammenhang zwischen Emotionen und wissenschaftlichen Karriereaspirationen wäre es interessant, neben den ergebnis- und attributionsinduzierten Emotionen, auch epistemische Emotionen wie beispielsweise Überraschung und Neugierde zu betrachten (Pekrun, Elliot, & Maier, 2009).
Ebenfalls könnten die hier erfassten soziokognitiven Faktoren longitudinal im Karriereverlauf verfolgt werden. Insbesondere der Zusammenhang mit der geäußerten Selbstwirksamkeitserwartung nach der Promotion und dem selbstregulatorischen Verhalten im Verlauf der Postdoktoranden-Phase wären hier interessant, d.h. das Aufwenden von Anstrengung und Persistenz beim Verfolgen der wissenschaftlichen Karriere. Die Selbstregulation könnte sich dann weiterhin auf die Performanz auswirken.
Während die vorliegenden Ergebnisse suggerieren, dass es in den Lebenswissenschaften keine Geschlechterunterschiede in Selbstwirksamkeitserwartung und wissenschaftlicher Karriereaspiration gibt, könnten diese Umstände sich in der fortgeführten wissenschaftlichen Karriere stark verändern. Aufgrund des hohen weiblichen Dropouts aus der

wissenschaftlichen Karriere in den Lebenswissenschaften (Neugebauer, 2006) und der Medizin (Bund-Länder-Kommission (BLK), 2004; Lind & Löther, 2007) könnten sich Unterschiede in der Selbstwirksamkeitserwartung auch zu späteren Zeitpunkten entwickeln. Beispielsweise konnte Abele (2006) zeigen, dass sich die berufliche Selbstwirksamkeitserwartungen zwischen Ärztinnen und Ärzten zwar nicht nach dem zweiten Staatsexamen, aber nach drei Jahren Berufserfahrung signifikant voneinander unterschieden.

Ein weiterer potentieller Einflussfaktor, der innerhalb der qualitativen Studie ermittelt wurde, ist die stellvertretende Erfahrung: Die Schwierigkeiten anderer talentierter Postdoktorandinnen und Postdoktoranden bezüglich einer Weiterbeschäftigung scheint ein demotivierender Faktor zu sein. In diesem Sinne wäre es denkbar, dass auch der abnehmende Anteil an weiblichen Wissenschaftlerinnen mit zunehmenden Karrierestatus eine Form der stellvertretenden Erfahrung darstellt, aus der Nachwuchswissenschaftlerinnen ihre Karrierechancen bezüglich einer Universitätslaufbahn ableiten. Diese Möglichkeit ziehen auch Ceci et al. (2009) in Betracht: „*It is also likely that the career status—the prevalence of each sex in different careers and at different levels—affects cultural expectations […]*. “

Beitrag der Dissertation und praktische Implikationen

Beitrag der Dissertation. Die vorliegende Dissertation konnte die Rolle der wissenschaftsbezogenen Selbstwirksamkeitserwartung im Hinblick auf das Anstreben einer wissenschaftlichen Karriere in der Humanmedizin und den Lebenswissenschaften unterstützen. Zudem wurden wissenschaftsbezogene Selbstwirksamkeitserwartungen und das Interesse an einer wissenschaftlichen Karriere erstmals zwischen Promovierten der Medizin und Lebenswissenschaften gegenübergestellt. In Übereinstimmung mit den Hypothesen, hatten Promovierte der Medizin eine geringere wissenschaftsbezogene Selbstwirksamkeitserwartung und äußerten weniger Interesse an einer wissenschaftlichen Karriere. Diese Ergebnisse stehen womöglich auch im Zusammenhang mit der medizinischen Ausbildung, deren geringer Forschungsanteil kritisiert wurde (DFG, 2010; Wissenschaftsrat, 2014).

Ein weiteres wichtiges Ergebnis der Dissertation bezieht sich auf Geschlechterunterschiede. Diese konnten sich *nur* in der Medizin finden, sodass Medizinerinnen geringere wissenschaftsbezogene Selbstwirksamkeitserwartungen hatten sowie auch geringere Intentionen, einer wissenschaftlichen Karriere nachzugehen. Das Ergebnis weist darauf hin,

dass bei der Untersuchung von Geschlechterunterschieden Studienfächer getrennt voneinander betrachtet werden sollten.

Darüber hinaus wurden die häufig vernachlässigten Quellen der wissenschaftlichen Selbstwirksamkeitserwartung untersucht, mit besonderem Augenmerk auf kausale Attributionen. Durch die Anwendung einer *critical incident*-Methode, der Erfassung von Attributionen bezogen auf ein natürlich auftretendes Lebensereignis (die Promotion) (vgl. Vispoel & Austin, 1995), wurde im Weiteren ein Beitrag zur Untersuchung der Relevanz kausaler Attributionen im „echten Leben" geleistet.
Es zeigte sich, dass neben objektiven Leistungsindikatoren – dabei vor allem Publikationen als Erstautor/in – auch kausale Attributionen in signifikantem Zusammenhang mit der wissenschaftsbezogenen Selbstwirksamkeitserwartung standen. Während die Erfolgsattribution auf externe Faktoren häufig als negativ und die Misserfolgsattribution auf externe Faktoren als positiv dargestellt wird, zeigte sich hier ein komplexeres Bild. So war die Erfolgsattribution auf den externen Faktor einer wohlwollenden Bewertung positiv mit der Intention einer wissenschaftlichen Karriere nachzugehen verbunden. Die Misserfolgsattribution auf eine schlechte Beziehung mit der Betreuerin/dem Betreuer war entgegen der Erwartung negativ mit der Selbstwirksamkeit und der Intention, einer wissenschaftlichen Karriere nachzugehen, assoziiert.
In Verbindung mit der qualitativen Studie wurden diese Ergebnisse so interpretiert, dass eine wohlwollende Beurteilung wahrscheinlich ein positives Erleben des wissenschaftlichen Umfelds bedeutet, eine schlechte Beziehung mit der Betreuerin/dem Betreuer hingegen durch einen Kommunikationsstil geprägt sein kann, der sich negativ auf die Wahrnehmung der eigenen Kompetenzen auswirkt.

Praktische Implikationen. Praktische Implikationen der Arbeit ergeben sich in Bezug auf die Doktorandenausbildung aber auch das grundständige Studium der Medizin. Da die Ergebnisse der vorliegenden Studie darauf hinweisen, dass insbesondere Ärztinnen und Ärzte ein geringes Interesse an einer forschenden Tätigkeit haben. Diese sind dennoch wichtige Akteurinnen und Akteure in der klinischen bzw. translationalen Forschung und an der Übertragung von Forschungsergebnissen ans Krankenbett beteiligt (Beisiegel, 2009). Aus diesem Grund könnte es hilfreich sein, Forschungsinhalte vermehrt ins reguläre Medizincurriculum zu integrieren (Epstein et al., 2016), um nicht nur das Forschungsinteresse zu wecken, sondern auch Forschungskompetenzen und damit die wissenschaftsbezogene Selbstwirksamkeitserwartung zu stärken.

In Anbetracht der hier hervorgebrachten Ergebnisse bezüglich kausaler Attributionen und der Hinweise auf die Bedeutung der Betreuenden, könnte es sinnvoll sein, Betreuerinnen und Betreuern im Sinne eines „konstruktiven attributionalen Feedbacks“ auszubilden. Eine weitere Möglichkeit wäre es, Doktorandinnen und Doktoranden zusätzlich Unterstützung durch Coaching/Mentoring anzubieten. Da es empirische Hinweise darauf gibt, dass sich sogenannte Reattributionstrainings positiv auf die Motivation auswirken können (z.B. Relich et al., 1986; Ziegler & Heller, 2000), wäre auch dies eine Möglichkeit, Promovierende zu unterstützen – insbesondere, wenn diese Schwierigkeiten im Rahmen der Betreuung erfahren. Natürlich müssten sich die hier vorgeschlagenen Maßnahmen zur Ausbildung des wissenschaftlichen Nachwuchses in weiteren Studien, im besten Falle Interventionsstudien, bewähren, bevor diese in größerem Stil umgesetzt werden können.

The E-Prom Project, Data Protection and Ethical Approval

The dissertation project was conducted within the project *"E-Prom: Einfluss der Promotionsphase von Nachwuchswissenschaftlerinnen und -wissenschaftlern in der Medizin und den Lebenswissenschaften"*[9] which was running from 2013 to 2016 and was financed by the Federal Ministry of Education and Research (BMBF). The project's aim was to study career paths of doctoral graduates in the fields of medicine and life sciences longitudinally, starting right after doctoral graduation. The empirical investigation of the dissertation's research questions was implemented within the two quantitative studies and the qualitative study of the E-Prom project. Both of the quantitative studies and the qualitative study were approved by the ethical committee of the medical faculty of the Ludwig-Maximilians-Universität, Munich, and its data protection official. Ahead of all conducted studies, participants were informed about the procedure and goal of the studies and signed an informed consent.

1. Introduction

1.1 Introduction to the Theoretical Framework

The aim of the present study is to analyze if and how sociocognitive factors influence the intention to pursue an academic research career in doctoral graduates in the fields of medicine and life sciences. The two interrelated sociocognitive constructs which the study focuses on are 1) causal attributions of success and failure (Weiner, 1985, 2000) and 2) self-efficacy beliefs (short: self-efficacy) (Bandura, 1977), each of which are highly relevant for the study of motivation in academic contexts (Bandura, 1977; Schunk, 1984; Schunk & Gunn, 1986). Self-efficacy beliefs are subjective expectations one has about his or her ability to successfully master a task (Bandura, 1977), for instance to write a journal article in the context of the academic research career. Whereas self-efficacy beliefs are related to *future* expectations, causal attributions address the evaluation of *past* achievements—successes and failures. According to Weiner (1985, 2000), success or failure alone do not explain the formation of future success expectancies with regard to attaining a goal (e.g., reaching professorship). Subjective theories of why one succeeded or failed in a specific past situation are considered to impact one's future success expectations and, thereby, motivation.

These subjective theories are also referred to as causal attributions, meaning that a supposedly explanatory cause is linked to a past event. To give an example, if one's paper has been

[9] More information on the project can be found here: http://www.klinikum.uni-muenchen.de/Institut-fuer-Didaktik-und-Ausbildungsforschung-in-der-Medizin/de/forschung/projekte/EProm/index.html.

published one's self-efficacy beliefs with respect to publishing in the future should be higher, if this success is attributed to ability rather than to luck. By this example the connection between the constructs of causal attributions and self-efficacy beliefs already becomes obvious: the assumed reasons—or causal factors—for success or failure should be linked to one's efficacy beliefs in relation to the same or similar tasks in the future. In addition, also Bandura pointed out how causal attributions can be an important source of self-efficacy beliefs (Bandura, 1977, p. 148):

> *"[P]eople can gain competence through authentic means but, because of faulty appraisals of the circumstances under which they improve, will credit their achievements to external factors rather than to their own capabilities. Here the problem is one of inaccurate ascription of personal competency to situational factors. Successes are more likely to enhance self-efficacy if performances are perceived as resulting from skill than from fortuitous or special external aids."*

Moreover, mastery experience, which is supposed to have the strongest impact on self-efficacy (Bandura, 1977), not only refers to mere performance, but includes interpretations and evaluations of performances (ibid.). As highlighted by the quote, causal attributions are such interpretations and evaluations. Hence, they can be seen as one contributor to the experience of mastery.

While Weiner focuses on subjective success expectancies (1985, 2000), these are very close to the concept of self-efficacy beliefs. Subjective success probabilities, as included in rational choice models (Breen & Goldthorpe, 1997; Erikson & Jonsson, 1996), can be equivalent to self-efficacy beliefs if one specific behavior is of interest: such as the subjective success probability or efficacy expectation of writing an excellent paper. However, subjective success probabilities are mostly measured on a more global level with respect to one superordinate goal/behavior, e.g., the subjective probability of successfully graduating from university. Self-efficacy beliefs are also subjective success probabilities but are often assessed in more detail through scales that consider various behaviors within the area of interest, such as mastering written exams, oral exams, a bachelor thesis, etc. Both constructs are, however, not to be confused with outcome expectancies which differ from efficacy expectations and are defined as the conviction that mastering a behavior will lead to a certain outcome: for instance, believing that graduating from university will lead to a desired job offer or that managing to get hired will lead to a reliable source of income etc. (Bandura, 1977).

Moreover, subjective success probabilities used within rational choice frameworks often remain unexplained black boxes. The importance of understanding what these success expectancies actually mean and how they develop is also articulated by Breen (1999, p. 466):

> *"But if these [subjective success probabilities] are to be of any use as genuine explanations some account needs to be furnished of why such beliefs exist."*

While this can be partly said for studies which include self-efficacy beliefs as well, Bandura's social cognitive theory includes (potential) sources of self-efficacy beliefs (see in depth Chapter 2.2).

When it comes to the added explanatory value of subjective success probabilities and self-efficacy beliefs, empirical evidence indicates that in achievement contexts, both are not equal to objective performance outcomes (e.g., school grades). Tolsma and colleagues (2010) can show that subjective success probabilities with respect to being able to study at the university vary with gender and migration background, even after controlling for grades. Furthermore, many studies in the academic research context find gender differences in self-efficacy beliefs. It must be noted, however, that these studies often do not control for objective performance indicators (Berweger & Keller, 2005; Jöstl, Bergsmann, Lüftenegger, Schober, & Spiel, 2012; Spies & Schute, 1999). In addition, studies found significant links between the other assumed sources, such as vicarious experience, and self-efficacy (Usher & Pajares, 2008).

Self-efficacy and causal attributions have been widely used to explain achievement behavior and academic motivation, especially in school settings or for undergraduate university students (Bong, 2004; Follette & Jacobson, 1987; Hsieh & Kang, 2010; Schunk, 1984; Schunk & Gunn, 1986; van Laar, 2000). Yet, only a few studies address their interrelatedness (Hsieh & Kang, 2010) and conjoint effect on motivation (e.g., Tolli & Schmidt, 2008). Research addressing sociocognitive influences on academic career aspirations has so far focused on exploring the role of research/scientific self-efficacy beliefs as an independent variable. While scientific self-efficacy beliefs have been shown to significantly contribute to intentions to pursue an academic career (Berweger & Keller, 2005; Bieschke, Bishop, & Garcia, 1996), sources of self-efficacy beliefs and specifically causal attributions have been not been studied in this context.

For doctoral graduates, attributing ones past achievements to causal factors may be a possibility to increase ones confidence with respect to the decision to continue the academic career, since a permanent position in academic research is only possible for a fraction of those

who continue this career path after the doctorate (Briedis, Jaksztat, Preßler, Schürmann, & Schwarzer, 2014; Krempkow, Brunnhuber, & Winkelhage, 2014). In addition, it has to be acknowledged that at the stage of just having completed the doctorate, doctoral graduates rather made little experiences within the academic career context. The performance within the doctorate should, therefore, not be a sufficient and reliable source to predict future performance, or even obtaining a full professorship/permanent position.

1.2 Relevance of Sociocognitive Parameters in the Early Academic Career

The situation of doctoral students is special since most of them are not only students but also young professionals: in Germany, while working on their dissertations, doctoral students are often employed as regular research assistants at the university and/or are engaged in teaching. Exceptions are medical doctoral students, who usually pursue their doctorate during their standard period of studies (Niethammer, 2004a)—unlike candidates in other fields of study, who must first complete a second degree, such as a Master's degree/Diploma or state examination.

Nonetheless, the academic performance of doctoral graduates, comprised in the dissertation and its by-products (e.g., publications and conference contributions), is crucial if one desires to continue research professionally on a postdoctoral position. Since academic research is a very uncertain career field, which especially applies to the German context (Musselin, 2005), doctoral graduation is an important decision point or time frame—to continue or drop out of the risky academic career path? Such a decision should not be based exclusively on personal interest. Nor should objective performance be taken as a precise predictor for career success in academia, considering that academic research is a highly competitive environment with an increasing amount of doctoral graduates who receive a degree with honors (Jaksztat, Preßler, & Briedis, 2012), not to mention the very few opportunities to attain a permanent position, which are almost exclusively limited to a full professorship (Fitzenberger & Schulze, 2014; Krempkow et al., 2014; Tuttenuj, 2014).

The probability of a successful application to professorship by a habilitated person was determined to lie somewhere in between 3.5 to 3.8 in 100 (Matthies, 2005, p. 174) and every second position in academic research is held by a doctoral candidate (Janson, Schomburg, & Teichler, 2007, p. 61). Another study by Hauss et al. (2012) estimates fewer than 50 percent of one "habilitation cohort" are appointed to full professorship, equalling 10 percent of doctoral graduates.

The scarcity of permanent positions is so relevant in the German context, since public research institutions can employ researchers in fixed term contracts for only six years after doctoral graduation, with the exception of third party funded positions.[10] The situation created by these circumstances has been described by the term "up or out" (Fitzenberger & Schulze, 2014): after six years there is almost no other choice than either attaining a full professorship, or leaving the academic career. Therefore, it might not only be important to deeply evaluate one's career aspirations after the doctorate, but also with every step taken further in the academic research career (Klecha & Reimer, 2008).

It is equally important to mention that in some disciplines, the doctorate can be referred to as the regular degree, meaning that the majority of students are getting a doctoral degree. This is the case in biology/life sciences and medicine (Hornbostel & Simon, 2010; Reimer & Falk, 2007, Jaksztat et al., 2010). While few medical graduates aspire to an academic career (Gensch & Waltenberger, 2006; Loos, Albrecht, Sander, & Schliwen, 2014), when entering the field of academic research, they necessarily compete with neighbouring disciplines and end up facing similar work conditions as other scientists. With such a competitive environment and low chances of career consolidation, it is plausible to assume that doctoral graduates interested in pursuing an academic career will think twice about their chances of surviving the "academic career pipeline".

As noted earlier, it is clear that a successful doctoral phase is not a sufficient predictor for getting appointed as a professor in the future. In addition it has to be acknowledged that the experiences of doctoral graduates within the academic career context are rather sparse, which makes it even more difficult to make estimates about the future. Thinking about why one was more or less successful within the doctoral phase and attributing successes and failures to certain causes could be a way to make a more grounded decision and increase confidence in one's career aspirations.

As career chances outside academia vary drastically between physicians and life scientists, this is a factor that also needs to be considered in the motivation developing process. For the field of biology, it can be even harder to get a job outside of academia (Jaksztat et al., 2010, p. 30). The dilemma is, however, that staying for a longer period in academic research also makes it harder to get employed in other branches (Enders 1996, p. 223). On the contrary, for

[10] This is prescribed by the law "Wissenschaftszeitvertragsgesetz" that entered force in April 2007. It regulates the possibility to employ researchers in fixed term contracts for universities and public research institutes: six years before and six years after attaining the doctoral degree, while unused time from before graduation can be taken into account afterwards (http://www.gesetze-im-internet.de/bundesrecht/wisszeitvg/gesamt.pdf). The only possibility to stay in academic research after six years without a permanent position is employment in third party funded projects.

medical graduates, opportunity structures outside of academia are excellent since there seems to be a lack of clinically working physicians in Germany (Blum & Löffert, 2010; Martin, 2010). Hence, academic career aspirations in life sciences must also be seen under a more limited set of career options.

1.3 Differences by Gender

In the context of academic research careers and also in attribution and self-efficacy research, gender is an aspect that has been paid much attention to. The well-documented gender gap on the labor market, with women being disadvantaged, can likewise been found in the scientific field (Allmendinger, von Stebut, & Fuchs, 2002; Hunter & Leahey, 2010; Kahlert, 2015; Leahey, 2007). Moreover, women's disadvantage on the labor market is not only a popular topic within the social sciences, but also a central topic of politics (Allmendinger & Hinz, 2002). There are several studies documenting that women attribute successes and failures in a less self-serving[11] manner than men (Beyer, 1998; Erkut, 1983; Kiefer & Shih, 2006; Ryckman & Peckham, 1987), and tend to have lower work-related self-efficacy beliefs (e.g., Abele, 2006), also in the academic career context (Berweger & Keller, 2005; Jöstl et al., 2012; Spies & Schute, 1999). Differences in attributional patterns, however, have rarely been researched in relation to academic careers.

A study by Curdes and colleagues (2003), which addressed attributional differences as a potential predictor for the intention to pursue a doctorate in math students, found less self-serving attributional patterns in females. Less self-serving attributions have been likewise inferred from or implied by research that did not specifically analyze causal attributions, but rather related concepts (Kaczmarczyk & Schulte cited in Dalhoff, 2005; Zimmer, Krimmer, & Stallmann, 2006). Given the importance of the "gender question" in academic research and empirical evidence supporting sociocognitive gender differences with respect to academic achievements, particular attention shall also be paid to gender in the following research project. Among other questions, it is asked if women actually develop less self-serving attributions when it comes to explaining their successes and failures of the doctorate and if they—as a consequence—form lower self-efficacy beliefs and intentions to pursue an academic research career.

[11] To protect self-esteem, people tend to attribute their successes more internally and their failures more externally (Weiner 1985, p. 561). This is phenomenon is also termed as "self-serving" or "hedonic" bias.

1.4 Differences between Fields of Study

The low academic career interest among medical students is often lamented in Germany (Epstein, Pfeiffer, Eberle et al., 2016; Deutsche Forschungsgemeinschaft (DFG), 2010; Gensch & Waltenberger, 2006; Gerst & Hibbeler, 2012; Hakimi, Geisbüsch, Kotelis, & Böckler, 2010; Loos, Sander, & Albrecht, 2014; Schölmerich, 2010; Stallmach, Bauer, Witte, & Siegmund, 2011), but also other countries (Bell, 2003; Buddeberg-Fischer, Stamm, & Buddeberg, 2009; Guelich, Singer, Castro, & Rosenberg, 2002; Zemlo, Garrison, Partridge, & Ley, 2000). While medical professionals and authorities in Germany are speaking about a lack of physician-scientists (Gerst & Hibbeler, 2012; Schölmerich, 2010), no meaningful data is available that would affirm an actual lack of physician-scientists. For instance data with respect to unoccupied research positions in university hospitals, or an insufficient number of physicians holding these positions, is missing.

Moreover, there is an implicit assumption, that graduates from related fields, as biology or, generally speaking, life sciences, have a higher research interest and are more apt to pursue research careers. However, a direct comparison between medicine and related fields is also lacking. Yet comparing medical graduates to life science graduates should be obvious, since graduates from both fields, when continuing to research, often end up in the same research areas, such as clinical/translational research (DFG, 2015). Briedis and colleagues (2014) show that medical graduates are 43 percentage points less likely to be in research after receiving their doctorate in comparison to doctoral graduates in natural sciences and mathematics. While this number gives a good first hint, the reference group of natural sciences and mathematics graduates is not optimal since it does not only includes life sciences but also fields, such as engineering, which are unrelated to medicine. Furthermore, it remains unclear whether life scientists or natural scientists stay more often in research due to higher interest in research or a lack of other employment opportunities.

While research indicates that self-efficacy does indeed play a role in the formation of academic career aspirations (e.g., Berweger & Keller, 2005; Estrada, Woodcock, Hernandez, & Schultz, 2011) and furthermore, that it is plausible to assume that scientific or research self-efficacy is lower among medical students, due to less research experience and training within the regular studies (Niethammer, 2004a; Wissenschaftsrat, 2014), there are currently no studies comparing these parameters between medical and life science graduates nor is their research about the possible ability of these parameters to account for group differences with respect to academic career aspirations.

1.5 Research Questions

Having introduced the main theoretical concepts of this work, the structural circumstances of the academic career in Germany and a brief overview of relevant research results, the main research questions that are central to this dissertation can be formulated as follows:

1. Are attributions with respect to success or failure within the doctorate related to scientific self-efficacy (SSE)?
2. Are causal attributions and SSE related to academic career aspirations after the doctorate?
3. Are there gender differences with respect to academic career aspirations? If so, can attributions and SSE contribute to explaining these differences?
4. Are medical doctoral graduates less interested in pursuing an academic research career in comparison to doctoral graduates from other life sciences? If so, can self-efficacy beliefs contribute to explain lower interest in an academic career among medical doctoral graduates?

Before coming to the empirical investigation of the stated research questions, the following part will go deeper into the theoretical constructs of attributions and self-efficacy while also addressing their interrelatedness. Moreover, relevant empirical results with respect to these constructs will be discussed.

2. Theoretical and Empirical Background

In the following the theoretical constructs of attributions (Weiner, 1985, 2000) and self-efficacy (Bandura, 1977) will be introduced in more detail. Further on, relevant empirical evidence will be discussed. In this context empirical studies, which analyze self-efficacy beliefs and attributions with respect to motivational and aspirational aspects, or the relationship between those constructs, are relevant. Research, which addresses group differences, such as gender differences and differences between academic disciplines, are separately described in Chapter 3 and 4.

2.1 Causal Attributions of Success and Failure, Weiner's Attributional Theory of Motivation and Emotion

As already pointed out, attributional theories assume that individual interpretations of success and failure are crucial in determining achievement motivation and persistence in goal pursuit

(Eccles & Wigfield, 2002). All attribution and attributional theories[12] can be traced back to Heider (1958), who first had the idea of man as lay scientist, trying to understand the things that happen in his environment. Weiner's ideas and theoretical assumptions were directly inspired by Heider's work (Weiner, 2010), who already assumed that performances can be attributed to internal or external causes.[13] Moreover, Heider also had the idea that the search for causal factors, which assumedly impacted an achievement outcome, was important in order to make the right decisions in the future: adapting oneself in order to avoid failure and to be successful:

> *"I make this inquiry not because of idle curiosity, but because only if I refer this relatively insignificant offshoot event to an underlying core event will I attain a stable environment and have the possibility of controlling it"* (Heider, 1958, p. 80).

Another example given by Weiner illustrates the concept of understanding in order to adapt very well, too:

> "*The warrior needs to know why he is winning battles so he can survive the next one, just as the union representative needs to explain why the industry is doing poorly in order to urge wiser actions in the future*" (Weiner, 1985, p. 549).

According to Weiner (1985, 2000) achievement results can be attributed to several causal factors, such as ability or task difficulty. To Heider's list of most common causal factors—ability, effort, and task difficulty—Weiner adds luck (Weiner, 1992, 2010). Moreover, the assumed causes for successes and failures were originally differentiated on three dimensions: locus of causality (short: locus), controllability and stability[14]. An internal locus means that the cause is something within the actor, such as ability and/or effort: while an external locus refers to an achievement that can be linked to something outside the actor, such as luck or a nice teacher. Stability refers to the persistence of the cause in the future, and controllability to

[12] Attribution theories deal with questions of when do causal ascriptions occur and what rules they follow, whereas attributional theories are concerned with the consequences attributions have, e.g., on expectancy, emotion and motivation (Stiensmeier-Pelster & Heckhausen, 2006).

[13] "In commonsense psychology (as in scientific psychology) the result of an action is felt to depend on two sets of conditions, namely factors within the person and factors within the environment." (Heider, 1958, p.82)

[14] While Heider (1958) in his work also referred to stable properties and their value for prediction, other causal dimensions than locus and externality were not yet formalized in his theory. For instance, he states "Instances of relatively unchanging structures are such object properties as color and size, such person properties as character and ability. We feel, for example, that John's good grades make sense when we refer his achievement, a relatively momentary event, to his high intelligence, *a more or less permanent property*, and we then believe we are safe in predicting a successful college career" (Heider, 1958, p. 80; emphasis added).

whether the cause can be personally manipulated or not. It has to be further noted that, unlike Rotter (1966), Weiner *distinguishes* locus and control, acknowledging that an internal factor, such as ability, may not be controlled (Weiner, 2010). And while Rotter explained shifts in expectancy with a trait—locus of control—Weiner argues that perceived causal stability, which can vary from situation to situation, is the main (perceived) property of a cause that leads to shifts in expectancy (ibid.).

Later on, other authors added the dimension of globality (Abramson, Seligman, & Teasdale, 1978), which indicates whether a causal factor is assumed to be influential only in a specific situation or in other situations and circumstances as well. Yet, another dimension that has been proposed is intentionality: a purposeful strategic behavior, which is not to be confused with effort. However, Weiner argues that intentionality is not a property of a cause, but rather "describes an action, or a motivational state of an organism" (ibid., p. 554). One could argue that intention is the outcome of an attributional process, as already implied by the term used by Weiner "a motivational state" (ibid.).

Search for Causal Factors: When do Causal Attributions Occur?

Weiner assumes that after a person has evaluated a performance outcome, he or she searches for causal factors that have contributed to it. The search for a causal factor should, furthermore, be more likely, if the outcome was unexpected, important or negative (Weiner, 1985, 2000, 2010). According to Weiner each of these conditions is sufficient to trigger the search for causal factors, which is terminated by a causal attribution. The assumption that people search for causal factors, which might have led or contributed to events and achievement outcomes has often been questioned (Stiensmeier-Pelster & Heckhausen, 2006, p. 395). Kuhl (1983) for example argued that thinking about potential causes for success or failure was an indicator of a personality that is not mastery oriented. He proposed that people with this personality type tend to ponder about causal factors as an end in itself. Empirically it has been shown that people search for causes after success and failure, but thinking about these causes any further almost only occurs if the outcome is negative and attributed internally, stably and globally (Stiensmeier-Pelster & Heckhausen, 2006). Rumination about the causes of a negative outcome after a causal attribution has taken place, occurs less often if the cause is perceived as external, variable and specific. Causal factors are also more intensely contemplated in cases of a negative and important event/outcome (ibid.).

The Meaningfulness of Causal Dimensions

Within the causal dimensions proposed by Weiner, the stability dimension is linked with the strongest motivational and behavioral influence. This is because a supposedly stable cause is expected to subsist in the future, thus, its influence on performance outcomes is expected to persist as well (Weiner, 2000, 2010). A critique to this argumentation (Dickhäuser & Stiensmeier-Pelster, 2002) will be discussed later on in this chapter.

The globality dimension is also considered to be highly influential, since it indicates how broadly the influence of an assumed causal factor is perceived (Stiensmeier-Pelster & Heckhausen, 2006). For instance, success in the dissertation could be attributed to aptitude. In this context, aptitude could be perceived as specific to the dissertation or as more widely applicable to academic research in general. In the latter case, aptitude would be perceived as being more global. Whereas one would not expect the dissertation-specific aptitude to influence other career outcomes, within or outside of academia, a general aptitude for research is more likely to be perceived as a crucial factor for career success within academia and beyond the dissertation.

Notwithstanding the theoretical soundness and empirical support linking the controllability (Stiensmeier-Pelster & Heckhausen, 2006) and locus (Stajkovic & Sommer, 2000) dimensions to expectancy, Weiner's original theory links both these dimensions not so much to expectancy as to emotions (Weiner, 1985, see later in this chapter).

Whereas Weiner's proposed dimensions are theoretically independent, they are often highly correlated in empirical studies (Weiner, 1985). This can easily be understood: many external factors in achievement situations are at the same time uncontrollable and unstable, such as a strict teacher or high task difficulty.[15] Internal causes are, however, often inherent personality traits, and hence perceived as stable. For this reason, his proposed dimensional structure has often been critiqued (ibid.). In response to that critique, Weiner points out that an empirical correlation of dimension does not equate to an erroneous theory. Differentiation on the conceptual level can still be meaningful, even if higher correlations between proposed concepts do exist: the correlation of two parameters does not indicate that they are interchangeably. Consider, for example, height and weight, which are inevitably correlated yet remain two distinct and meaningful entities (ibid.). Thus, whereas these dimensions may be unique or distinct on a theoretical level, this fact must be kept in mind for statistical analysis, when multicollinearity may become a problem.

[15] There are cases, in which external factors can be perceived as stable, e.g., in case of discrimination (van Laar, 2000).

Stability versus Stable Influence/Behavioral Efficacy

With respect to causal dimensions, *"behavioral efficacy"*[16] is another relevant construct (Dickhäuser & Stiensmeier-Pelster, 2002). Empirical results indicate that the effect of underlying dimensions on subjective success probabilities and motivational constructs is more complex. The effects of causal factors may not be followed back to their assumed underlying dimensions, but their perceived relevance for future behavior. In other words, it may not matter if an assumed cause is perceived as stable, but the stability of its effect on future outcomes is important. Dickhäuser and Stiensmeier-Pelster (2002) can elegantly demonstrate that a stable cause, which is irrelevant to future behavior, does not affect subjectively perceived success probabilities.

In their experiment, participants were instructed to imagine that they were not able to open a file, which they had previously saved on the computer. The reasons for the inability to open that file were either: 1) a defective disc (stable but not controllable) or 2) insufficient computer knowledge (not stable but controllable). In the condition of a defective disc, the future success expectancy with respect to opening computer files was much higher. The cause "defective disc" was indeed stable, but not with respect to the ability to open files in the future. In other words, the defective disc was not relevant to respondents' future behavior, because they could store computer files on other data storage media. The attainment of new computer knowledge as in condition 2, however, would be costlier.

While this experimental setting might seem very abstract, and may seem irrelevant in real life situations, the differentiation between the stability of a cause and the stability of its influence is important. In the context of an academic career setting, one could imagine some scenarios in which this differentiation would be crucial: for example, a student might think that the personality of the supervisor was leading to unsatisfying doctorate results. While the personality of the supervisor is probably perceived as stable, it is not necessarily going to influence future career outcomes, if one changes employers etc. Consequently, it is not important whether the assumed causal factor is perceived as stable, but rather, whether one assumes that the cause's *influence* on future performance outcomes will persist.

As the reader might have noticed, some causal factors have been illustrated as having fixed characteristics with respect to causal dimensions, such as effort, which has been described as controllable, unstable and internal. While tendencies in the perception of causal factors exist (Schuster, Forsterlung, & Weiner, 1989), the per se allocation of causal factors to dimensions has been criticised, because the researcher's perception may not be equivalent to the subjects'

[16] Free translation by the author of the term "Verhaltenswirksamkeit" (Dickhäuser & Stiensmeier-Pelster, 2002).

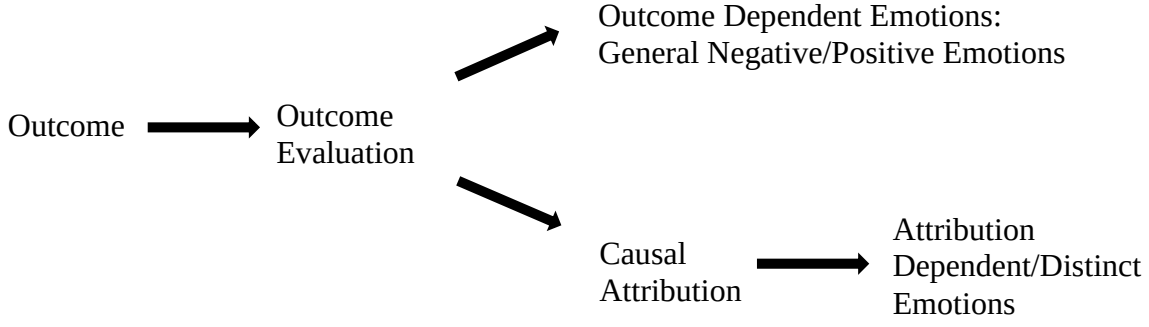
perceptions (Russel, 1982; Weiner, 1985; Dickhäuser & Stiensmeier-Pelster, 2000). One person might believe that ability in mathematics is a stable, uncontrollable trait, whereas another person might think that math ability can be trained and is, thus, the converse: controllable and unstable (Weiner, 1985, p. 551). The per se allocation of causal dimensions to causal factors has been called the *"fundamental attribution researcher error"* (Russel, 1982).

Affective Reactions/Emotions

While affective reactions and their impact on motivation are not at the centre of the pursued research question, emotional responses to attributions, which play a major role in Weiner's theory of achievement motivation and emotion, will be briefly described. According to Weiner, causal attributions impact both expectancy *and affect* which in turn guide motivated behavior (Weiner, 1985, 2000). In addition to outcome-generated emotions, which are directly related to an outcome and appear before any causal attribution has taken place, such as joy when being successful or frustration in case of failure, Weiner assumes that all causal dimensions *"affect a variety of common emotional experiences including anger, [and] gratitude"* (1985, p. 548). These attribution-generated or attribution dependent emotions, however, occur later, after the outcome-generated affect and the attributional process, which is supposed to follow the immediate emotional response (see Figure 1). Attribution-generated emotions are for example surprise, occurring when an unexpected event is attributed to luck, pride, after an internal attribution of success, or gratitude when success is attributed externally to other people. Internal attributions of success or failure are, moreover, related to self-esteem.

Figure 1: Cognition and Emotion

(Based on Weiner, 1985)



Whereas all dimensions are regarded as meaningful with respect to emotional consequences, the dimensions of locus and control are central and linked to most of the attribution-generated emotions mentioned by Weiner. The locus of an attribution determines whether the elicited emotion is directed towards the self or others. As noted above, one feels pride if success is attributed internally, or gratitude when attributed externally to the support of others. If failure is attributed internally, it is expected that persons feel shame, or anger if attributed to external and uncontrollable factors (Weiner, 1985). Furthermore, feelings of guilt should occur when failure is attributed to internal and controllable factors, such as lack of effort.

The stability dimension is related to feelings of hopelessness. Whereas attributions are theoretically linked to these emotions, it has to be mentioned that Weiner does not assume that attributions will inevitably cause the respective affective responses.

Empirical Results

Weiner's theory of causal attributions has been applied in different contexts and with different methods. Before discussing empirical results, the variety of methods that studies have used—and continue to use today—will be briefly addressed here. A more detailed discussion will take place in Chapter 6.

Studies based on Weiner's theory at first differ with respect to the circumstances in which attributions are assessed. Many studies assess attributions within experimental laboratory settings. In such studies, participants have to, for instance, engage in a laboratory task (such as solving anagrams) and are provided with feedback afterwards (e.g., Riess et al., 1981; Lyden et al., 2000). Another method is to create hypothetical success/failure events. In this approach, subjects are asked to imagine that they have just experienced a specific instance of success or failure, such as succeeding or failing in an important exam (e.g., Curdes et al., 2003). The disadvantage of these methods—hypothetical events or controlled laboratory tasks—is their transferability to naturally occurring events (Vispoel & Austin, 1995).

The relevance of attributions in artificially created test situations (such as solving tasks that are totally unrelated to real life) is questionable. It is also questionable whether or not it is possible to equate the attributions of hypothetical events with the attributions experienced after actual success and failure. Therefore, it is probably preferable to measure attributions in real life situations, such as after getting back a school exam (Thomas & Mathieu, 1994; Vispoel & Austin, 1995). With this approach, also called "*critical incident approach*", it is also better possible to make assumption about real life attributions (Vispoel & Austin, 1995).

In addition, studies differ in their measure of attributions: whereas a multitude of different attributional scales exist, the two approaches of measuring either causal factors or causal dimensions are particularly important. A myriad of studies measure participants' attributions to causal factors, for instance via importance ratings of a list of causal factors that have been predefined by the researchers (e.g., Dickhäuser & Meyer, 2006; Curdes et al., 2003). In these studies the underlying causal dimensions of causal factors are mostly a part of the interpretation by the authors, while some studies also make use of external raters to assess the underlying dimensions (see Benson, 1989).

In the other type of study, underlying dimensions are measured directly. Thus, the respondents rate the stability, controllability and locus of an assumed causal factor (Dickhäuser & Stiensmeier-Pelster, 2000; Stajkovic & Sommer, 2000). Again, the advantages and disadvantages of both methods will be further discussed in Chapter 6.

Although the evidence is not always consistent, overall, the postulated mechanisms by Weiner find indeed empirical support. The majority of studies on causal attributions are, however, located within the school context (Erkut, 1983; Schunk, 1984; Schunk & Gunn, 1986; van Laar, 2000) or are conducted with undergraduate university students (e.g., Beyer, 1998). In addition, a few studies have been conducted in occupational contexts (Greenhaus & Parasuraman, 1993) and areas like competitive sports (Bond, Biddle, & Ntoumanis, 2001; Donovan & Williams, 2003). An attributional approach has also been applied in depression research (Seligman, Abramson, Semmel, & Von Baeyer, 1979). The "depressive attributional style" has been described as attributing most negative experiences to internal, stable and global factors, and reversely, attributing most positive events to external and unstable factors. This attributional pattern would, thus, result in hopelessness and depression.

In the following, a separate empirical overview of study results will be given for research which measured attributions to causal factors and research which measured attributions to causal dimensions.

Studies measuring causal factors show particularly positive effects of ability attributions in success situations. Attributing success to ability is associated with higher self-efficacy beliefs (e.g., Schunk & Gunn 1986, Schunk 1984; Vasil, 1992), higher motivation, respectively higher persistence (e.g., Sekaquaptewa, 2011, Kiefer & Shih, 2006; Curdes et al., 2003; Schunk, 1984) and also test performance (Hsieh & Schallert, 2008). In a study with university staff, Vasil (1992) could show that attributing a hypothetical success (acceptance of a paper) to ability was significantly related to higher research/scientific self-efficacy beliefs and, vice

versa, attributing a hypothetical failure to ability was associated with lower self-efficacy beliefs. In the negative case, however, the effect was only significant at the 10 percent level. Furthermore, the cross-sectional design of the study is a limitation. Therefore, the causal direction might just as well be the other way round, and researchers with higher self-efficacy beliefs are simply more likely to attribute success to ability and failure to other factors than ability. Given the theoretical and empirical reciprocal connection between attributions and self-efficacy (Bandura, 1977; Stajkovic & Sommer, 2000), both might be true.

Curdes et al. (2003) analyze attributions of university mathematics students in relation to their intention to take a doctoral degree. In the study, ability attributions in (hypothetical) success situations were positively related to the attitude towards taking a doctoral degree, even after controlling for interest in mathematical research. Furthermore, differences in attributions explained the more positive attitude of men towards attempting a doctorate in comparison to that of women.

Beyond that, an increase in motivation has been reported, when failure is attributed to lack of effort or external, variable factors (i.e., Andrews & Debus, 1978). It must be noted, yet, that there are instances, in which an external cause can be perceived as stable, such as in the case of ethnic/racial discrimination. In such cases, the external attribution would lead to lower motivation (van Laar, 2000)

The research results of Schunk (1986) suggest that attributing success to luck has a negative impact on future performance. However, attributing success to one's ability positively impacts performance. In addition, intervention studies provide evidence that reattribution trainings[17] can increase performance (Weiner, 2010). For instance, in a study by Ziegler and Heller (2000) school girls who passed reattribution training in physics had significantly better grades at the end of the school year, when compared to the control group with no training. The reattribution training in the study was realized via verbal and written feedback by the teacher, who gave a "lack of effort" feedback after the experience of failure and an "ability feedback" after the experience of success. Another study by Relich, Debus, and Walker (1986) implemented an attributional training with school children. Their analysis shows that the attributional retraining affected subsequent self-efficacy which was, moreover, positively related to persistence and performance outcome.

Since effects of causal attributions on performance are most probably mediated by a change in motivation and, hence, self-regulation (Weiner, 2010, p. 35), it is clear why effects of attributions on performance cannot always be supported (e.g., Erkut, 1983). While changing

[17] Within a reattribution training attaining persons learn to attribute failure to unstable and controllable causes, such as lack of effort, and success to their ability.

one's behavior, i.e., increasing effort, can result in higher performance, such investments may not always be rewarded, if for instance an increase in performance is limited by ability or the wrong strategy was pursued.

Studies measuring causal dimensions as independent variables, come to very similar results. For instance in a study on computer related attributions, Dickhäuser and Stiensmeier-Pelster (2000) found, that attributing success to stable, global and controllable causes was related to a higher ability concept. Thomas and Mathieu (1994) showed that attributing success to stable causes leaded to higher self-efficacy beliefs within a sample of school students. Similarly, Stajkovic and Sommer (2000) provide evidence that attributing success internally results in higher self-efficacy beliefs. With respect to instances of failure, it has been supported that attributions to presumably stable causes are linked to lowered aspirations (Donovan & Williams, 2003), while attributing failure to a controllable cause has been linked to an increase in aspiration level (Williams, Donovan, & Dodge, 2000).

Rarely, *both measures* of causal factors and dimensions have been used and compared. Hsieh and Schallert (2008) who studied the link between attributions, self-efficacy and performance, measured attributions with the revised Causal Dimension Scale (CSDII) (McAuley, 1992) and additionally importance ratings causal factors. Their analysis solely revealed a significant effect of ability attributions and self-efficacy on test performance, no effect was found for causal dimensions. Hsieh and Kang (2010) were able to detect a self-serving bias in attributional patterns with both methods, measuring attributions to factors and dimensions. The self-serving bias is a well-documented phenomenon in the causal attribution context (Lyden et al., 2002; Mezulis, Abramson, Hyde, & Hankin, 2004) and, therefore, often used as an indicator of construct validity (Russel, 1987).

Attribution and Emotion. With respect to attributions and emotions, empirical studies support the existence of attribution-generated emotions on top of emotions that are solely outcome-generated. A study by McFarland and Ross (1982) for example, can support that ability attributions in success situations are related to higher self-esteem. Furthermore, the study related attributions to emotions which were originally conceptualized as outcome-generated: general positive and negative affect. Smith and colleagues (Smith, Haynes, Lazarus, & Pope, 1993) found a stronger connection between appraisal and emotion than between attributions and emotion. However, their results supported that appraisal is a mediator between attributions and emotions. In addition, van Laar (2000) was able to explain the paradox of

Afro-American students' high self-esteem despite their low grades with their attributional style: by attributing failure to discrimination, these students could maintain their self-esteem. Goetz and colleagues (2010) found a link between perceived controllability, value appraisal and emotions of enjoyment, pride and contentment. These links were found both for achievement and non-achievement situations.

Furthermore, a study which implemented a training to enhance attributional style in sales employees (Proudfoot, Corr, Guest, & Dunn, 2009) showed a significant increase in self-esteem and well-being subsequent to the intervention.

2.2 Self-Efficacy Beliefs

Theoretical Background

Self-efficacy beliefs refer to the expectations of a person to conduct courses of actions successfully (Bandura, 1977, 1982). Hence, self-efficacy is also a kind of perceived control over one's own performances and goals (Ajzen, 2002), and is an important predictor for coping behavior, aspiration, motivation and persistence. According to Bandura, there are four central *sources of self-efficacy*: past experiences of success and failure (mastery experience/performance accomplishments), seeing others succeed and fail (vicarious experience), verbal influence from the social environment (verbal persuasion), which can be encouraging or discouraging, and affective states (physiological/emotional states), such as stress or anxiousness. Among these sources of self-efficacy, mastery experience is attached with the highest importance (see Bandura, 1997; Zeldin & Pajares, 2000; Usher & Pajares, 2008). It has to be noted that the term mastery experience does not only refer to objective performance outcomes. As the term experience already implies, it refers to personal interpretations and evaluation of performance outcomes (Bandura, 1997; Usher & Pajares, 2008).

As Bandura (1997, p. 81) stated: *"[T]he same level of performance success may raise, leave unaffected, or lower perceived self-efficacy depending on how various personal and situational contributions are interpreted and weighted"*. With this sentence, it already becomes clear that attributions—which are nothing more than interpretations of experienced successes and failure—may be an important contributor to mastery experience. Also Bandura (1977) pointed out to the importance of causal attributions in the formation of self-efficacy beliefs: not only success and failure shape expectations about the future, but also the interpretations of these outcomes, meaning the factors that one assumes to be the cause for an outcome.

Moreover, Bandura assumed that attributions and self-efficacy are mutually related to each other (Bandura, 1986): self-efficacy beliefs at one point of time can affect the interpretation of success or failure, those interpretations, i.e., causal attributions can in turn influence or reinforce a person's self-efficacy beliefs (Bandura, 1986; Hsieh & Kang, 2010). Attributions and self-efficacy belief's mutual influence on each other, hence, have the potential to provoke a positive, and reversely, a negative chain.

It is also plausible, that attributions are not only affected by former self-efficacy beliefs and related constructs (such as ability concept), but also by verbal persuasion, which are as well related to self-efficacy. This is an obvious suggestion made by studies which demonstrate effects of attributional feedback—which is a form of verbal persuasion—on self-efficacy (Schunk, 1982, 1984; Schunk & Gunn, 1986). Within this realm of research, feedback from the supervisor or supervisors and the scientific community could influence attributions of doctoral candidates and thereby affect their scientific self-efficacy beliefs.

Another suggested source of self-efficacy is vicarious experience. Vicarious experience is thought to be important in cases, in which persons have little experiences themselves (Bandura, 1977). A lower influence is suggested for verbal persuasion, especially in comparison to own mastery experiences (Bandura, 1977). While Bandura made relatively vague statements about the importance of each of the assumed sources, he did not hypothesize about the relative contributions for each of these (Usher & Pajares, 2008).

Empirical Results

The construct of self-efficacy has been studied in various contexts and its relevance has found broad support (Eccles & Wigfield 2002, p. 111). Furthermore, many studies on self-efficacy have been conducted in academic and occupational settings. Lent, Brown and Larkin (1984) for example found that undergraduate students who reported higher self-efficacy beliefs persisted longer in technical/natural sciences majors and also achieved higher grades. Zimmermann, Bandura and Martinez-Pons (1992) could link student's efficacy beliefs to their self-set academic goals. When it comes to the relevance of self-efficacy within the career/occupational context, studies show effects on career intentions/the choice of occupational area (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001) as well as career success/performance (Abele-Brehm & Stief, 2004; Abele & Spurk, 2009; Stajkovic & Luthans, 1998). These results also apply to the academic career context, where a relationship between research related/scientific self-efficacy and the intention to pursue a doctoral degree

(Spies & Schute, 1999) and an academic research career could be supported (Berweger & Keller, 2005; Bieschke et al., 1996; Estrada et al., 2011).

Empirical results on the interrelatedness of self-efficacy beliefs and causal attributions. To address the link between attributions and self-efficacy, Schunk and colleagues (Schunk, 1982, 1984; Schunk & Gunn, 1986) conducted empirical studies in which the effect of attributions on self-efficacy beliefs was analyzed. Within these studies, attributions were experimentally manipulated by feedback (ability, effort or luck feedback etc.) given to school children subsequent to a performance. The results of those studies supported the notion that attributing success to ability and effort is positively related to self-efficacy beliefs. However, within one study effort feedback was negatively related to self-efficacy (Schunk & Gunn, 1986). This result was interpreted as consistent with developmental research, which shows that ability becomes increasingly important with respect to explaining success and failure. Moreover, it has been argued that success that was attained with little effort should strengthen self-efficacy beliefs even more: *"Success with minimal effort fosters ability ascriptions that reinforce a strong sense of self-efficacy"* (Bandura, 1977, p. 149). In the study by Schunk & Gunn (1986), not only effort but also luck feedback was, consistent with attributional theory, negatively related to self-efficacy beliefs. The studies conducted by Schunk and colleagues do not only provide evidence for an association between attributions and self-efficacy beliefs, but beyond that support the relationship between verbal persuasion and self-efficacy beliefs.

A similar study was conducted by Relich et al. (1986). As described in the previous section, the school children in the treatment group who received attributional feedback (such as lack of effort feedback in case of failure) had significantly higher achievement outcomes than the control group. The effect of attributional feedback on achievement was, moreover, mediated by self-efficacy beliefs which increased children's persistence.

Corresponding to these results, the already mentioned study of Vasil (1992) found a positive effect of ability attributions on self-efficacy in a success situation and respectively a negative effect of ability attributions in a failure situation: Researchers who attributed a hypothetical rejection of a paper to ability were expressing lower self-efficacy beliefs, whereas those who attributed success (the hypothetical acceptance of a paper) to ability, had higher self-efficacy beliefs.

Furthermore, Tolli and Schmidt (2008) provided evidence for the mediating effect of self-efficacy between attributions and aspirations: Study participants who attributed positive feedback internally had a boost in self-efficacy and revised their goals upwards. Thomas and

Mathieu (1994) were able to show that school students who attributed their exam success to stable causes, had the biggest increase in self-efficacy and confidence, also when compared to equally successful students who attributed their success to not as stable causes. In accordance with these results, Hsieh and Kang (2010) found that school students who attributed success internally expressed higher self-efficacy beliefs. Beyond that, less successful students who attributed their failure to controllable factors expressed higher self-efficacy beliefs than those who attributed failure to not as controllable factors.

Evidence for the claimed reciprocal relationship between attributions and self-efficacy was given by Silver, Mitchell and Gist (1995) and Stajkovic and Sommer (2000). Within an experimental setting, Silver, Mitchell and Gist (1995) showed that high self-efficacious study participants tented towards more self-serving attributions: attributing success to more stable factors than participants with lower initial self-efficacy. The opposite applied to instances of failure, in which high self-efficacious participants made attributions to less stable factors. Additionally, the authors demonstrated in a second experiment that both attributions and past performance were associated with subsequent self-efficacy. In addition to the study by Silver and colleagues, Stajkovic and Sommer (2000) also conducted an experiment in which students had to do a brainstorming task. The authors showed that initial self-efficacy, measured before task performance feedback, was related to attributions, which were furthermore related to self-efficacy measured after task performance feedback.

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3. Gender

Gender differences within the academic career are a main research topic and so are gender differences in achievement related cognitions, such as causal attributions, self-efficacy beliefs, academic self-concept etc. In the following, an overview of research results on gender differences in academia, including sociocognitive aspects, will be given. Furthermore, difficulties and open questions arising from existing research and related possibilities and recommendations for future research will be discussed.

3.1 Gender Differences in the Academic Career—Status Quo

The pure meritocratic character of academic research has long been unquestioned, until finally research on the disadvantages of women and minority groups evolved (Gross & Jungbauer-Gans, 2007). The lower status position of women in academic research continues to be an issue of research and politics (Allmendinger & Hinz, 2002; Kreckel, 2005; Schubert & Engelage, 2011). While half of the student population in Germany is female, only twenty percent of professorships are held by women (Brodesser & Samjeske, 2015). In human medicine only twelve percent of professorships in Germany were held by women in 2011, and eleven percent in dental medicine (Deutsche Hochschulmedizin e.V.). Hence, the female count of professorships in medicine remains below the overall average. This is surprising since females make up over 60 percent of medical students in Germany (ibid.).

The dropout of female physicians seems to mostly happen after doctoral graduation: between the doctorate and the habilitation 30 percent of female physicians drop out of academic research (Bund-Länder-Kommission (BLK), 2004; Lind & Löther, 2007). Moreover, Lind and Löther (2007) find a disadvantage for habilitated women, specifically as regards to the field of medicine. Only in the field of medicine the share of female first appointments was below their share of habilitations. Thus, the chances of habilitated physicians to get appointed as a professor were higher for males than for females (ibid., p. 259).[18] Taken all fields together, the amount of appointments slightly exceeds the amount of habilitations, whereof Brodesser and Samjeske (2015) conclude that the female dropout can be traced back to the postdoctoral phase and not to appointment procedures. According to the presented data from Lind and Löther (2007), this does not seem to hold true for the field of medicine.

While there is no data available with respect to the current gender distribution of professorships in biology or life sciences, Lind and Löther (2007) found that 33 percent of

[18] The numbers are estimated on the basis of prototypical academic research careers. Analyzed data reaches from 1986 to 2005.

female doctoral graduates in biology do not habilitate. In the subject group of mathematics and natural sciences, in which gender distributions are very mixed depending on the specific field (ibid.), the share of female professorships as a whole added up to 14 percent in 2013 (Statistisches Bundesamt, 2014). This number already includes junior professorships and visiting professors, therefore, cannot be equated to the amount of full professorships.

Moreover, with data from 2003, Neugebauer (2006) found similar trends in the life sciences in Germany as compared to medicine: a steep decrease of female scientists with higher ranks and an amount of professorships just over 10 percent. This is not only shown for Germany, but also the UK and France (ibid.). It has to be noted, however, that these data do not necessarily represent perfectly the current status. Yet, when looking at the overall number of female professorships from 2001 to 2013, the amount grew by 0.84 percentage points every year (Brodesser & Samjeske, 2015). Therefore, the numbers from 2003 will probably not deviate dramatically from the current ones. Although there are generally more female professors in female dominated fields, such as medicine and biology[19], than in male dominated fields, higher female dropout rates for the period between graduation and professorship are detected for female dominated fields. Whereas in the male dominated fields, the number of female students is already low from the beginning, more women "survive" the academic career pipeline (Allmendinger et al., 2002; Lind & Löther, 2007). While this phenomenon is not yet resolved, possible explanations might be a self-selection of women with specific characteristics into male dominated fields or a comparably lower dropout rate as a result of a diminished intragroup competition.

The fact that female fluctuation in academic research increases with a higher percentage of female researchers (Lind & Löther, 2007; Tolbert, Simons, Andrews, & Rhee, 1995), is pointing to a potential importance of intragroup competition. Only when the amount of female researchers exceeds 35 percent to 40 percent, fluctuation seems to decline again (Tolbert, Simons, Andrews, & Rhee, 1995). Additionally, studies hint to an advantage of males within female dominated occupations. This advantage is designated as the "glass escalator" (Hultin, 2003; Williams, 1992). While the mechanisms behind these career patterns are not completely understood yet, it can be stated that a higher share of female staff does not necessarily lead to a decline in status inequality between genders, and may in some cases even be associated with higher inequality.

Additionally, positions of female postdoctoral researchers appear to differ from those of their male colleagues. Female postdocs in Germany are four times more likely to receive a fixed

[19] http://www.jobmensa.de/ratgeber/studium/frauen-in-mint-faechern

term employment contract and their employment contracts have shorter periods than those of their male counterparts. As a consequence, they are also less satisfied with their career when compared to their male colleagues (Konsortium Bundesbericht Wissenschaftlicher Nachwuchs, 2013.). While some studies found that female researchers in sociology are more likely to get tenured, when controlling for publications and other achievement variables (Lutter & Schröder, 2014), these do not take into consideration that groups may have different chances in attaining publications. Women's fewer publications may, for instance, result from poorer networks, poorer work conditions (shorter contracts, more limited contracts etc.) and higher burdens from childcare.

Theoretical attempts to explain the underrepresentation of women in higher positions in academic research or professorships are various. They can be roughly broken down into structural and individual approaches. Structural approaches focus more on external conditions, such as networks, family work load and childcare. Individual approaches focus on gender differences on the personal level as explanatory factors, such as self-efficacy, personal orientations and goals (career orientation, family orientation, job involvement etc.). Naturally, these approaches are not to be regarded as distinct from each other, they are interrelated: as for example the orientation towards career and family and structural constraints that arise from family workload. While the present work is focusing more on individual, cognitive differences, a research overview shall be given of both structural and individual explanatory approaches. A broad overview might as well be beneficial for the interpretation of forthcoming empirical results, implications, and suggestions for future research.

3.2 Structural Approaches: Discrimination, Networks and Family

Discrimination

Explaining lower career output for women in academic research with structures rather than characteristics of the researcher strongly shakes the basis of the idea of academia as a purely meritocratic institution. This is especially true for the strain of research that focuses on discrimination of female scientists. Empirical results regarding this topic are mixed, with some studies supporting a gender bias in preference of males, and some not (summarized in Ceci, Williams, & Barnett, 2009). Evidence with respect to female discrimination also exists in the fields of academic medicine and life sciences. In this context, a study by Wennerås and Wold (1997) needs to be mentioned. The authors of the study analyzed the allocation of postdoc fellowships by the Swedish Medical Research Council (MRC) to scientists in biomedical research and which characteristics of a researcher were important for attaining the

postdoc fellowship. The allocation procedure incorporated a non-anonymous peer-review by eleven evaluation committees who allocated domain specific competency points to the applying researchers. One important domain of those was scientific competency, which was evaluated on the basis on scientific productivity, i.e., publishing activity. In their analysis, the authors found a gender bias in the evaluation of scientific productivity, which they measured by six different indicators: 1) all publications of original articles, 2) published first author articles, 3) impact factors for all publications, 4) impact factor of first author articles, 5) citations of all publications and 6) citations of first author articles. In their article it is concluded that men with equal productivity were given higher competency points by the jury. The most productive group of females with 100 impact factors was given the same amount of competency points as the male group with the least impact factors, namely 20. The study, furthermore, revealed a significant "friendship bonus": applying researchers who knew someone from the committee were given significantly better evaluations. A repeated analysis in 2008 found gender neutral funding, while nepotism appeared to have prevailed (Sandström & Hällsten, 2008).

While the study of Wennerås and Wold (1997) received wide attention, it has been also methodologically critiqued for not considering the specific subfields of applicants (Ceci et al., 2009) and entering each productivity variable separately into their regression model, rather than regarding these together (Sommers, 2008). In addition, large scale analyses of other institutions' grant awarding practices (such as the NIH, National Science Foundation and the Australian Science Foundation) suggest that there are no systematic gender differences in funding (summarized in Ceci et al., 2009). Beyond that, analyzing longitudinal data from 1971 to 2001, Ginther & Kahn (2006) overall found no gender differences with respect to being promoted to tenure or to a full professor. Yet, a small difference was found in the life sciences, where women were by eight percent less likely to be tenured when control variables were included into the analysis.

Other studies yet again, point more towards discrimination of females at the workplace. For instance Steinpreis, Andres, and Ritzke (1999) found that male applicants with the same CV were favored over females as assistant professors in psychology. Within the study, female and male participants favored male applicants. Evidence from a nonacademic area suggests that more females are chosen for an orchestra position when the audition is blind (Goldin & Rouse, 2000). Since double blind peer review is still not a standard that is implemented in every field and institution (see Budden et al., 2008), these research results might still be relevant today, despite the mixed evidence.

In relation to academic medicine, Carr et al. (2000) found that in U.S medical schools female faculty were 2.5 times as likely to report gender discrimination and 50 percent of female faculty reported experiences of sexual harassment. Within a qualitative study conducted with recent PhD graduates in biomedical sciences, females reported to having experienced direct discrimination by male colleagues or supervisors, for example by sexual harassment or by being verbally put under pressure not to have children (Gibbs & Griffin, 2013). A participant of the study for instance described a situation, in which a colleague preferred to hire a male student instead of an equally qualified female student because *"women can't do math and they're not really competent in mathematics"* (ibid., p. 717). Whereas the examples within the qualitative study are not sufficient to detect systematic discrimination within academic research in general, they add up to the empirical evidence. It also has to be acknowledged that there was not one single case of a male PhD graduate in the study who reported an even roughly comparable experience.

Within the German context a recent qualitative study of (male and female) university teachers (Kahlert, 2015) is supportive of prevailing stereotypical beliefs and expectations with respect to female junior scientists. While the interviewed university teachers claimed to be gender neutral in their promotion of junior scientists, they at the same time expressed doubts with respect to women's ability to pursue their research careers in a targeted manner.

In summary it can be said that research results with respect to female discrimination at the (academic) workplace is conflicting. Whereas some studies support that gender equal treatment at the academic workplace is not fully achieved yet, others don't. Moreover, systematic and recent research on this issue with a representative amount of participants is needed to finally evaluate the importance of the topic, in Germany as well as other countries. As Ceci and colleagues (2009, p. 247) conclude *"[m]uch of the evidence is dated or anecdotal".* Additionally, when it comes to analyze discrimination, fields of study should be regarded separately.

Networks, Integration into the Scientific Community

Networking is another aspect that appears to be important in the discussion of gender and is somehow related to discrimination. There is evidence that being networked within the scientific community is an important predictor for staying in academic research, as well as for a successful career in academic research (Gross & Jungbauer-Gans, 2007). Collaborating with other researchers has, furthermore, been linked to higher research productivity (Landry, Traore, & Godin, 1996; Lee & Bozeman, 2005). However, studies suggest women to be less

integrated into their scientific communities (Beaufaÿs, 2003; Krais, 2000; Kyvik & Teigen, 1996; Schubert & Engelage, 2011), or to profit less from their contacts within their community in comparison to men (Fuchs, Von Stebut, & Allmendinger, 2001). Whereas Fuchs and colleagues (2001) found no gender differences in self-reported support by former doctoral students of the Max Planck society, only male graduates profited from their external research contacts, meaning that external contacts increased the males' but not females' probability to stay in academic research after graduation. The finding indicates that for whatever reason, female researchers weren't either able to mobilize their social capital, or their social ties substantially differed from those of males. Since external social ties were vaguely operationalized as "external scientific work experience" and an "external mentor supporting their work" (ibid., p. 194), it cannot be finally concluded why females profited less from their contacts. External work experience can be very diverse and linked to less or more integration into the (local) work environment. Also a mentor can differ with respect to status, social network and dedication to the mentee. In addition, the status of the doctoral supervisor has been linked to academic career success of doctoral graduates (Gross & Jungbauer-Gans, 2007).

While Fuchs and colleagues' (2001) findings point to no differences in (reported) social support by gender, other studies provide evidence for female scientists' poorer integration into the scientific community. Schubert and Engelage (2011) found that female doctoral candidates in German-speaking-Switzerland—which can be compared to Germany because of similar structures in academic science and a similar situation of female researchers (ibid.)—are less integrated into the scientific community during their doctorate and find their first job after graduation less frequently over a social (academic) contact. They also found that women in male dominated fields publish significantly fewer articles than their male colleagues. However, this did not apply to other fields. The finding hints to a poorer integration of female researchers into the scientific community in male dominated fields, since collaboration can be linked to publication productivity (Landry et al., 1996; Lee & Bozeman, 2005). Whereas other studies don't find gender differences in the amount of collaborations, such as Hunter and Leahey (2008) for the field of sociology, this could be a matter of discipline. However, when evaluating such research results, it has to be noted that measuring collaboration quantitatively does not allow drawing conclusions about the quality of collaborations and their benefit to the collaborators.

In addition, Schubert and Engelage (2011) do not find any significant gender difference with respect to the probability of habilitating. Seeing the habilitation as an indicator of a successful

academic career is, however, problematic, since the habilitation does not guarantee a position as a full professor. With respect to female researchers' social capital it is also found that women receive less mentoring which is found to be beneficial for academic research careers (Fuchs et al., 2001).

While research indicates a lower productivity of female researches, measured by the number of published articles (e.g., Fox, 2005; Jagsi et al., 2006; Sidhu et al., 2009; Symonds, Gemmell, Braisher, Gorringe, & Elgar, 2006) , rather than being the cause, lower quantitative productivity might as well be a result of generally lower status positions of women (Gross & Jungbauer-Gans, 2007; Fox, 2005). As Fox puts it (2005, p. 31): "*Publication productivity reflects women's depressed rank and status, and partially accounts for it*." While it has not been finally cleared how cause and effect are actually intertwined for status and publications, a bidirectional, self-amplifying effect seems plausible.

Specialization seems to be another factor influencing scientific productivity and scientific visibility (Leahey, 2007). Analyzing a sample of scientists in the fields of sociology and linguistics, Leahey (2007) found that women specialize less than men and therefore publish less. Specialization and productivity in turn influence the visibility of the researcher, which was measured by the Social Science Citation Index for sociologists and the Arts and Humanities Index for linguists.

Family Burden

There is a high rate of childlessness in German academia, moreover, female researchers have even higher rates of childlessness than male researchers (Kunadt, 2014). This also applies to professors, which, however, more often have children than other academic staff. Female professors, however, are twice as often childless than male professors (ibid.). These patterns are not only found in Germany, but for instance, also in the US (Mason & Goulden, 2004a). It seems that employees in academic research are very concerned about possible harmful effects of children on their career, and hence, repeatedly postpone the family planning to a seemingly better point of time (Metz-Göckel, Heusgen, Möller, Schürmann, & Selent, 2014). Due to a very long qualification time and limited contracts in academia, the career security researchers wish in order to start a family, only comes with full professorship, in Germany around an age of 40 (Lind & Löther, 2007). In addition, within a surveyed sample of physicians working in a university hospital in Germany, more women than men indicated to have postponed child bearing due to work (Hanika, 2015).

Speaking of the influence of family and childcare on women's careers in academic research, empirical results are somehow conflicting. Some studies find negative effects of children, some do not find any effects and some studies even find positive effects on the female academic research career (summarized in Hunter & Leahey, 2010). Apparently these contradicting results are also to be seen as a result of differing operationalization, for instance dichotomously measuring the presence of children versus measuring the number of children, controlling or not controlling for children's age etc. (ibid.).

Most studies on this topic are cross-sectional, but the birth of a child will influence the lives of parents to different extents over the life span, because care intensity will vary with child's age. Moreover, the compatibility of childcare and work in academic research may also vary with field of study. For instance a child may be more hindering to productivity, when one has to be at a laboratory all day to generate research results, than if one can mostly work on the desktop, which is more compatible with working from home (ibid.). For physician-scientists in clinical fields, who often have to research in their spare time, on weekends or during their holidays (Hanika, 2015), reconciliation of work and family might be even more difficult.

The study of Hunter and Leahey (2010) overcomes many of the limitations of previous cross-sectional studies by tracing the careers of scientists, male and female, retrospectively. This leads to a longitudinal dataset which makes it possible to analyze how and when a child affects research productivity. Results of the study support that productivity of male and female researchers is lowered after childbirth, but more so for women. Childbirth also negatively affected visibility of researchers, but this effect did not significantly differ by gender. Whereas female researchers' career seemed to suffer more from childbirth, the study might be even biased in favor to gender equality, since it was limited to tenured researchers in the fields of linguistics and sociology. The group of (female) scientists who reached a tenured position, however, might already be a positively selected group with respect to career success and motivation, social support systems etc. Larger differences might be detected beneath the level of tenured positions. Moreover, a study by Mason and Goulden (2004b) shows that men who had a baby within five years of their receiving the PhD, were 38 percent more likely to get tenured than their female counterparts. This pattern was stable over the analyzed fields of study: humanities, social sciences and "hard sciences".

One can imagine as well that in life sciences and medicine childbirth could have a stronger effect on research productivity, if the undergone research is mainly situated in the laboratory, or conducted next to a full time job in patient care. New research results from Germany support the negative effect of childbirth on female academic researchers' careers. A study of

Althaber and colleagues (2011) come to the result that women still bear most of the responsibility when it comes to childcare, especially in the first year after childbirth. Due to reduced work time, absenteeism and reduced mobility, the career of women in academia who gave birth to a child is suffering (ibid.). Even in partnerships with egalitarian gender role values, the authors observed a shift towards traditional labor division after childbirth. Despite the initial goodwill, women were engaging more in housework and childcare and an equal division between partners was not realized. This pattern is also supported by other studies (Reimann & Alfermann, 2014; Kunadt, 2014).

Kunadt (2014, p. 3) describes the division of labor between men and women as semi-traditional: *"In our sample the share of house- and care-work between men and women depicts semi-traditional role-models: in relationships with and without children female scientists take over more than half of all house-work duties (59% respectively 58%), men take over one third (32% respectively 37%). Nearly the same percentages are revealed concerning care for children (women: 56%, men: 32%)."*

A recent study with physicians working in a university hospital also finds, that female physicians indicate significantly more often to be primarily responsible for childcare and housework (Hanika, 2015). The surveyed female physicians also indicated to have less time to conduct research in their spare time. Furthermore, female physicians agreed significantly more to the statements that research and family is hardly to combine, and that their family situation would not allow them to relocate for career reasons. This pattern can also be confirmed by American studies. Schiebinger and Gilmartin (2010) who conducted a study among researchers at elite research universities, describe that woman *"continue to do the lion's share of housework"*. While the division of housework between couples both working in academic research was a bit more egalitarian, females still took over more than half of the duties at home. The authors concluded that *"[t]he public world is changing, pushed forward by legislation and institutional action. The private world of the home, however, remains largely mired in tradition."*

Beyond that, some German studies indicate that female scientists also anticipate more "career damage" by having children. In a survey of junior professors and junior research group leaders who had been funded by the Emmy-Noether program, women agreed significantly more to the statement that having children will lead to a decline in ascribed competence by their work environment (Berndt, Burkhardt, Nickel, Püttmann, & Rathmann, 2014). Even if children would not have any effect on career success, such anticipation could be associated with an early dropout out of academic research. In the aforementioned study by Ginther &

Kahn (2006), found gender differences with respect to career advancement could be largely explained by children and marriage. While married men with children had an increased likelihood of being promoted, conversely, marriage and children decreased the likelihood of career advancement for women.

Another hindering career factor is that women more often than men have a partner with an equally high education or a partner who is also in academia. Since the male partners are less likely to cut back on their careers, realizing family and work is even harder for women. In the aforementioned survey by Schiebinger and Gilmartin (2010), 50 percent of male researchers indicated that their career is put first within their partnership, only 20 percent of female researchers indicated that their careers were primary considered. In a study of Rudd, Morrison, Picciano, Nerad (2008), 25 percent of female social scientists with a PhD changed their job for their partner, but only 14 percent of the male social scientists with a PhD did likewise. This is consistent with other evidence suggesting that women are more likely to be "tied movers"—meaning that they are more likely to comply with their partner's preferences when it comes to the place of residence. However, new studies (not focusing on couples in academia) seem to suggest diminishing or insignificant gender differences with this respect (e.g., Smits, Mulder, & Hooimeijer, 2003; Abraham, Hinz & Auspurg, 2010).

As family formation tends to negatively influence women's careers in academia, no such effects are found for men, and some studies even find positive career effects (Abele, 2003a, 2003b, 2006; Ginther & Kahn, 2006; Husung, 2007; Rusconi, 2013). A recent study of Rusconi (2013) suggests that fathers have career advantages over married men, especially when their wife takes care of the children. This is not surprising, since having a partner that takes care of housework and childcare allows one to focus on the career even more. However, in Rusconi's study those fathers who were equally participating in childcare did not suffer in terms of career success. The group of women who were in relationships with engaging partners was as well most probable to be successful in their career as well.

3.3 Gender Differences on the Individual Level with a Focus on Attributional Patterns and Self-Efficacy as Potential Influences on the Pursuit of an Academic Career

Causal Attributions

An equal amount of attribution research has been dealt with gender differences (e.g., Kiefer & Shih, 2006; Ziegler & Heller, 2000; Beyer, 1998; Erkut, 1983). Many of these studies have looked into gender differences in attributional patterns as an explanation for the lower amount of female participation and performance in male dominated disciplines. The underlying assumption of these studies is that women exert less favorable attributions than men (Beyer, 1998). Some studies researching this topic indeed found that within male dominated fields, women tend to attribute their successes to more external factors or effort than to ability, when compared to men (Kiefer & Shih, 2006; Beyer, 1998). Though when failing, they tend to make more ability attributions (Beyer, 1998). Furthermore, Kiefer and Shih (2006) found that females, who attributed their failure in a mathematic task to ability, were less persistence in practicing mathematical tasks subsequently.

However, it has to be noted that studies cannot altogether support a pattern of a more "pessimistic" attributional style for females. Especially with samples consisting of college students, often no differences are found (Campbell & Henry, 1999; Kaufman & Shikiar, 1985; Petiprin & Johnson, 1991). Another study by Feather (1969) found that women were more likely to attribute both successes and failures to external factors.

Explanations to these various and sometimes contradicting findings might be the use of different methods, for instance with respect to the success/failure situations that participants are confronted with, the use of hypothetical success/failure events and also characteristics of the population studied. Campbell & Henry (1999) argue that college students might be more "androgynous" in attributions since they have not made enough experiences in a sexist work environment yet, that is segregated horizontally as well as vertically. For this reason it is argued that gender related identity might not be as distinct within college students yet. While this sounds like a reasonable explanation, it does not explain gender differences in attributional patterns in school children (Dickhäuser & Meyer, 2006). In addition, the argumentation is inconsistent with findings on gender stereotypes in school children (Cvencek, Meltzoff, & Greenwald, 2011; Tiedemann, 2000) which seem to be related to parental stereotypes (Tiedemann, 2000). The learning of gender, therefore, seems to be rooted much earlier before the beginning of work life. It is therefore argued that inconsistent results,

most likely, are a product of methodological differences and context differences (field of study, description of hypothetical events).

The importance of the context is also implied by studies on stereotype threat. Within these studies women are told to solve exercises and are given the additional information that women are in general performing not as good as men (or the exercise is in a subject were males are stereotypically considered to be better). With these extra information, women perform significantly worse than if they aren't aware of performance differences by gender (Spencer, Steele, & Quinn, 1999; Kiefer & Shih, 2006; Koch et al., 2008). Therefore attributional differences might as well occur in fields where gender stereotypes at expense of females exist. In addition, some studies can explain attributional differences between genders by controlling for gender stereotypes (Erkut, 1983; Kiefer & Shih, 2006).

Causal Attributions within the Academic Career Context

Also within the context of academic careers, some research results indicate that gender differences in cognitions and beliefs about ability and performance exist. For example, within the German context female physician-scientists have been found to underestimate their abilities and to see their future career perspectives in a more negative light as their male colleagues (Kaczmarczyk & Schulte cited in Dalhoff, 2005). Zimmer, Krimmer, and Stallmann (2006), who conducted interviews with female and male professors, came to the conclusion that the interviewed female professors emphasized to a considerably higher extent the support they had been given on their career path. The authors, however, point out to the limitations of their methodological approach, which does not allow the conclusion that female professors attribute their success to external factors more than their male counterparts. In the aforementioned study of Curdes et al. (2003), female math students more often attributed their successes to effort (and not to ability), while simultaneously attributing failures more often to a lack of ability than male students. These differences in attributional patterns were accounting for less positive attitudes towards taking a doctoral degree among women. In a study researching attributions of scientists after an acceptance or rejection of a submitted paper, showed that an acceptance was more likely to be attributed to controllable factors than a rejection (Wiley, Crittenden, & Birg, 1979). This self-serving bias, however, was found to a lesser extent in women. A similar study was conducted by Vasil (1992) who analyzed attributions of university faculty after a hypothetical rejection or acceptance of a paper. In the study, ability attributions in the acceptance scenario were significantly and positively related to research self-efficacy, in the rejection scenario ability attributions were negatively related to self-efficacy beliefs. While this study unfortunately did not compare male and female

faculty with respect to their attributional patterns, it found significantly higher research self-efficacy beliefs expressed by male faculty.

Self-Efficacy Beliefs

This leads us straight to the domain of research self-efficacy, its relevance in the academic career context and, moreover, in explaining gender differences. Whereas causal attributions have been rarely studied within academic career contexts, more research has been conducted on self-efficacy. A problem within these studies are inconsistencies in measuring scientific self-efficacy (also see Chapter 4.2), and in some cases, not being clear about the theoretical concept used. With this in mind, it does not surprise, that results are somehow, as so often, conflicting. For example Fuchs and colleagues (2001) report not having found differences in "self-esteem" and conclude that gender differences on the individual level are most probably no good explanatory factor with respect to academic career outcomes. But it remains unclear what was actually measured here—academic self-concept, self-efficacy, or something else? In addition, it has to be noted that their analyzed sample consisted of former doctoral graduates of the Max-Planck-Institute, which is probably an already highly selected group, in terms of motivation etc.

Moreover, there are studies which measure research self-efficacy, thereby focus on self-efficacy beliefs with respect to performing various research tasks, and studies that also incorporate other important areas of an academic research career, such as supervising students and organizing research projects. The latter are hereafter designated as scientific self-efficacy beliefs. A study that measured research self-efficacy beliefs among doctoral students in biology, physics and social sciences (Bieschke et al., 1996) also found no gender differences.

However, Berweger and Keller (2005) found significantly lower scientific self-efficacy beliefs in female doctoral graduates within the fields of humanities and social sciences. This result is, however, limited to a bivariate comparison. Multivariate comparisons which control for actual achievements within the doctorate (e.g., in form of published articles and grade), were not conducted. Although the multivariate analyses supported the hypothesis that self-efficacy beliefs significantly influence the intention to pursue an academic career, the separate analyses of female and male doctoral students does not allow concluding that differences in self-efficacy beliefs explained gender differences in career aspirations.

Another study by Spies and Schute (1999) found lower scientific self-efficacy beliefs in female graduates within the fields of biology and mathematics. These differences partially accounted for their weaker intention to pursue a doctoral degree. In addition, gender differences were bigger in the field of mathematics, which is more male dominated. Within

this study a scale for measuring "general self-efficacy" was used in combination with the introductory phrase, to evaluate the presented items with respect to academic research. This procedure, however, may not be optimal, since self-efficacy is a context-specific construct and not a trait. A scale, which is supposed to measure research/or scientific self-efficacy should, therefore, contain specific actions that are required within the context of academic research (see Chapter 6.2).

Another study which suggests gender differences in scientific self-efficacy was conducted by Jöstl and colleagues (2012). The authors analyzed scientific self-efficacy and imposter feelings among doctoral students in Austria, comprising the fields of humanities, natural sciences, social sciences, economics, jurisprudence, theological sciences and human medicine. The results indicated lower scientific self-efficacy beliefs and a higher prevalence of imposter feelings among female doctoral students. The imposter phenomenon [20], furthermore, was significantly and negatively related to scientific self-efficacy beliefs.

Also for the medical field, gender differences in research related self-efficacy have been found. Bakken and colleagues (2003) found significantly lower research self-efficacy in female physician-scientists. While both male and female physician-scientists reported an increase in self-efficacy after attaining research training, gender differences were even larger afterwards, indicating a higher psychological profit for men. Furthermore, Buddeberg-Fischer and colleagues (2009) concluded from their qualitative analysis of physician-scientists, that females had lower professional self-efficacy and exhibited less proactive behavior.

Using the data from a longitudinal graduates' survey, Abele (2006) analyzed work related self-efficacy in medical graduates after the second state examination and after three years of work experience. Whereas men and women did not differ in work related self-efficacy at the time of the second state examination, after three years of having entered the labor market, full time working women had significantly lower self-efficacy beliefs than full time working men. This is an interesting finding since it points to possibly different experiences of men and women in the labor market. These might impact self-efficacy beliefs and career intentions at a later stage.

The already mentioned study conducted at the Charité university hospital in Berlin came to the conclusion that even female physician-scientists with a doctoral degree and excellent grades were more pessimistic with respect to their future career in comparison to male

[20] The imposter phenomenon describes a state of competent persons, who think that they are incompetent in reality and only got by chance to the position they are in. Due to this belief, they are afraid of being" unmasked" (Jöstl et al., 2012). The role of attributions in the occurrence of this phenomenon is obvious here as well: Success is not attributed to aptitude/ability but to chance.

scientists within the group of worst grades and without a doctoral degree (Kaczmarczyk & Schulte cited in Dalhoff, 2005). In a recent study conducted at another German university hospital in Munich, female physician-scientists agreed significantly more to the statement that they were lacking the abilities to conduct good research (Hanika, 2015). They also expressed significantly lower agreement to the item stating that one had learned to conduct good research. Gender comparisons in this study, though, were only made on a bivariate level, not including age, years of experience and other factors that are actually important determinants of self-efficacy beliefs.

Interest in an Academic Career

One popular explanation for the lower share of females in academic research is that women are just not as interested in academic careers, i.e., academic research (Buddeberg-Fischer 2009, Kaderli et al. 2011, Watt et al., 2005). Studies which focus on the subgroup of medical students are, however, inconclusive: an array of studies finds either no gender differences in expressed academic career interest between female and male physicians after graduation, or even higher interest by females (Cain et al., 2001; Leonard and Ellsbury, 1996; Schroen et al., 2004). However, within a study of Watt et al. (2005), who surveyed physicians who formerly participated in an MD-PhD program, fewer females expressed research as their primary professional goal.

In addition, females' interest in pursuing an academic career seems to diminish over the course of specialist training (Cain et al., 2001; Leonard and Ellsbury, 1996). This result, again, points at the potential influences of work experience. A study with German physicians at a university hospital indicates lower interest of female physicians in research and pursuing a research career (Hanika, 2015)—but due to a comparison that stays at the bivariate level, factors that explain the occurring divergence can only be the object of speculation. As noted earlier, studies also find gender differences in the intention to pursue an academic career or doctorate within other fields of study (Berweger & Keller, 2005; Curdes et al., 2003; Spies & Schute, 1999). However, it must be noted that interest in an academic career as an explanatory variable for pursuing one, should be viewed with caution. The question is rather from where the interest arises and why it changes. Otherwise, one may end up with a circular argument in which the dependent and explanatory variable are basically interchangeable.

A Realistic Pace of Change

While many of the points discussed above are relevant for explaining the higher dropout rates of female scientists in the postdoctoral phase, when evaluating future developments, one has

to keep in mind a certain path dependency: Brodesser and Samjeske (2015) can show that even if all retiring professorship positions were filled by women, the share of female professors would be 50 percent in 2023. If half of those vacancies would be filled with females, the number of female professors would increase to 36 percent in the same time period. However, the current female share of appointments stands at 30 percent.

4. Academic Career Interest and Pursuit

When studying graduates in medicine and other life sciences, it is important to consider differences between these groups which are found on both the individual and the structural level. For the medical population of doctoral graduates, the literature often implies a lower research and academic career interest (summarized in Epstein et al., 2016). With respect to structural differences, labor market opportunities for medical graduates and other life science graduates play a major role. Furthermore, medical graduates who pursue research in clinical fields face an additional problem that life scientists do not: they have to balance research, teaching *and* clinical work. These issues will be discussed in the following.

4.1 Interest in and Pursuit of an Academic Career in Medicine

In Germany as well as in Anglophone countries, the low interest of medical students/graduates in research and pursuit of academic careers is a source of worry and complaint (Bell, 2003; Buddeberg-Fischer et al., 2009; Epstein et al., 2016; DFG, 2010; Gensch & Waltenberger, 2006; Gerst & Hibbeler, 2012; Guelich et al., 2002; Zemlo et al., 2000). While there are a few studies analyzing medical students' interest in pursuing research careers along with factors contributing to this interest, studies which systematically compare academic career interest between medical and life science graduates are lacking.

Empirical evidence suggests that most medical students were primarily motivated to study medicine in order to treat patients afterwards (Crossley & Mubarik, 2002; Halter, Tschudi, Bally, & Isler, 2005; Loos, Sander, et al., 2014; Sönnichsen, Donner-Banzhoff, & Baum, 2005). Within the German context, it has additionally been found that medical students expect their studies to have a strong practical orientation. In contrast to students from related fields, fewer medical students expect to learn how to conduct research (Loos, Sander, et al., 2014).

Moreover, medical students have expressed lower motivation to attain their doctorate for professional reasons and career interests in comparison to students from other fields (including related fields, such as biology) (Grotheer, Isleib, Netz, & Briedis, 2012). However, in this German survey, doctoral candidates in biology and medicine did not differ with respect to their expressed motivation to pursue academic careers (in both fields about 30 percent) (ibid.). While it seems that medical students emphasize research interest as a motivation to pursue a doctorate less in than students in other life sciences, still about 60 to 70 percent of medical graduates indicate they have been motivated by research interest (Berning, 2006; Grotheer et al., 2012; Loos, Sander, et al., 2014). On the downside, even more medical doctors seem to have been motivated by the commonness of the doctorate in their field, the

anticipated professional advantages and societal prestige (Baum, Förster, & Schmidt, 2009; Beisiegel, 2009; Berning, 2006; Loos, Sander, et al., 2014).

A graduate survey carried out by the *Deutsches Zentrum für Hochschul- und Wissenschaftsforschung* (DZHW) in 2013, found that medical doctoral graduates had a significant lower chance to stay in academic research after graduation in comparison to doctoral graduates in the fields of mathematics, informatics and natural sciences. The medical group was 43.3 percentage points more likely not to be employed in academic research than the natural sciences group after graduation (Briedis et al., 2014).

Furthermore, the *Konsortium Bundesbericht Wissenschaftlicher Nachwuchs* of 2013 lists the numbers of doctorates, habilitations, junior professorships, and appointed professorships of the years 2000, 2005 und 2010). While the presented data does not allow direct conclusions about dropout rates and its interpretability is further limited due to field grouping (medicine and health sciences vs. maths and natural sciences), the numbers give an impression and allow a rough estimate: about ten percent of doctoral graduates in medicine and health sciences habilitate or get a position as junior professor. Moreover, one percent of doctoral graduates and nine percent of habilitated researchers/junior professors in medicine are appointed as full professors. In the subject group of mathematics and natural sciences, two percent of doctoral graduates but 30 percent of habilitated researchers/junior professors get appointed as full professors.

These numbers could indicate that fewer physicians than natural scientists are active in research after their habilitation. This would not be surprising, since it has been claimed that physicians habilitate to pursue clinical rather than an academic careers. A habilitation can be helpful in the clinical career, since clinics seem to preferably hire habilitated physicians for head physician positions (Beisiegel, 2009; Niethammer, 2004b). However, it cannot be ruled out that habilitated (physician) scientists who do not get appointed as full professor stay active in academic research nonetheless. Before drawing any final conclusions, this topic needs to be further researched.

From the numbers of the *Konsortium Bundesbericht Wissenschaftlicher Nachwuchs* (2013), one can also see that many more natural scientists choose the junior professorship over habilitation, while the opposite is true for the fields of medicine and health sciences. One reason for this pattern could be a misfit of the junior professorship to the needs of physicians—who not only want to advance in their academic career, but in their clinical career as well. It has also been criticized that junior professorships only appeal to natural

scientists who work full time in the laboratory, and not to physicians who have to—or want to—continue their clinical qualification (Loos, Albrecht et al., 2014).

From the presented analyses by Briedis et al. (2014) it remains unclear why the dropout in physicians after the doctorate is higher than in other natural sciences. Is this due to a lack of general research interest, lower scientific self-efficacy or simply due to the high workload in academic medicine evoked by the "threefold burden" of research, teaching and patient care? While it is unclear if this extra workload discourages physician-scientists in their pursuit of an academic career, a study of the IGES institute shows that physician-scientists in academic research would actually like to invest more time in research and reduce their duties in patient care (Loos et al., 2014). While physicians were not less satisfied in comparison to their non-physician research colleagues, their dissatisfaction in regard to combining patient care and research was very prominent. In this respect, also an American analysis diagnosed a high dropout rate for physician-scientists (Donowitz, Germino, Cominelli, & Anderson, 2007). However, the dropout rate of physician-scientists was not related to the dropout rate in subsidiary fields, i.e., other life scientists.

4.2 Factors Influencing Academic Career Interest & Pursuit

Returning to studies that have analyzed students' and graduates' academic career interests, it has been found that factors with a positive impact on academic career interest highly correspond between disciplines. These are primarily intrinsic interest in research activities and intrinsic career motivation, such as self-development (Abele & Krüsken, 2003; Hauss, Kaulisch, & Tesch, 2015; Roach & Sauermann, 2010; Rubeck et al., 1995; Straus, Straus, & Tzanetos, 2006). Furthermore, studies have identified research/scientific self-efficacy as an important influence on the intention to pursue an academic career (Berweger & Keller, 2005; Bieschke et al., 1996; Estrada et al., 2011). This relationship has been primarily shown in fields other than medicine (ibid.). However, Neacy and colleagues (2000) found that medical students who were more confident in their research competencies also expressed stronger intentions to pursue a research career. It is also not surprising that medical doctors who graduated with honors have been shown to be more interested in academic careers (Giesler, Biller, & Fabry, 2013).

In the context of research-related or scientific self-efficacy, it has to be mentioned that medical education in Germany has been continuously and recently criticized for its lack of research content (Wissenschaftsrat, 2014). Furthermore, the quality of medical dissertations in Germany has been publicly questioned and debated (Baum et al., 2009; Ziemann &

Oestmann, 2012). For these reasons, it is plausible to assume that medical students and medical doctoral graduates have lower research/scientific self-efficacy beliefs in comparison to other life scientists.

Moreover, an association between institutional embeddedness and doctoral candidates' academic career interests has been found. Hauss and colleagues (2015) showed that the reputation of the professors and number of supervisors were positively associated with doctoral candidates' interest in academic research careers. However, self-selection of highly research-oriented doctoral students into more prestigious faculties and good supervisory environments cannot be excluded. Additionally, it has to be noted, that academic career interest was measured as interest in several activities which make up part of an academic career. Interest in research activities, though, might not translate into actual career preferences and aspirations.

The results of Hauss and colleagues also indicate the importance of considering fields of study: life scientists, natural scientists and engineers were less likely to aspire to an academic career than doctoral students from the humanities and social sciences. While this was not analyzed by the study, this effect could have resulted from the diverging employment opportunities between those fields: doctoral students from humanities and social sciences may face worse occupational possibilities outside of academia and, therefore, might be more determined to remain in academic research. Another explanation for this phenomenon might be that persons who choose humanities and social sciences as a fields of study are generally more intrinsically motivated (for instance by learning and developing their personalities) (Briedis, Fabian, Kerst, & Schaeper, 2008) whereas persons who choose natural sciences seem to be more extrinsically motivated, hoping for advantages on the labor market (Lörz & Schindler, 2011; Schramm & Kerst, 2009).

For medical students, early experiences with research during undergraduate studies also appear to be important for developing interest in an academic career (Kassebaum, Szenas, Ruffin, & Masters, 1995; Neacy et al., 2000). For instance, Kassebaum et al. (1995) showed that medical students at strong research faculties were more likely to retain or to develop research interest than those who studied at faculties that were less research strong. Evaluations of different kinds of research programs integrated into regular medical studies, are pointing to an increased interest in academic careers among attendees that exceeds self-selection of already more interested students (Borges, Navarro, Grover, & Hoban, 2010; Hunskaar et al., 2009; Laskowitz, Drucker, Parsonnet, Cross, & Gesundheit, 2010). In this respect, also structured doctoral programs, respectively MD-Ph.D programs, which have

gained popularity in Germany, should be mentioned. These programs are also considered to be the best preparation for an academic career in medicine (Kuehnle, Winkler, & Meier-Abt, 2009). From a theoretical point of view, structured doctoral programs could possibly influence academic career interest by providing a closer supervision and research related courses. However, the evidence with respect to program attendance and academic career interest/pursuit is yet insufficient.

There is some evidence that programs help to recruit young physician-scientists in the USA (Brass et al., 2010; Watt et al., 2005) and Switzerland (Kuehnle et al., 2009). These studies showed that a high percentage of medical graduates from such programs were working in research afterwards. However, since there was no measure of academic career interest before graduation, self-selection of already research-oriented students into structured programs cannot be ruled out. This limitation also applies to the study of Pfeiffer et al. (2011), which showed a higher intrinsic motivation and interest in research among medical doctoral students who attended a structured program at the Ludwigs-Maximilians-Universität, in comparison to those who conducted their doctorate individually. However, the study of Hauss et al. (2015) finds no effect of formal membership in a doctoral program on academic career intention, but—as noted above—effects of the "research and training environment", such as supervision, were shown.

In addition, a decreasing academic career interest has been observed over the course of doctoral training (Hauss et al., 2015; Sauermann & Roach, 2012). These studies included also doctoral students from the life sciences.

4.3 Structural Boundaries: Labor Market Opportunities in Medicine and Life Sciences

In order to understand the careers of medical and life sciences doctoral graduates, it is important to consider the different labor market conditions for each group. Individual level characteristics and preferences are important, but choices are not made in a vacuum. If one wants to pursue a career in the private sector, she or he only can do it if a corresponding job is available. This is highlighted by results of Sauermann and Roach (2012). They found that a high number of life sciences doctoral students wished to pursue a research career when asked to disregard job availability. The number of PhD students interested in faculty positions, though, clearly exceeded the number of available positions.

For medical students, moreover, a career in academic research (in Germany) is far less attractive in comparison to a clinical career, with respect to salary and promotion prospects

(Baum et al., 2009; Loos, Albrecht, et al., 2014). As noted earlier, combining clinical work—specialist training in particular—with research is another barrier for aspiring physician-scientists. In addition, the time invested in research is usually not credited to specialist training (Loos, Albrecht, et al., 2014). After the completion of specialist training, the threefold burden of patient care, research, and teaching continues to make the academic research career unattractive to physicians (Loos, Sander, et al., 2014; Rohde, Bestmann, & Wellmann, 2004; Rosta, 2007). As a consequence, physician-scientists often seem to conduct their research at the end of the work day and on weekends (Hanika, 2015; Loos, Albrecht, et al., 2014).

In summary, medical graduates face very good career prospects outside academia (Baum et al., 2009; Donowitz et al., 2007; Loos, Albrecht, et al., 2014), whereas their career prospects within academia are very similar to those of doctoral graduates in other fields: high numbers of limited contracts and insufficient long-term prospects (Loos, Albrecht, et al., 2014).

While physicians can easily circumvent the risky academic pipeline, life scientists may not always have the choice: while career prospects in academic research are bad enough, getting a foothold on the non-academic labor market may be even more difficult (Jaksztat et al., 2010). As noted earlier, with the continuation of the academic career track, chances to "successfully drop out"—finding an adequate position outside academia—decrease even further (Enders, 1996). Hence, academic career aspirations in life sciences must also be seen under a more limited set of career options.

5. General Hypotheses and Heuristic Model

For reasons of clarity and in order to give a brief overview of the theory and empirical results discussed so far, expected relations between the main variables, which are causal attributions, scientific self-efficacy (SSE) and academic career aspirations (ACAs), are summarized here in the form of preliminary hypotheses. Furthermore, Figure 2 illustrates the claimed relations graphically in form of a path model.

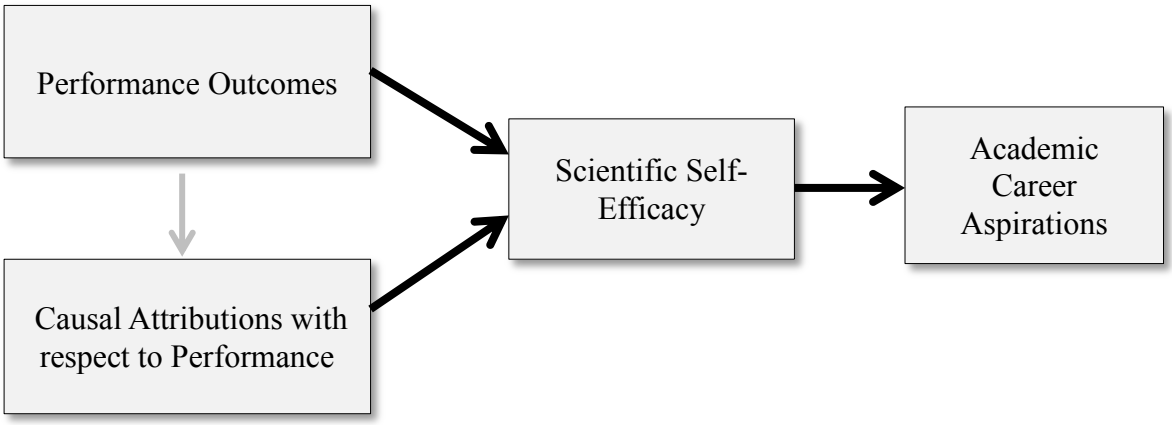
Whereas the in the following stated hypotheses mainly aim at summarizing the general expected relationships, concrete hypotheses that take account of the operationalization of constructs are presented in the respective studies.

Hypothesis 1 – Attributions and SSE: Causal attributions with respect to success and failure of the doctorate are significantly related to scientific self-efficacy beliefs.

Hypothesis 2 – SSE and ACAs: Higher scientific self-efficacy beliefs are significantly related to higher academic career aspirations.

Hypothesis 3 – Attributions and ACAs: Causal attributions with respect to doctoral success/failure are significantly related to academic career aspirations, this effect is mediated by scientific self-efficacy beliefs.

Figure 2: Graphical Illustration of the Heuristic Model[21]



[21] For reasons of clarity, only central variables are diagrammed, while control variables are omitted.

6. Measuring Causal Attributions and Scientific Self-Efficacy

Before coming to the empirical implementation of the research question, an overview of the approaches, recommendations and practices of measuring causal attributions and self-efficacy beliefs within quantitative research is given.

6.1 Measuring Causal Attributions

In the following, different approaches to operationalizing causal attributions are discussed more deeply. These are particularly important to the empirical implementation of the research question. As already described, ever since the introduction of Weiner's attribution theory, a multitude of different methods to assess attributions has been used and differences in operationalization prevail until today. When Weiner's theory first began to be empirically tested, most researchers measured attributions to those causal factors considered to be central in Weiner's theory: ability, effort, task difficulty and luck (Weiner, 1985). Methodological differences were mostly present with respect to the scales used, such as percentage ratings, Likert scales, semantic differentials (Elig & Frieze, 1979), or even summarizing causal factors into causal dimensions (see Anderson, 1983; Benson, 1989). A comparison of these methodologies was conducted by Elig and Frieze (1979), comparing the following approaches:

1) Importance ratings on a Likert scale: Subjects had to rate the importance of each given cause, according to its respective outcome.
2) A percentage rating scale totaling 100 percent. As a consequence, ratings for the given causes are not independent from each other.
3) An open assessment of the main reason that led to a test result and a post priori rating of causal dimensions by two raters.

The authors came to the conclusion that, among the test approaches attempting to measure causal attributions, the Likert scale was the most suitable. Their two major critiques with respect to the open assessment concerned: 1) misunderstandings with respect to the question: subjects often listed their criteria for success and failure, rather than the factors they assumed to have led to the attainment of these criteria and 2) problems with the percentage ratings, as subjects felt limited due to the interdependence of the ratings. The allocation of causal factors to causal dimension by the researcher himself and not by the researched subjects, denoted as the "fundamental researcher attribution error" (Russel, 1982), remained unmentioned in the

study of Elig and Frieze (1979). The measurement of causal factors versus causal dimensions was addressed by Russel and colleagues (1987). Their methodological comparison included:

1) An open assessment of the main reason for a success or failure and evaluation of this main reason on the Causal Dimension Scale (CDS) (Russel, 1982) by the respondents.
2) An open assessment of the main reason for success and failure with a post priori rating of underlying dimensions by two independent raters.
3) An importance rating of given causes on a Likert scale.

With respect to convergent validity, significant correlations between the CDS and the importance rating were found. Construct validity was tested on the basis of the self-serving bias and emotions evoked by discrepancies between expected and actual performance. A self-serving bias was detected for both the CDS and the importance rating. Furthermore, the authors expected that the difference in subjects' actual and expected performance would be negatively associated to stability and controllability measures. This was shown for the CDS as well as for importance ratings, but not for the open assessment of attributions. The theory's predictions with respect to emotions could not be confirmed with none of the methods:
Moreover, a confirmatory factor analysis was carried out with all the three instruments, assuming a three-dimensional structure consisting of controllability, locus and stability. Results indicated a good fit to the observed data. For all three methods of assessing causal attributions, the items loaded significantly on the corresponding dimension, with the exception of the ability attributions within the importance rating, which did not significantly load on the stability dimension. Whereas the results of the conducted confirmatory factor analyses suggest good model fits for all measures, the authors raise doubts about the discriminant validity of the dimensions due to significant associations between locus of causality and controllability. Although the results of the study don't point clearly to a superiority of the CDS, the authors conclude that the CDS scale is the instrument of preference. In another study by Benson (1989) also compared three methods of assessing causal attributions:

1) An open assessment of causes and subsequent dimensional rating by external raters.
2) Choosing causal factors from a list, and subsequent dimensional rating by external raters.
3) Direct ratings of dimensions performed by participants.

The authors concluded that the open assessment and derived-score techniques were sufficiently high in interrater and test-retest reliability and were suitable for research purposes. However, the direct measurement of dimensions was superior with respect to construct validity. To the author's knowledge, no newer studies exist with respect to the assessment of causal attributions. Moreover, studies continue to apply different methods for measuring causal attributions, mostly measuring approval to causal factors or causal dimensions.

The following reasons probably account for the continued widespread use of measures of causal factors among researchers: 1) Although a superiority of dimensions is implied by comparative research, other instruments as importance ratings or open assessments still yield adequate results. 2) Therefore, studies measuring causal factors or causal dimensions come to very similar conclusions. 3) In addition, the results of studies which measure causal factors allow more practical recommendations. Since attributions can be formed by feedback, recommendations can be given on what kind of feedback is suitable, such as ability feedback versus effort feedback, etc. From results that only refer to causal dimensions, it is difficult to derive practical implications. What would a stability or controllability feedback look like? This is well illustrated by intervention studies, such as reattribution trainings. Within these trainings, participants' performance is enhanced by attributing failure usually to lack of effort and success to ability (e.g., Ziegler & Heller, 2000). 4) Moreover, research indicates that, despite inter-individual differences in the dimensional perception of causal factors, there is a high agreement with respect to the dimensionality of some common causal factors (Weiner, 1985), in the sense that ability is perceived as internal, stable and not controllable; whereas luck is perceived to be external, not controllable and not stable (Weiner, 2000). This is also supported by empirical studies (Schuster et al., 1989). 5) Finally, there are some causal factors that are very common in causal attribution. Whereas the assumed causal factors also depend on context and situation (Anderson, 1983), "*it is evident that ability, effort […] and task difficulty are among the main perceived causes of achievement performance"* (Weiner, 1979, p. 4). Moreover, effort and ability are probably the most dominant perceived causal factors (Weiner, 1979, 1985).

6.2 Measuring Scientific Self-Efficacy

As noted above, studies point to the importance of self-efficacy beliefs in the academic career context (Berweger & Keller, 2005; Bieschke et al., 1996; Jöstl et al., 2012; Spies & Schute, 1999). However, the comparability of study results is impaired by the use of different instruments. Furthermore, there are cases in which the instrument employed is not optimal in assessing self-efficacy in academic research contexts. Spies and Schute (1999), for instance, use a measure of general self-efficacy combined with an introductory sentence to evaluate the items with respect to academic research as a predictor for the intention to pursue a doctoral degree. If one manages to remember that self-efficacy is not a trait, but is context-specific and should refer to actions that are relevant with the context at interest (Bandura, 1982, 2006), this method might not be optimal. Saying it in the words of Betz and Hackett (2006, p. 9)*: "[…] there is no such thing as "self-efficacy" or "career self-efficacy" […] without reference to specific domains of behavior"*.

Not only is the concept of self-efficacy context-specific on the theoretical level, it has also been empirically shown to vary between contexts and situations (Bong, 1997; Lent, Brown, & Gore, 1997). Furthermore, context-specific assessments of self-efficacy have been shown to have a better predictive validity than unspecific measures (Gore, 2006; Lent et al., 1997; Pajares, 1996). In this respect, scales that assess a general kind of occupational self-efficacy (e.g., Abele et al., 2000) are not suitable for the context of the (early) academic career.

More suitable German scales that are matched to an academic research context are presented by Bewerger & Keller (2005), and Jöstl et al. (2012). However, it is notable that these are not totally transparent with respect to how items were chosen and not all items are presented in the respective papers (Berweger & Keller, 2005; Jöstl et al., 2012). Furthermore, these studies' instruments do not include some tasks which are important within the academic career, such as acquiring third party funds or networking with other researchers. English scales suitable to the academic context are presented by Bakken et al. (2003) (medicine specific), Greeley et al. (1989) (Bieschke et al., 1996), Phillips & Russell (1994), and O'Brien, Malone, Schmidt, & Lucas (1998) (see Forester, Kahn, & Hesson-McInnis, 2004, for a summary).

Bakken's scale (2003) is adjusted to the context of the clinical research career and is, therefore, not suitable to other academic research contexts, such as basic biomedical research. The research self-efficacy scale (RSES) (Greely et al. 1989 cited in Bieschke et al., 1996) as well as the scales introduced by Phillip and Russel (1994) and O'Brien and colleagues (1998) address a larger variety of fields; these, however, consist of 33 to 56 items, and are not

suitable for larger surveys that include various other measures and scales (problems with non-response and drop-out could occur). Moreover, all of these scales focus on the research process (reviewing literature, choosing the right method etc.). Academic career success, however, depends on more than just conducting research "correctly". Project management and being connected with the scientific community, among others, may be at least equally important. As a result, the mentioned scales are probably more suitable for students than aspiring scientists.

In addition, there are some studies which analyze self-efficacy related concepts, but remain ambiguous with respect to their underlying theory and operationalization. For instance Fuchs et al. (2001) report having found no gender differences in "self-worth" among junior researchers, but what was actually measured remains obscure. Moreover, Hauss et al. (2015), who study career intentions among doctoral students, find no effect of internal and external locus of control with respect to academic career aspirations. While the authors report to having measured context-specific items, which referred to the respondents' *"belief that he or she can accomplish dissertation-related tasks and succeed in the doctorate"* (ibid., p.131), the item contents are not listed. It also remains unclear how their concept is to be distinguished from self-efficacy beliefs.

7. Methodological Procedure: Within- and Between-Methods Triangulation

To investigate postulated assumptions, three studies were conducted: two quantitative studies with different approaches to assess causal attributions *(within-methods triangulation)* and one qualitative study *(between-methods triangulation)* (Denzin, 1978). Triangulation can be defined as *"the combination of methodologies in the study of the same phenomenon"* (Denzin, 1978, p. 291). It has been argued that using multiple methods with respect to a research question increases the validity of the results (Jick, 1979). As Jick (1979, p. 602) poses it: *"It is largely a vehicle for cross validation when two or more distinct methods are found to be congruent and yield comparable data*". The convergence of various methods would, thereby, strengthen the certainty about the results being generated by the theoretical concepts, rather than leaving doubt that they may actually be methodological artifacts (ibid.). Hence, triangulation was not only applied to better understand and interpret results, in the sense of a *"Vertiefungsmodell"* (Mayring, 2001), but also to increase their validity.

To assess causal attributions with two different instruments, the first two waves of the panel surveys of the E-Prom project (Cohort 1 and Cohort 2) were used. The first cohort consisted of doctoral graduates in medicine and life sciences who graduated between April 2013 and April 2014, and the second cohort comprised doctoral graduates who finished their degrees between April 2014 and April 2015. Moreover, qualitative structured interviews with a subgroup of respondents from the first cohort were conducted between the quantitative surveys (and in part overlapping with Cohort 2).

With two cohorts at hand, it was possible to investigate causal attributions with two instruments: for the first cohort, causal attributions were measured by importance ratings of causal factors. This allowed exploring the role of the dominant causal factors of effort and ability within the academic career context and, possibly, deriving practical implications with respect to feedback strategies, also in conjunction with the qualitative interviews (see Chapter 6.1). Since it is argued that the dimensional properties of a causal factor are actually linked to success expectancies, the role of underlying dimensions was explored within the second cohort, in which respondents had to choose one main causal factor and rate it with respect to its dimensional properties.

Success or failure in the doctorate is more complex in comparison to the success and failure situations that are usually subject to attribution research, which are characterized by shorter time intervals and clearer evaluation criteria, such as grades received in an exam or performance in a sport competition or a controlled laboratory task. The doctorate is, however,

conducted within a longer period of time, and, most probably, always comprises both moments of success and failure. Therefore, the qualitative study was seen as an opportunity to get more insight into causal attributions and motivational processes that occur during the doctorate. The qualitative study was also an opportunity to explore the role of emotions. Within Weiner's theory, attributions not only affect motivation via expectancy, but also affective reactions, such as pride, gratitude or anger (see Chapter 2.1). Furthermore, the role of the supervisor with respect to causal attributions and self-efficacy beliefs were topics of interests within the qualitative study.

8. Study 1 – Attribution to Causal Factors, Self-Efficacy, and Academic Career Aspirations

Summary

The major interest of the present study was to explain academic career aspirations in doctoral graduates in the fields of medicine and life sciences with a sociocognitive approach, focusing on attributions (Weiner, 1985, 2000) and self-efficacy (Bandura, 1977, 1982). It was hypothesized that attributions indirectly affect academic career aspirations via scientific self-efficacy (SSE). Within successful doctorates, attributions to ability and effort were expected to be positively related to SSE, and thereby to academic career aspirations, whereas external attributions, such as help from a supervisor, were assumed to be negatively associated with SSE and academic career aspirations. Conversely, in cases of an unsuccessful doctorate, ability attributions were expected to be negatively associated with SSE and academic career aspirations; whereas attributions to external factors and lack of effort were expected to be positively related to these constructs. Empirical analyses were based on the E-Prom-survey which was carried out between April and August 2014. The survey included doctoral graduates from medicine and life sciences. Analyses, based on complete case analysis as well as multiply imputed data, were supportive of the associations between attributions, SSE and academic career aspirations. However, results were mixed with respect to external attributions. In addition, attributing failure to a lack of effort was not significantly related to SSE.

8.1 Introduction

Social Cognition and Achievement Motivation

As already summarized in Chapter 2, attributional theories assume that individual interpretations of success and failure are crucial in determining achievement motivation (Eccles & Wigfield, 2007, p. 117). Equal performances can imply different perceptions of individual aptitude because success can be linked to either internal factors, such as ability and effort, or external factors, such as luck (Weiner, 2000). Moreover, ability is considered as a stable factor; hence, it is assumed that attributing success to ability leads to the highest change in expectancy and motivation. The practice of linking causal factors (such as ability and effort) to causal dimensions (such as stability and controllability) by default has, however, been criticized [known as the *"fundamental attribution researcher error"*, Russel (1982)].

However, it is empirically supported, that attributing success to internal factors, and specifically to ability, is associated with motivationally desirable outcomes, such as higher self-efficacy (Schunk, 1986, 1984, Vasil, 1992), motivation and persistence (Kiefer & Shih, 2006; Curdes, 2003; Schunk, 1984), as well as performance (Hsieh & Schallert, 2008). Furthermore, it is a common conception that *"ability limits the extent to which effort can increase performance"* (Nicholls, 1978, p. 800). For failure, attributional effects naturally look quite different. Thus, motivation is higher when failure is attributed to lack of effort or to external, variable factors, as opposed to internal, stable factors, like ability (Andrews & Debus, 1978, Williams et al., 2003).

In addition, self-efficacy beliefs (Bandura, 1977), which comprise expectations about the capability to conduct courses of actions successfully, are important predictors of behavior and motivation (Eccles & Wigfield, 2007, see also Chapter 2). While performance is an important source of self-efficacy, mastery experience (which is supposed to have the strongest influence on self-efficacy) not only refers to performance outcomes, but interpretations and evaluations of these outcomes (Bandura, 1977; Usher & Pajares 2008). Such interpretations could, for instance, be causal attributions. In addition, other sources of self-efficacy, which were suggested by Bandura (1977)—such as vicarious experience and verbal persuasion (Chapter 2.2)—have received empirical support (Usher & Pajares, 2008).

A vast amount of studies on academic achievement motivation have been carried out on school or undergraduate students (e.g., Bong, 2004; Follette & Jacobson, 1987; Hsieh & Kang, 2010; Schunk, 1984; Schunk & Gunn, 1986; van Laar, 2000). The current study, in contrast, focuses on doctoral students, who are a particularly interesting sample, since they still find themselves in a qualification phase, but at the same time are often young professionals.

In Germany, doctoral students are in many cases employed at the university, working in research projects and/or teaching.[22] Since the academic system, especially in Germany (Krempkow et al., 2014; Musselin, 2005), is characterized by a very long qualification episode that continues after the doctorate up until habilitation/professorship, a simultaneous situation of occupation and training is almost always present. Furthermore, researchers below the level of a full professorship are under a constant pressure to prove their competence via publishing. As previously argued, under such circumstances of high competition and uncertain long-term prospects, the performance during the doctorate is neither a sufficient indicator for future performance, nor for achieving a full professorship or other permanent

[22] In Germany doctoral students often are regularly working research staff and at the same time working on their dissertation (Berning & Falk, 2006).

position. In addition, it has to be considered that doctoral students' experiences within the academic career context are limited to a relatively short time frame.

While there is empirical evidence that research related, or scientific self-efficacy (SSE) impacts the formation of academic career aspirations (e.g., Berweger & Keller, 2005; Estrada et al., 2011), little is known about the sources of self-efficacy beliefs in the academic career setting. Studies analyzing the role of self-efficacy beliefs with respect to the intention to pursue an academic career (Berweger & Keller, 2005), or the intention to pursue a doctorate (Estrada et al., 2011; Spies & Schute, 1999), rarely discuss and investigate potential sources of self-efficacy beliefs that could possibly contribute to explaining reported group differences, as for instance lower self-efficacy in females (eBerweger & Keller, 2005; Spies & Schute, 1999) or ethnic minorities (Estrada et al., 2011).

Causal attributions are theoretically and empirically related to self-efficacy (Bandura, 1977; Schunk, 1984; Schunk & Gunn, 1986) and to (academic) aspirations (Tolli & Schmidt, 2008). However, they have been neglected as potential sources of scientific self-efficacy and career aspirations in the context of early academic careers. Even though the majority of studies have investigated the impact of self-efficacy and attributions on motivation separately, a few studies considered the interrelatedness of these constructs (Schunk, 1984; Schunk & Gunn, 1986; Thomas & Mathieu, 1994; Hsieh & Kang, 2010) and their joint impact on motivation (Tolli & Schmidt, 2008).

While these studies are conducted in school and undergraduate settings, they support the idea, that attributing success to ability, to internal or stable factors (depending on whether causal factors or dimensions were measured) is related to higher self-efficacy beliefs and aspirations. Additionally, evidence has been provided for the mediating effect of self-efficacy between attributions and aspirations (Tolli & Schmidt, 2008).

Furthermore, one of the few studies conducted in a university framework, analyzed the effect of attributions on the intention to pursue a doctorate in mathematics students. The study indicates that ability attributions of success positively influence the attitude towards taking a doctoral degree (Curdes et al., 2003).

Gender Differences

Gender is a reoccurring topic within the domain of performance cognition and also academic careers. Although there has been a rise of female staff at German universities, the presence of an "academic pipeline", with a diminishing percentage of women in higher status positions, persists (Schubert & Engelage, 2011; Kreckel, 2005; Allmendinger & Hinz, 2002). In addition, the female dropout rate seems to be even larger in fields of study with a higher share

of female students, like medicine and biology [23] (Konsortium Bundesbericht Wissenschaftlicher Nachwuchs, 2013).

While attributional patterns in the early academic career have rarely been analyzed, females have been found to make less self-serving causal attributions and to discount their talent in cases of success (Curdes et al., 2003; Dickhäuser & Meyer, 2006; Mok, Kennedy, & Moore, 2011; Stetsenko, Little, Gordeeva, Grasshof, & Oettingen, 2000). In addition, studies also suggest that females, more than males, attribute failure internally (Koch, Müller, & Sieverding, 2008; Mok et al., 2011). These results mostly apply to fields in which women are stereotypically expected to perform worse or to be less talented as men, such as mathematics (Dickhäuser & Meyer, 2006).

Beyond that, attributional patterns have been linked to behavior. For instance, Kiefer and Shih (2006) have shown that females who attribute their failure to ability show less persistence in practicing mathematical tasks. In the aforementioned study by Curdes et al. (2003), which linked ability attributions of success to higher intentions to pursue a doctoral degree in mathematics, female participants attributed their success to a lesser extent to ability. Controlling for attributional patterns, the formerly negative relationship between females and intentions to pursue a doctoral degree in mathematics led to nonsignificance.

While there is empirical support for the hypothesis that women are less self-serving in their attributions, other studies did not find significant gender differences (e.g., Fatemi & Asghari, 2012; Hirschy & Morris, 2002). However, studies are conducted within different settings and academic domains, which could explain the opposed results. For instance, foreign language learning (Fatemi & Asghari, 2012) is considered a domain of female competence in most western societies.

Returning to academic careers, it has been repeatedly shown that females express lower self-efficacy beliefs in academic and academic career settings (Bakken et al., 2003; Berweger & Keller, 2005; Jöstl et al., 2012; Spies & Schute, 1999). This also applies to the medical field, where gender differences with respect to research self-efficacy have also been reported. For instance, Bakken et al. (2003) found significantly lower research self-efficacy beliefs in female medical students. Within another study by Hanika (2015), female physicians in a German university hospital had agreed significantly more to the statement that they lacked the abilities to conduct research in comparison to their male colleagues.

However, other studies could not support that women in academia differ in their self-efficacy beliefs (Bieschke et al., 1996) or related constructs (Fuchs et al., 2001). A limitation many of

[23] In Germany, medicine and biology are female dominated fields of study with two thirds of female students (Metz-Göckel et al. 2010; Konsortium Bundesbericht Wissenschaftlicher Nachwuchs, 2013).

these studies is not controlling for actual performance measures, which could potentially explain all of the observed variances.

Differences between Fields of Study

A sociocognitive approach may partially account for supposed differences in academic career interest between fields of study. A low research interest/academic career interest by medical students is lamented in Germany (Epstein et al., 2016; Beisiegel, 2009; Buddeberg-Fischer et al., 2009; Schölmerich, 2010; Gerst & Hibbeler, 2012) as well as many other European and English speaking countries (Bell 2003; Buddeberg-Fischer et al., 2009; Guelich et al., 2002; Ley & Rosenberg, 2005; Zemlo et al., 2000). Considering that in Germany, medical studies are lower in research content in comparison to other life sciences, and that the dissertation is the only scientific thesis in medical studies, it is plausible to assume that scientific self-efficacy is lower among medical students (see. also Chapter 4).

In the following study, the relationship of causal attributions and self-efficacy beliefs shall be explored, and moreover, their (conjoint) relationship with academic career aspirations. Furthermore, presumable differences in academic career aspirations by gender and field of study will be given special attention, in consideration of attributions and self-efficacy as potential mediators.

8.2 Hypotheses

The dissertation itself consists of many subtasks which are also required in the continued academic career, such as conducting research, writing and publishing scientific articles (Kyvik, 2013). Therefore, it is expected that causal attributions of success and failure of to the doctorate, influence scientific self-efficacy and, thereby, the intention to pursue an academic career. It has been shown that in the case of success, internal, and especially ability attributions, have a positive impact on self-efficacy beliefs and motivation (Tolli & Schmidt, 2008; Kiefer & Shih, 2006; Curdes, 2003). Consequently, it is assumed that for successful doctorates, ability and effort attributions both are positively related to scientific self-efficacy and academic career aspirations, whereas the effect of ability attributions is assumed to be stronger. Moreover, a negative effect of external attributions on scientific self-efficacy and academic career aspirations is expected in the case of a successful doctorate. Beyond attributional effects, scientific self-efficacy is assumed to positively impact academic career aspirations. Attributions are, thus, expected to be indirectly related to academic career aspirations by their association to scientific self-efficacy. On the contrary, in cases of failure, ability attributions are expected to negatively influence scientific self-efficacy and academic career aspirations. Since effort is something one can control, attributing failure to a lack of effort is expected to positively affect scientific self-efficacy and career aspirations. The same is expected for attributing failure to external factors (see Chapter 2.1).

Scientific Self-Efficacy and Academic Career Aspirations

Hypothesis 1: Scientific self-efficacy is positively linked to academic career aspirations, so that higher levels of expressed scientific self-efficacy beliefs are related to higher levels of expressed academic career aspirations.

Attributions to Success and Scientific Self-Efficacy

Hypothesis 2a: Attributing a successful doctorate to ability and effort is associated with higher scientific self-efficacy, whereas the effect of ability attributions is stronger.

Hypothesis 2b: Attributing a successful doctorate to external factors is negatively related to scientific self-efficacy.

Attributions to Success and Academic Career Aspirations

Hypothesis 3a: Ability attributions and effort attributions are positively linked to academic career aspirations via scientific self-efficacy (indirect effect), whereas the effect of ability attributions is stronger.

Hypothesis 3b: In case of a successful doctorate, external attributions are negatively associated with academic career aspirations. This effect is indirect and mediated by scientific self-efficacy.

Attributions to Failure and Scientific Self-Efficacy

Hypothesis 4a: Attributing an unsuccessful doctorate to ability is associated with lower scientific self-efficacy beliefs.

Hypothesis 4b: Attributing an unsuccessful doctorate to external factors and to a lack of effort is associated with a higher level of scientific self-efficacy.

Attributions to Failure and Academic Career Aspirations

Hypothesis 5a: Attributing an unsuccessful doctorate to ability is negatively associated with academic career aspirations. This effect is indirect and mediated by scientific self-efficacy.

Hypothesis 5b: Attributing an unsuccessful doctorate to effort and external factors is positively associated with academic career aspirations. This effect is indirect and mediated by scientific self-efficacy.

Gender Differences

Considering the aforementioned gender differences, it is assumed that female doctoral graduates have lower academic career aspirations than their male counterparts. Furthermore, it is assumed that female doctoral graduates express lower scientific self-efficacy and are less self-serving in their causal attributions to success and failure.

Hypothesis 6a: Female doctoral graduates have lower academic career aspirations.

Hypothesis 6b: Female doctoral graduates express lower scientific self-efficacy beliefs.

Hypothesis 6c: Female doctoral graduates' attributional patterns are less self-serving, which accounts for their lower scientific self-efficacy beliefs.

Hypothesis 6d: Lower academic career aspirations by female doctoral graduates are mediated by their lower scientific self-efficacy beliefs.

Disciplinary Differences

Previously reported differences between medical doctoral graduates and doctoral graduates from other fields/other life sciences, lead to the following hypotheses:

Hypothesis 7a: Medical graduates have lower academic career aspirations in comparison to doctoral graduates from other life sciences.

Hypothesis 7b: Medical graduates express lower scientific self-efficacy beliefs in comparison to life science graduates.

Hypothesis 7c: Lower academic career aspirations by medical graduates can be is not significant when controlling for scientific self-efficacy beliefs.

8.3 Method

Sample Description

The sample was retrieved from the E-Prom survey which was conducted in between April and August 2014 with doctoral graduates. The surveyed graduates earned their degree from medical and biological faculties in Germany[24] in between April 2013 and April 2014. The respondents were invited by their faculties to participate in the online study. All participants were informed of the goals of the study and signed an electronic informed consent. After study completion, participants received a five euro voucher as a gesture of appreciation.

For the analyses, six persons who received their degree before 2013 were excluded, because unknown events after graduation could have influenced scientific self-efficacy and career aspirations to a stronger extent. Moreover, for reasons of comparability, participants with social sciences and humanities backgrounds (N=25) and graduates from dental medicine (N=81) were not included in the analyses. Life scientists were defined as persons with a natural sciences background, who either received their degree from a biological or medical

[24] Participating universities were: Ludwigs-Maximilians-Universität München, Technische Universität München, Universität Würzburg, Friedrichs-Alexander-Universität Erlangen-Nürnberg, Universität Regensburg, Universität Witten-Herdecke, Rheinische Friedrich-Wilhelms-Universität Bonn, Universität zu Köln, RWTH Aachen, Ruhr-Universität Bochum, Heinrich-Heine-Universität Düsseldorf, Technische Universität Dresden, Universität Duisburg-Essen, Universität Aachen.

faculty. Moreover, the age distribution of the respondents from both disciplines was similar, with a mean of 32 years for both fields.

The final sample contained 285 graduates from life sciences and 407 medical graduates. The gender distribution in both fields was very similar, with 63 percent of female graduates in life sciences and 65 percent in medicine. In medicine, females were slightly overrepresented, since German-wide females made up around 60 percent of medical doctors in 2013/2014 (Statistisches Bundesamt, 2014, 2015). For life sciences, there were no representative statistics available with respect to the gender distribution of these fields. Statistics which summarize mathematics and natural sciences, are too heterogeneous and, therefore, not a valid frame of reference. However, in a study of (Hauss et al., 2015) the gender distribution in the life sciences was very similar, with around 60 percent females.

Considering the circumstances of acquiring a doctorate, the majority of life scientists, 71 percent, held a position as a research fellow during the doctorate, 27 percent financed their doctorate with a scholarship and seven percent had a position as a student research assistant. The numbers did not add up to 100 percent since multiple answers were possible and doctoral students sometimes have to finance their training in various ways over their doctoral training period. In comparison to life science graduates, very few medical graduates held a position as research fellows during the doctorate, namely eight percent. This was not surprising since most medical students in Germany conduct their doctorate within the regular course of studies (see Chapter 4). In addition, 12 percent of medical graduates indicated to have had a scholarship and ten percent were student research assistants. Most medical graduates (60 percent) financially relied on their parents and family, or a job unrelated to research (30 percent). Within the life scientist group, only 12 percent were supported by their parents or family and 13 percent had a job unrelated to research.

Operationalization

The scales, i.e., items involving dis/agreement, reported hereafter were all assessed by 5 point Likert scales, with one indicating low agreement and five indicating high agreement.

Success during the doctorate. Since causal attributions in relation to success and failure are of main interest in this study, it has to be defined what success and failure mean in the context of the doctoral phase. Studies analyzing causal attributions to success and failure mostly use subjectively defined success and failure as a starting position. Since perceptions of success and failure can vary tremendously between respondents, depending on their former

experiences and thereby formed aspirations, this approach is considered as most suitable (Arkin & Maruyama, 1979). Furthermore, with respect to the validity of this method, it has been shown that measures of objective performance are strongly associated with the subjective perception of success (ibid.). Additionally, success within the doctorate or the doctoral phase is more complex, because several success indicators, not only attained grade, but published articles or conference attendances, might be relevant to doctoral graduates. And each of these indicators might be attached with more or less relevance by single individuals, resulting in different degrees of satisfaction. For these reasons, respondents were asked to indicate on a 5-point Likert scale, how successful they perceived their doctorate. Respondents who indicated their doctorate was very successful (5) or rather successful (4) were classified as successful graduates, respondents who indicated their doctorate was only partly successful (3), rather unsuccessful (2) or not successful at all (1) were classified as unsuccessful. According to this classification, respondents were given the attributional items that referred to either success or failure.

Attributions. As already implied by the introduced hypotheses and pointed out in the introductory part (Chapter 5 and 7) causal attributions were measured as importance ratings of causal factors. Causal factors included ability and effort (internal) and several external factors: since the common external factors, luck and task difficulty, did not match the context of the doctorate very well, other external factors that probably matter more within the doctorate were collected with a group of researchers. The final version incorporated the external causal factors of (lack of) help from others—for instance from (the) supervisor(s)—a good (or bad) relationship with supervisors, benevolent (or strict) grading, and little (or high) workload besides the doctorate. Since these were all individual causes that could not be summarized into one scale, each cause was individually introduced into the conducted analyses.

Scientific Self-Efficacy was measured by asking the respondents how confident they were in mastering specific tasks/achieving goals that are important to an academic research career. The central activities of a researcher were chosen based on an article of Kyvik (2013), which empirically investigates the central tasks of a researcher today. Furthermore, the work of Berweger (2008), which also deals with scientific/research self-efficacy, was considered. In contrast to Berweger (2008), a different formulation in the opening phrase was used. The phrase was deemed closer to the original concept of self-efficacy, as a perceived confidence in the ability to conduct courses of actions in the future successfully (Bong & Skaalivik, 2003) (see Appendix, 1.).

To assess scale validity, first an exploratory factor analysis was conducted with the criterion for the factors having an eigenvalue greater than 1. Three items were excluded due to low factor loadings. These were teaching and presenting one's work at conferences as well as one item that included two domains of action (determine research strategies and research priorities for the future) (see also Lachmann, Epstein & Eberle, 2016). The low factor loadings of the teaching and conference items might indicate that these tasks are perceived as less relevant for an academic career. While participating at conferences may be an important part of networking with the scientific community, conference proceedings do not have the same importance as journal publications, which seem to be the most important determinants of career success in academia (Plümper & Schimmelfennig, 2007).

After the exclusion of these items, a Scree-test and Velicer's Minimum Average Partial Correlation test (MAP-test) were run to determine the correct number of factors (O'Connor, 2000; Velicer, 1976; Velicer, Eaton, & Fava, 2000).[25] The MAP-test was conducted because the eigenvalue criterion often leads to an overestimation of factors, whereas the Scree-test has been criticized to lack objectivity (Bühner, 2011; O'Connor, 2000). All methods, eigenvalue, Scree-plot, and the MAP-test, were in favor of a one dimensional structure (Appendix, 1.4).

The final items comprised project management, conducting research, publishing in peer reviewed journals, to habilitate, to attract third party funding, and getting approval and cooperating with other researchers of one's scientific community. A Cronbach's alpha of 0.93 indicated a good scale reliability. Subsequent to factor analysis, the scores of the latent variable were predicted (M=0.01; SD=0.97; min= -1.59, max=1.59). These were used in the multivariate path models. In analyses that referred to group differences in scientific self-efficacy, an additive index was used for reasons of presentiveness.

While the short scale can be interpreted as three dimensional, too—preparing of a research project (items 1 and 2), conducting research (item 3 and 4) and visibility in the scientific community (items 5 to 7) (Lachmann et al., 2016)—the one dimensional approach was favoured in multivariate analyses, because these subdimensions were highly correlated with each other (from 0.91 to 0.96), which leaded to problems of multicollinearity.

[25] The MAP-test was conducted with the user written program for SPSS.

Academic career aspirations were operationalized as expressed long-term career goals. Respondents were asked whether in the long run, they would aspire to an academic research career and aspire to a professorship. These two items were summarized as academic career aspirations (Cronbach's alpha=0.92). Whereas other studies measure interest in specific academic and non-academic tasks and interpret those as academic career intentions (Hauss et al., 2015), it is not assumed that task interest can be set equal to career intentions. A reason for that is, that publishing and other academic tasks can be conducted in other career settings, such as industrial research. Another reason is that enjoying specific tasks does not necessarily mean that one actually intends to pursue a specific career.

Since little time had passed between graduation and the survey, expressed aspirations were considered as a more valid measure of long-term career intentions than the occupational position right after the doctorate. In addition, 28 percent of doctoral graduates kept the job they had during their doctorate for some months and the majority of medical graduates started their specialist training. It must also be noted that job market constraints play a significant role and doctoral graduates often do not find a position in their preferred sector right away (Konsortium Bundesbericht Wissenschaftlicher Nachwuchs, 2013). Additionally, the open answers of the survey indicated that specifically life science graduates sometimes have to continue their academic career due to a lack of alternatives.[26] Within the conducted qualitative interviews (cf. Chapter 10), it also became apparent that a fair amount of graduates frequently changes jobs in the beginning of their careers, or take not optimal jobs as a transition until they find something that matches their aspirations.

For ***field and gender***, four binary variables were created differentiating between field (medicine/life sciences) and gender (male/female). This operationalization was chosen, since gender could play a different role within medicine and other life sciences.

Additionally, ***control variables*** that were expected to be related to SSE and/or academic career aspirations were incorporated. Of course ***performance***, as an important source of self-efficacy (Bandura, 1977), had to be controlled for. Furthermore, objective performance measures would probably also directly influence academic career aspirations. The chosen indicators of objective achievements were attained grade, the amount of published articles as

[26] For instance, one respondent commented: "Viele 'retten' sich nach ihrer Promotion auf eine Postdoc-Stelle, um nicht ohne Job da zu stehen, sind also schnell in einem Beschäftigungsverhältnis. Der Berufseinstieg in einem Feld, das auch längerfristig eine Perspektive bietet, steht dann allerdings noch aus und fällt wesentlich schwerer."

first author and co-author, as well as conference proceedings. Since in medicine experimental doctorates are considered as scientifically most demanding (Deutsche Forschungsgemeinschaft, 2010), a binary variable for having conducted an experimental or non-experimental doctorate was included when analyzing medical doctoral graduates separately. Also the duration of the doctorate in months was assessed.

Another important control measure was ***intrinsic research motivation*** (short: intrinsic motivation) to confer a doctorate, which equals to being motivated by an interest in research. Especially in fields in which most students/graduates pursue a doctoral degree, as in medicine and life sciences, motives underlying the decision to pursue the doctoral degree might have been different from aspiring to have an academic career or being truly interested in research. Likewise, empirical results show that pursuing a career in academia is strongly related to intrinsic motivation (Roach & Sauermann, 2010; Abele & Krüsken, 2003). Intrinsic motivation was operationalized as an additive index of the items "I wanted to take a doctoral degree in order to work in research", "…in order to develop my professional skills", "…in order to being able to research during the doctorate" and "…in order to research about the specific topic of my doctorate". The reliability of the scale (Cronbach's alpha=0.81) indicated a good reliability. Additionally, a Scree-test and a MAP-test supported a one dimensional construct.[27]

Moreover, it was controlled for if graduates attained their degree on a ***position as a research assistant***. Doctoral graduates who attained their title within a position as a research associate might be more experienced and/or more interconnected with other researchers. They might, as a result, perceive higher scientific self-efficacy.

Lastly, it was controlled for if the respondents' ***first job right after graduation*** was a position as research assistant at the university or another public research institution. As already explained, approximately one third of doctoral graduates still held the job they had during graduation and the majority of medical doctoral graduates started their specialist training. Therefore, their first job cannot be seen as the final occupational area of the respondent and is not equivalent to career aspirations. However, having a research job right after graduation might be associated with higher scientific self-efficacy beliefs and possibly a more positive perception of career chances within academia.

The survey was professionally translated to English. It has to be noted, though, that scales were not back-translated. Since the amount of graduates who responded in English was very

[27] See Appendix, 2.1. Determination of Factors, Exploratory Factor Analyses.

low (5.9 percent, N=36), these cases were not excluded from the results. All of the following analyses were conducted with the statistical package Stata, version 12.

8.4 Results

To get an impression of the study population and possible differences between groups, the main variables of interest were analyzed on a descriptive/exploratory level. These main variables included subjective success of the doctorate, attributional patterns, scientific self-efficacy, intrinsic research interest as motivation to start the doctorate, and academic career aspirations.

8.4.1 Descriptive and Exploratory Results

Performance Measures

First, a brief overview of objective performance measures of the doctorate shall be given, distinguishing between fields of study and gender. With respect to the discussed differences between medical and life sciences, graduates in relation to research interest, but also gender differences in relation of pursuit and dropout of academic careers, it is interesting to examine whether those groups vary with respect to outcomes of the doctorate: attained grades and publications.

Looking at the *grade distribution,* both in medicine and in life sciences, most graduates received the grade of *magna cum laude* (72 percent in medicine and 50 percent in life sciences). However, in the life sciences a higher amount of graduates received a grade of cum laude or worse in comparison to the medical graduates (28 percent vs. 9 percent). Moreover, there were more medical graduates who received a *summa cum laude*: 19 percent of medical graduates were evaluated with the highest grade, but only 13 percent of life scientists. This result could hint at different evaluation practices between the fields, with potentially higher standards in the life sciences. When regarding gender and grade, it was also apparent, that more male than female life science graduates received a grade of *summa cum laude* (24 percent vs. 16 percent). In medicine, gender differences were even more distinct, with fewer women receiving the highest grade (7 percent vs. 13 percent), but also noticeably more females receiving grades below *magna cum laude* (44 percent vs. 34 percent).

With respect to *first author publications* it was evident that life scientists published more during their doctorate than medical graduates. 70 percent of medical graduates had not published an article as first author, but only 32 percent of life scientists. Moreover, 40 percent

of life scientists published more than one first author article, whereas 9 percent of medical graduates published more than one first author article. With respect to gender, slightly more females did not publish a first author article in the life sciences (24 percent vs. 29 percent), whereas a more distinct gender gap was visible in medicine (76 percent vs. 60 percent).
In addition, distinctly more medical graduates had not *published as a co-author* in comparison to the life scientists (45 percent vs. 20 percent). In accordance with these results, women also more often had no co-authorships, both in life sciences (21 percent vs. 17 percent) and medicine (46 percent vs. 41 percent), while the differences were smaller.

According to these results, it can be summarized that medical graduates received better grades, however they published less, especially as first authors. In addition, the outcomes of the doctorate of females were, in both fields, behind those of males, with the tendency towards more inequality in medicine.

Intrinsic Research Motivation for the Doctorate

Research shows a high correlation of intrinsic research motivation and the intention to pursue an academic research career. This has been found for non-medical fields (Abele & Krüsken, 2003; Roach & Sauermann, 2010) as well as medicine (Rubeck et al., 1995; Straus et al., 2006). Since the existing literature and empirical studies point to a generally low research interest in medical students (Epstein et al., 2016; Deutsche Forschungsgemeinschaft, 2010; Gensch & Waltenberger, 2006; Gerst & Hibbeler, 2012; Hakimi et al., 2010; Loos, Sander, et al., 2014; Stallmach et al., 2011; see also Chapter 4), it can be further expected, that medical graduates would be to a lesser extent motivated by their interest in research in comparison to life science graduates. Consistent with the assumption, a two-sided t-test revealed significantly higher research interest in life science graduates (N=226) in comparison to medical graduates (N=345) (M=3.97, SD=0.84 vs. M=3.09, SD=1. 5; $p<0.001$). There were no significant gender differences with respect to intrinsic motivation, whether looking on gender differences within the fields of study separately or overall.[28]

Subjective Success of the Doctorate

Since attributions of subjective success and failure of the doctorate were measured, it is important to analyze which variables are related to the perception of success, i.e., which variables are predictors of perceiving the doctorate as success or not. This is not only

[28] Women in life sciences had a mean of 4.02 and men 3.89. In medicine, women had a mean of 3.04 in intrinsic motivation and men 3.19.

important as a validation of the subjective assessment of success, but also in terms of group comparisons. Women are often reported to differ with respect to attributional patterns, but some research also hints to women underrating their (academic) successes in comparison to men (Sieverding, 2003). If women had a lower probability to be in the group of subjectively successful doctorates, everything else held equal, further analyses of attributions and SSE would be misleading: if women were less likely to attribute success to internal factors but also less likely to classify the doctorate as a success, results would be biased in favor of no/lower group differences.

To assess what influences the perception of success and failure, a logistic regression with doctoral success as dependent variable (dummy coded) and achievement variables (grade, published articles, duration of the doctorate), intrinsic motivation, and the field/gender groups as independent variables was conducted (see Table 1). The analysis revealed that objective achievement variables were significantly related to the perception of success and failure: Graduates with the grade *summa cum laude* and *magna cum laude* rated their doctoral success significantly higher. Both published articles as first author and co-author were significantly related to classifying the doctorate as success, whereas the effect of co-authored articles was only marginally significant (see Table 1).

Having attended conferences with own contributions was not significantly related to the perception of doctoral success. As discussed above, conference attendance might be perceived as less relevant, since in academic research published articles are most important with respect to career success. Furthermore, a longer duration of the doctorate was related to a lower probability of perceiving the doctorate as successful. Interestingly, older correspondents were more likely to see their doctorate as a success.

Controlling for objective performance indicators and sociodemographic variables, male and female graduates from medicine were significantly more likely to classify their doctorate as a success. This could mean that medical graduates have different standards of defining successful doctorates due to little prior research experience, lower research interest and having good career possibilities outside of academic research. No gender differences with respect to classifying the doctorate as successful were apparent. The nonsignificant effect of intrinsic research interest, further, indicated no motivational bias.

Table 1: Logistic Regression, Dependent Variable: Subjective Success of the Doctorate

Variables	B	SE	p
Male medicine*	1.31	0.50	0.009
Female medicine*	0.92	0.45	0.037
Female life sciences*	0.28	0.42	0.508
Grade: *summa cum laude***	2.39	0.78	0.002
Grade: *magna cum laude***	1.08	0.28	0.001
Articles as 1st author	0.34	0.16	0.030
Articles as co-author	0.18	0.10	0.067
Conference attendances	0.03	0.10	0.781
Intrinsic motivation	0.09	0.14	0.495
Duration of the doctorate	-0.02	0.01	0.002
Age of respondent	0.07	0.04	0.045
Constant	-2.14	0.29	0.099
N	431		
Prob > chi^2	0.001		
Pseudo R^2	0.14		

Legend: *Reference category male life sciences, **reference category *cum laude* and worse. Standard errors (SEs) and coefficients are rounded to the second, p-values to the third decimal place.

To assess if medical graduates and life science graduates had different standards towards a successful doctorate, the analysis was reconducted separately for both fields (Table 2). The separate analysis showed a positive significant effect for first authored articles among life scientists, but not for medical graduates. While the effect of grade was significant for medical graduates, it was only marginally significant for life scientists. These results hint at possibly different evaluation criteria within these groups. However, these results should not be over-interpreted, as for instance medical graduates might perceive their authorships differently when they received a lot of assistance (as also suggested by Study 3, Chapter 10). In addition, neither the number of co-authors, nor the quality of the journals was assessed, which both could further influence the evaluation of one's publications.

Moreover, respondents' age was only significantly related to success perception for medical doctoral graduates who, with increasing age, were more likely to see the dissertation as a success. Medical students who decided to do their doctorate later might have made a more elaborate decision and could have been more confident about the purpose and meaningfulness of their doctorate. The duration of the doctorate was only negatively related to the perception of success in the medical group, possibly because medical dissertations are usually conducted within a shorter time frame (Berning & Falk, 2006). However, in this sample there were no significant differences in the duration of the doctorate between fields of study.

Table 2: Logistic Regression, Dependent Variable: Subjective Success of the Doctorate, Medical and Life Science Graduates Separately

	Field: Medicine			Field: Life Sciences		
Variables	B	SE	p	B	SE	p
Female*	-0.49	0.37	0.193	0.30	0.44	0.492
Grade: *summa cum laude***	2.50	1.09	0.023	2.11	1.17	0.071
Grade: *magna cum laude***	1.39	0.35	0.000	0.60	0.53	0.255
Articles as 1st author	-0.25	0.27	0.350	0.66	0.22	0.003
Articles as co-author	0.22	0.16	0.163	0.14	0.13	0.311
Conference attendances	0.02	0.17	0.921	0.06	0.12	0.623
Intrinsic motivation	-0.02	0.01	0.001	0.01	0.01	0.741
Duration of the doctorate	0.23	0.18	0.191	-0.06	0.25	0.822
Age of respondent	0.10	0.04	0.024	-0.02	0.09	0.811
Constant	-1.66	1.55	0.285	0.17	2.65	0.950
N	254			193		
Prob > chi²	0.001			0.003		
Pseudo R²	0.13			0.15		

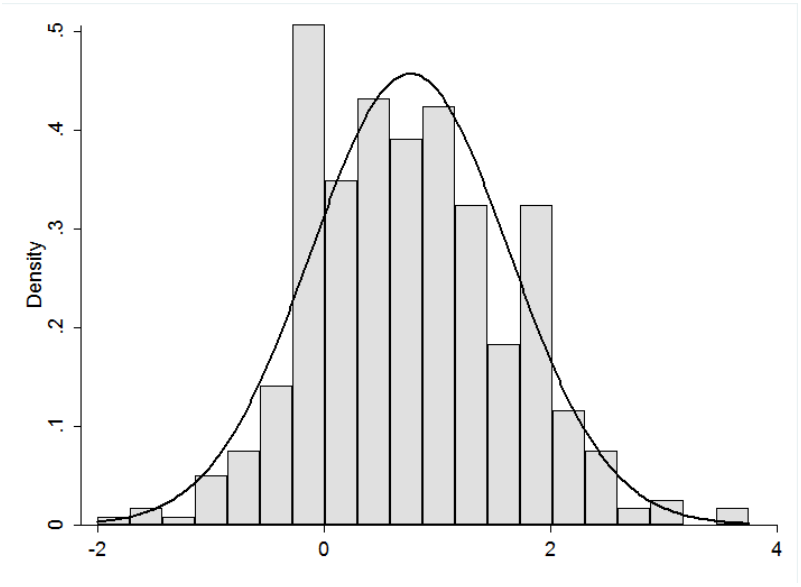
Legend: *Reference category male life sciences/male medicine, **reference category *cum laude* and worse. Standard errors (SEs) and coefficients are rounded to the second, p-values to the third decimal place.

Causal Attributions to Success

The next variables analyzed are causal attributions with respect to success and failure. Looking at the attributional items as regards a subjectively successful doctorate, it is notable that all items receive high approval: the mean for ability being *M*=4.09 (*SD*=0.69), for effort 4.34 (*SD*=0.72) and external variables taken together *M*=3.44 (*SD*=0.64).[29] While a slight hedonic bias can be recognized, at first sight, the answers to the attributional items do not seem much differentiated. Still, different attributional patterns are thinkable, so that people differ in their consent behavior as a whole, giving more value to internal or external factors. To give an example, respondents might discount ability and/or effort by giving external factors more weight. Therefore, attributional patterns were investigated in a next step, differentiating between internal and external attributions. For this purpose, an index was created, subtracting the mean sum of external attributions from the mean sum of internal attributions. Positive values reflect internal attributions and negative values external attributions. A mean of *M*=0.76 (*SD*=0.87) indicated a slight propensity to attribute success more internally and supports a tendency towards self-serving attributions (Mezulis et al., 2004; Riess et al., 1981). Looking at the distribution of internal and external attributions on a histogram (Figure 3) revealed a higher differentiation between respondents: very few almost solely attributed their success internally, to ability and effort, and few people almost only attributed their success externally.

[29] See Appendix (2.2) for table with means and standard deviations of all attributional variables of Study 1.

Figure 3: Distribution of External vs. Internal Attributions of Success



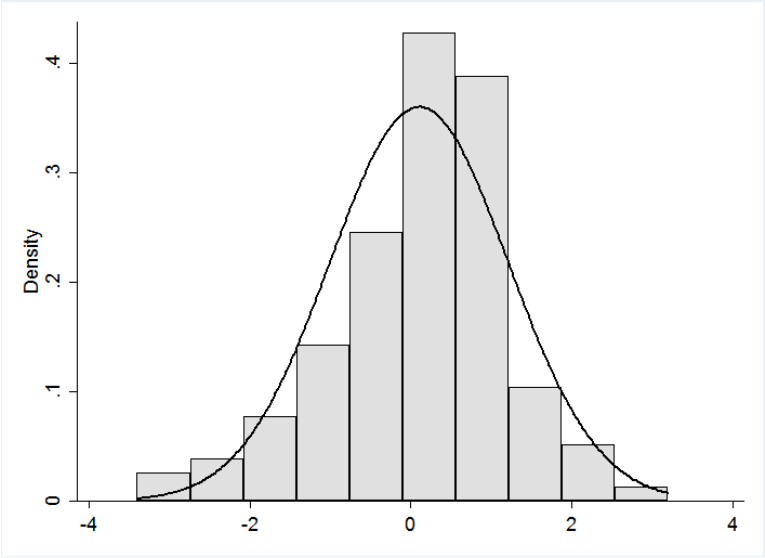
External Attributions Internal Attributions

There were no differences in attributional patterns between fields of study or gender—whether looking at the means of all items individually or at the amount of internal versus external attributions (Appendix, 2.2). This finding speaks against ***hypothesis 6c***, which states that women express less self-serving attributions and ***hypothesis 6d*** that expected less self-serving attribution to (partly) account for females' lower self-efficacy beliefs.

Causal Attributions to Failure

For subjectively (rather) unsuccessful doctorates, agreement to the different items was generally lower. The mean value for ability attributions was *M*=2.27 (*SD*=0.68), for effort *M*=2.17 (*SD*=1.23) and for external attributions *M*=2.84 (*SD*=0.68). Other than in the subjectively successful sample, comparing internal versus external attributions would not make sense in the case of failure, since ability and effort attributions are expected to have opposite effects in this context: attributing failure to ability should be negatively associated with respect to further motivation, yet, attributing failure to a lack of effort should be positively associated with motivation. Therefore, the attributional index was computed by subtracting the mean of effort and external attributions from ability attributions, so that negative values stand for stronger ability attribution and positive values stand for stronger external/effort attribution.

Figure 4: Distribution of External/Effort vs. Ability Attributions for Subjectively Rather Unsuccessful Doctorates



Ability Attribution

Effort / External Attribution

The attained histogram revealed that few respondents attributed failure to almost solely a lack of ability and likewise, few respondents linked failure almost solely to a lack of effort/external factors (see Figure 4). Moreover, a tendency towards more external/effort attributions was visible (*M*=0.10, *SD*=1.11). Again, there were no significant differences in attributional patterns between gender and fields of study. In conjunction with the results regarding subjectively successful doctorates, ***hypotheses 6c and 6d*** are rejected at this point.

Construct Validity of Scientific Self-Efficacy: What about Other Career Aspirations?

Before testing the postulated hypotheses, it was explored if scientific self-efficacy is really a construct that is specific for the academic career context or the research career context in general. It might be feasible that an underlying trait, such as general confidence in one's (career) abilities, would influence expressed levels of SSE. If this was the case, SSE would be also related to levels of aspirations in other career domains. To explore this possibility, regression analyses were carried out with SSE as independent and career aspirations in different domains as dependent variables: academic career aspirations, general aspiration to have a career outside of academic research and aspiring to a career in industrial research.

For medical graduates, aspiring to a career that focuses on patient care was additionally analyzed. The analyses were conducted separately for medicine and life sciences, to see whether SSE would impact their intentions differently. A significant relationship between

SSE and academic career aspirations was apparent for both fields of study (Appendix, Table 31), supporting ***hypothesis 1***.

When analyzing the intention to pursue a career in industrial research, there was no relationship between SSE and aspirations for life scientists (Appendix, Table 33). However, in the medical group the association between SSE and career aspirations in industrial research was significant (ibid.). This might indicate that life scientists, who have more research experience, are more familiar with the career circumstances in academia and industrial research. They may, as a result, know more about different requirements and abilities one needs in both career branches. Regarding the intention to have careers unrelated to research, there was no (negative) significant relationship with SSE—neither in medicine nor in life sciences (Appendix, Table 32). The results can be interpreted with respect to the career prospects in academic research. While SSE is positively associated with academic career aspirations for both fields, aspiring to an academic career does not necessarily mean excluding other careers as an option. In general, the intention to pursue a career outside of academia was higher among all respondents in comparison to the intention to pursue an academic career (M=3.49, SD=1.19 vs. M=2.26, SD=1.40).

In addition, for physicians, SSE was negatively associated with aspiring to a career with patient contact (Appendix, Table 34)—however, this association was not significant. Physicians, moreover, had the highest intentions to pursue a clinical career (M=4.37, SD=0.98). It has to be kept in mind though, that physician-scientists often not only do research, but also work clinically. Academic research and patient care do not exclude one another, but may go hand in hand when working in a university hospital.

The results suggest that SSE is indeed a context related construct that is strongly associated with aspirational levels in academic research. For medical doctoral graduates, who may not see academic and industrial research as distinct, SSE might additionally be a suitable predictor for career aspirations in domains that are generally related to research.

8.4.2 Hypotheses Testing

Group Differences in Self-Efficacy Beliefs

To test for the assumed gender and field of study differences multivariate regression analyses were carried out. These results are depicted in Table 3. The abbreviations M1, M2, etc., designate different statistical models.

Differences between Fields of Study (see Table 3, M1 and M2). In model 1 (M1), differences between fields of study are depicted on a bivariate level, not controlling for achievement variables. In that model it is apparent that male and female medical graduates expressed significantly lower scientific self-efficacy beliefs in comparison to life science graduates. In model 2 (M2), these differences remained significant after introducing various control variables (grade, published articles and conference attendance). This result supported ***hypothesis 7b*** which states lower SSE for medical graduates. Since there were apparently no gender differences in the life sciences, only medical graduates were further analyzed with respect to varying degrees in self-efficacy by gender.

Gender Differences in Medicine (see Table 3, M2b). Medical graduates were analyzed separately. Here it showed that female medical graduates had significantly lower self-efficacy beliefs than male medical graduates even when additionally controlling for having conducted experimental versus non-experimental research. ***Hypothesis 6b***, in which lower scientific self-efficacy beliefs were expected for females can consequently be supported for the field of medicine, but has to be rejected for the field of life sciences.

Since the scientific self-efficacy scale can be differentiated on three dimensions (conducting research, visibility in the scientific community, see also Chapter 8.3), it was subsequently analyzed if gender differences existed on all subtasks for medicine, or on some of these in the life sciences. Consistent with the results depicted in Table 3, female medical graduates had significantly lower levels on all subdimensions. However, no gender differences were found in the life sciences (Appendix, Tables 25 and 26).

Table 3: Stepwise Multivariate Regression Analysis, Effects of Field of Study and Gender on Scientific Self-Efficacy Beliefs

	M1 Differences between fields of study			**M2** Differences between fields of study			**M2b** Gender Differences in Medicine		
Variables	B	SE	p	B	SE	p	B	SE	p
Male medicine*	-0.83	0.12	0.000	-0.42	0.12	0.001			
Female medicine*	-1.30	0.09	0.000	-0.73	0.11	0.000	-0.27	0.10	0.008
Female life sciences*	-0.01	0.08	0.922	-0.15	0.12	0.192			
Grade: *summa cum laude***				0.37	0.14	0.007	0.57	0.21	0.006
Grade: *magna cum laude***				0.11	0.09	0.186	0.06	0.11	0.566
Articles as 1st author				0.17	0.04	0.000	0.39	0.07	0.000
Articles as co-author				0.03	0.03	0.343	-0.01	0.04	0.832
Conference attendances				0.07	0.01	0.000	0.11	0.02	0.000
Experimental dissertation (medicine only)							0.17	0.11	0.125
Constant	3.09	0.07	0.001	2.68	0.12	0.000	2.07	0.11	0.000
N	541			450			261		
P>F	0.000			0.000			0.000		
Adj. R^2	0.22			0.44			0.35		

Legend: *Reference category: male life sciences; in M2b male medical graduates, **reference category: *cum laude* and worse. Standard errors (SEs) and coefficients are rounded to the second, p-values to the third decimal place.

Group Differences in Academic Career Aspirations

In this section it was tested whether medical graduates expressed lower intentions to pursue an academic research career (hypothesis 7a) and, whether this effect was mediated by self-efficacy (hypothesis 7d).

Differences between Fields of Study (see Table 4, M1 and M2). In the conducted multivariate analyses, which are depicted in Table 4, it showed that especially female medical doctors stated lower intentions to pursue an academic career (M1). While male medical doctors also stated lower academic career aspirations, these were smaller and only significant at the 10 percent level. Controlling for scientific self-efficacy beliefs in model 2 (M2), academic career aspirations were even significantly higher for male and female medical doctors (Table 4, M2).

These results supports ***hypothesis 7a***, which states that medical graduates express lower academic career aspirations, and ***hypothesis 7d***, which states that SSE accounts for lower academic career aspirations by medical graduates.

Table 4: Stepwise Multivariate Regression Analyses, Effects of Field of Study on Academic Career Aspirations

	M1			M2		
Variables	B	SE	p	B	SE	p
(Reference category: male life sciences*)*						
Male medicine	-0.34	0.17	0.056	0.30	0.16	0.056
Female medicine	-0.75	0.14	0.001	0.30	0.15	0.043
Female life sciences	-0.02	0.19	0.922	-0.04	0.16	0.804
SSE				0.89	0.06	0.001
Constant	2.62	0.11	0.001	1.91	0.16	0.056
N	578			563		
P> F	0.001			0.001		
Adj. R^2	0.05			0.138		

Legend: Standard errors (SEs) and coefficients rounded to the second, p-values to the third decimal place.

Gender Differences in Medicine (see Table 3, M2b). Since again, no gender differences were found within the field of life sciences (see Table 4), only potential gender differences within the field of medicine were further analyzed. The results displayed in Table 5 show that on a bivariate level, female medical graduates expressed lower academic career aspirations than males. However, when controlling for scientific self-efficacy beliefs, there were no significant differences with respect to academic career aspirations between female and male medical graduates. These results support ***hypothesis 6a*** (lower academic career aspirations in females) and ***hypothesis 6d*** (no differences after control of SSE) only within the field of medicine. For life scientists, male and female doctoral graduates neither differed in stated academic career aspirations nor scientific self-efficacy, which leads to the rejection of ***hypotheses 6a*** and ***6b*** for the doctoral graduates in the life sciences.

Table 5: Stepwise Multivariate Regression Analysis, Effects of Gender and Scientific Self-Efficacy on Academic Career Aspirations

	M1			M2		
Variables	B	SE	p	B	SE	p
Female	-0.40	0.15	0.007	0.03	0.12	0.835
SSE				0.97	0.06	0.001
Constant	2.28	0.12	0.001	0.30	2.39	0.056
N	346			324		
P> F	0.001			0.001		
Adj. R^2	0.02			0.43		

Legend: Standard errors (SEs) and coefficients are rounded to the second, p-values to the third decimal place.

Interim Discussion Exploratory Results and Group Differences

Differences between Fields of Study. From the results presented in the previous section, scientific self-efficacy appears to be lower for medical graduates, especially for female medical graduates, as compared to life science graduates. In addition, the hypothesis that medical graduates would have lower academic career aspirations was supported. This difference was smaller and only marginally significant for the male medical group, but larger and highly significant for female medical graduates. While controlling for scientific self-efficacy beliefs, medical graduates had even higher academic career aspirations than life scientists and also gender differences within the medical group became insignificant, it cannot be concluded that differences in scientific self-efficacy *caused* differences in expressed academic career interest. While establishing a causal link is always problematic, this is especially the case in cross-sectional study designs, such as in the current study.

Gender Differences. In addition, female medical doctors deviated also expressed significantly lower self-efficacy beliefs in comparison to their male counterparts. Contrary to the hypotheses, attributional patterns did not differ between genders. Therefore, the hypothesis that attributional patterns lead to lower self-efficacy beliefs in females had to be rejected.
Moreover, female medical doctors stated lower academic career aspirations in comparison to male medical doctors. When controlling for scientific-self-efficacy, gender differences within the medical group became insignificant. Again, no gender differences with respect to academic career aspirations were found within the life sciences.

While it was attempted to control for all objective performance and experience differences, the possibility of unobserved heterogeneity is still given: the assessed performance measures of the doctorate—grade, publications, conference attendances and experimental vs. non-experimental research in medicine—might not have accounted for all differences in scientific ability and experience. For instance, being a sole author could affect self-efficacy beliefs differently than being a first author. More possible explanations are debated in the final discussion (Chapter 8.5).

Path Models—Attributions, Self-Efficacy and Academic Career Aspirations

Item Nonresponse/Missing Values

Due to the inclusion of more variables and the separate analysis of subjectively successful and (rather) unsuccessful doctorates, the path analyses were substantially reduced in sample size when using listwise deletion/complete case analysis (approximately 40 percent reduction in sample size in both cases). The drop in sample size did result from low amount of missing values on all variables and not from a high item nonresponse on a specific variable.

Due to the high reduction in sample size it was examined if it was possible to use multiple imputations. Moreover, the use of listwise deletion, especially when losing a high percentage of survey participants (and power), has been criticized, since resulting estimates may be biased when data is not "missing completely at random" (MCAR) (Allison, 2001; Böwing-Schmalenbrock & Jurczok, 2010; Horton & Kleinman, 2007). MCAR means that there is a significant link between observed variables from the dataset with the missingness of the other variables at interest. Imagine that people who attribute failure were less likely to report self-efficacy beliefs, in this case, the data would be "missing at random" (MAR).

A requirement to do multiple imputations is that data is MAR and not "missing not at random" (MNAR). In the condition of MAR, observed variables are allowed to be significantly related to the probability of missingness on other observed variables at interest. Conversely, under the condition of MNAR, variables of interest are related to unobserved variables and/or characteristics of respondents on the variable itself: imagine that the probability of item nonresponse in income is related to the income of respondents itself, i.e., people with very high income and/or very low income would be more likely to not report their income. However, the assumption of MAR vs. MNAR is important but cannot be statistically tested and has to remain on a theoretical level. As McKnight et al. stated *"there is no diagnostic procedure, numeric or graphic, that validly differentiates between MAR and*

MNAR. Instead, we must rely on logic and a sound understanding of the study design and domain" (2007, p. 95).

To test for the data being MCAR versus MAR the groups with missing and no missing values were separately compared for unsuccessful and successful doctorates.

For the subjectively successful sample as well as for the subjectively unsuccessful sample, t-tests revealed significant differences in SSE between respondents with missing and no missing values: In the subjectively successful sample SSE was lower for the group with missing values. In the unsuccessful sample SSE was higher within the group with missing values. Furthermore, in both subjectively successful and unsuccessful samples, graduates with missing values had a significantly higher age. However, the higher probability of missing values for older participants is not regarded as problematic, since graduates who conducted their doctorate at an older age are more likely to already have a career outside of academia and, therefore, may not constitute the population of interest here: doctoral graduates who about to start their career. With respect to the described missingness pattern in SSE, this might also not be problematic but even desirable here. Participants with lower SSE in the successful sample who would be excluded by complete case analysis might not have been as confident about the success of their doctorate as other graduates. Respectively, in the unsuccessful sample, participants with higher SSE who would be excluded by complete case analysis might not perceive their doctorate as unsuccessful as the other participants in the group.

However, as discussed, the missingness in the data is probably not of concern here, two methods of multiple imputations were used in addition to complete case analysis to gain more confidence in the results. Missing values were imputed with full information maximum-likelihood estimation (FIML), which is available in Stata version 12 for the structural-equation-modeling (SEM)-command (used for the path model). Since the use of maximum likelihood for imputing non-normally distributed variables (categorical variables as well as continuous but skewed variables, both present here) is debated and can lead to biased estimations (Lee & Carlin, 2010; von Hippel, 2012), multiple imputations via chained equations (MICE) were applied additionally. Since data generated by MICE cannot be analyzed with the SEM-command in Stata version 12, the with MICE imputed data was analyzed with three separate regression analyses: a regression analysis with self-efficacy as dependent variable and two regression analyses with academic career aspirations as dependent variable—with and without SSE as predictor—were conducted. The two regression analyses

with academic career aspirations as dependent variable, including and omitting SSE, were conducted in order to account for the postulated indirect effects of attributional variables.

However, it has to be noted that no direct effect between dependent and independent variable is necessary for a mediation to occur (Rucker, Preacher, Tormala, & Petty, 2011). Therefore, the results of the stepwise regression analyses are only partially suitable to capture indirect effects. Furthermore, it shall be noted that path analysis operates with maximum likelihood, hence, results from path analyses and regression analyses can be slightly different.

As recommended in the literature, the dependent variables (scientific self-efficacy and academic career aspirations) were used in the imputation models but their imputed values were not included in the final analyses (Young & Johnson, 2010). On the ground that SEM command can only be specified for the whole model, imputed values of SSE had to be also excluded in the models were academic career aspirations was the dependent variable. Furthermore, people who indicated to not have received a grade (yet) were not included in the imputation model, since this category was neither theoretically nor empirically related to other measured constructs. This results in small variations in sample size between the MICE and the FIML models.

Due to problems with perfect prediction when specifying ordinal regression as a method within the imputation model, ordinal variables were imputed with predictive mean matching (Vink, Frank, Pannekoek, & Buuren, 2014). The imputations were conducted separately for the subsamples of subjectively successful and unsuccessful graduates. Since the percentage of missingness on each variable was very low, with the highest amount of missingness being 10 percent for the subjectively successful sample and 13 percent for the unsuccessful sample, a number of 15 imputations were chosen for both subsamples. Comparing the distribution of non-imputed and imputed values, the imputed values hardly varied from the non-imputed values. The fact that some coefficients reached significance only in the models with imputed values or had lower p-values probably occurred due to the higher sample size and, hence, power in these models.

Path Model Successful Doctorates

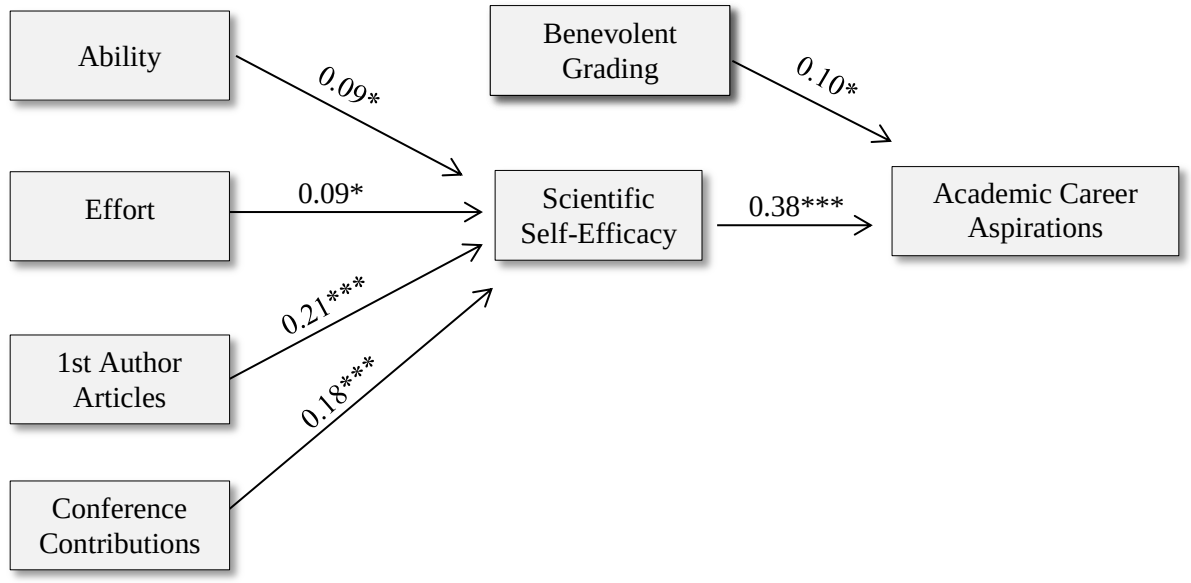
In order to test the hypothesized relationships between attributions to success, scientific self-efficacy and academic career aspirations, a multivariate path model was conducted with scientific self-efficacy as a mediator variable and academic career aspirations as the dependent variable. The path models were conducted with complete case analyses and multiply imputed values, using FIML and MICE. Since the path models were just identified

and all possible paths were estimated, no overall fit indices can be calculated (Thomas & Mathieu, 1994). Moreover, effects of the psychological constructs (attributions, self-efficacy, intrinsic motivation) were interpreted as significant if in at least two of the three estimation methods a p-value not greater than 0.10 was attained. The p-value was chosen as such, since these instruments were newly developed and may need to be further optimized within future research. In the case that two methods of analyses were showing a p-value not greater than 0.10, it was assumed that the probability for a random effect was diminished. For the other sociodemographic measures, effects were interpreted as significant if at least two of the three applied methods indicated p-values smaller or equal to 0.05.

The results of the analyses with complete cases and imputed data were very similar, specifically with respect to the central variables of attributions and self-efficacy. Therefore, results of the complete case analysis are depicted here. The tables of the results which were obtained with imputed data are found in the attachment (see Appendix, 2.3, Tables 27 and 28).

Table 6 shows the results from multivariate path analysis with direct effects on scientific self-efficacy (M1), direct effects on academic career aspirations (M2) and indirect effects on academic career aspirations (M3). These are described separately in the following. Additionally, the results with respect to the main variables—attributions, performance indicators, self-efficacy, and academic career aspirations—are illustrated in Figure 5.

Figure 5: Path Model, Attributions to a Successful Doctorate, Scientific Self-Efficacy and Academic Career Aspirations



Legend: Selected results from Table 6 are illustrated. +p<0.10; *p<0.05; **p<0.01; ***p<0.001

Effects on Scientific Self-Efficacy (see Table 6, M1). As expected, ability attributions and effort attributions were positively and significantly related to scientific self-efficacy. This was, moreover, also supported within the models where missing values have been imputed. According to the effect sizes, the effect of ability attributions was not larger, as compared to the effect of effort attributions. While results support ***hypothesis 2a*** with respect to the positive relationships between ability and effort attributions to scientific self-efficacy, a larger effect of ability attributions on self-efficacy cannot be supported.

With respect to external attributions, none of the here considered variables significantly affected scientific self-efficacy beliefs. Attributions to "external support" and "benevolent evaluation" were negative; however, they did not reach statistical significance. Consequently ***hypothesis 2b***, which states a negative effect of external attributions on SSE, is rejected here.

Further to the hypothesized relationships, significant effects of *performance outcomes* on self-efficacy beliefs were found: published articles as a first author as well as the amount of attended conferences were positively related to scientific self-efficacy beliefs, while neither achieved grade nor articles as co-author were associated with SSE. As one would expect, respondents with a job in academic research right after the doctorate also reported higher self-efficacy beliefs. Respondents who indicated to have been a research associate within the doctorate, however, seemed to have lower self-efficacy beliefs. This effect was significant

within both models with imputed values and was no result of collinearity. Moreover, doctoral graduates who indicated higher *intrinsic research motivation* prior to the doctorate also had significantly higher levels of scientific self-efficacy.

On the contrary, the duration of the doctorate was in all three models negatively related to SSE. In addition, interestingly, also the number of children was negatively related to SSE. For field and gender, the results were similar as for the overall population in the previous analyses (see Group Differences), in that female medical graduates had significantly lower SSE in comparison to the reference category of male life scientists. There were no significant differences for male medical graduates and female life scientists in comparison to male medical graduates. Looking at effect sizes overall, intrinsic motivation and first author articles were most strongly associated with scientific self-efficacy. While the single coefficients of effort and ability attributions were smaller, their conjoint effect was comparable to the effect of publications as first author.

Table 6: Path Model with Academic Career Aspirations (ACAs) as Dependent Variable and Scientific Self-Efficacy as Mediator Variable, Subjectively Successful Doctorates

	M1 Direct Effects on SSE			**M2** Direct Effects on ACAs			**M3** Indirect Effects on ACAs		
Variables	ß	SE	p	ß	SE	p	ß	SE	p
SSE				0.38	0.06	0.000			
Ability	0.09	0.05	0.040	0.03	0.05	0.514	0.04	0.04	0.053
Effort	0.09	0.04	0.048	-0.01	0.05	0.847	0.03	0.03	0.061
External support	-0.04	0.05	0.359	-0.04	0.05	0.458	-0.02	0.03	0.365
Benevolent grading	-0.02	0.04	0.659	0.10	0.04	0.016	-0.01	0.02	0.660
Good relationship	0.03	0.05	0.549	-0.11	0.05	0.022	0.01	0.02	0.551
Low workload	0.05	0.05	0.264	-0.01	0.05	0.893	0.02	0.02	0.273
Male medicine*	0.00	0.07	0.962	0.09	0.07	0.205	0.00	0.09	0.962
Female medicine*	-0.17	0.08	0.032	0.05	0.08	0.510	-0.06	0.09	0.045
Female life sciences*	0.00	0.05	0.983	-0.13	0.06	0.025	0.00	0.06	0.983
Age	0.06	0.05	0.191	-0.08	0.05	0.131	0.02	0.01	0.202
Duration of doctorate	-0.09	0.04	0.030	-0.12	0.05	0.011	-0.04	0.00	0.042
Articles as 1st author	0.21	0.05	0.000	-0.01	0.05	0.834	0.08	0.02	0.001
Articles as co-author	0.04	0.05	0.409	0.12	0.05	0.015	0.01	0.02	0.413
Grade: *summa cum laude***	0.05	0.06	0.457	0.18	0.07	0.006	0.02	0.09	0.461
Grade: *magna cum laude***	0.05	0.06	0.373	0.01	0.06	0.813	0.02	0.07	0.378
No grade**	0.08	0.05	0.086	0.00	0.05	0.966	0.03	0.12	0.100
Conference attendances	0.18	0.05	0.000	0.05	0.06	0.382	0.07	0.02	0.003
Children	-0.09	0.05	0.053	-0.01	0.05	0.812	-0.03	0.03	0.067
Research associate during doctorate	-0.10	0.06	0.101	-0.26	0.06	0.000	-0.04	0.07	0.114
Research associate after doctorate	0.10	0.04	0.025	0.29	0.05	0.000	0.04	0.05	0.037
Intrinsic motivation	0.33	0.05	0.000	0.22	0.05	0.000	0.13	0.04	0.000
Constant	-2.49	0.58	0.000	1.74	0.64	0.007			
N	272								
R^2	0.59			0.55					
Overall R^2	0.71								

Legend: *Reference category: male life scientists, **reference category *cum laude* and worse. Standard errors (SEs) and standardized coefficients rounded to the second, p-values rounded to the third decimal place.

Direct and Indirect Effects on Academic Career Aspirations (see Table 6, M2 and M3). In support of ***hypothesis 1***, SSE was positively and significantly related to stated academic career aspirations in all three models—complete case analysis, FIML and MICE. Furthermore, there were positive indirect effects of ability and effort attributions on academic career aspirations, which were mediated by self-efficacy beliefs (M3). While these effects were only significant at the 10 percent level in complete case analysis, the effect of ability attributions was significant at the 5 percent level within the models with imputed data which were higher sample size, respectively power. Additionally, the MICE regression analyses revealed a significant direct association between ability attributions and academic career aspirations. Therefore, ***hypothesis 3a***, which assumes an indirect effect of ability and effort attributions on academic career aspirations mediated by self-efficacy, can be supported here. However, it has to be noted that these indirect effects were rather small.

With respect to external attributions, no effect was found for attributions to external support or to low workload besides the doctorate. But attributing doctoral success to a benevolent grading was significantly and positively related to academic career aspirations in all models, with imputed and without imputed values. While attributing doctoral success to a good relationship with the supervisor was negatively associated with academic career aspirations (M2), this was not the case in both analyses with imputed data. Nevertheless, the results lead to the rejection of ***hypothesis 3b,*** stating that attributing success to external factors has a negative effect on academic career aspirations that is mediated by SSE.

Unlike previous analyses with the whole sample, female life scientists in the subjectively successful sample had lower intentions to pursue a career in academic research. These results were significant in the path model using complete case analysis (M2) and significant at the 10 percent level in the MICE regression analysis but not the path model using FIML—suggesting rather small differences, if any. Consistent with previous analysis, lower academic career aspirations by female medical graduates were mediated by self-efficacy beliefs.

Looking on the impact of objective indicators of doctoral success, i.e., *performance outcomes*, doctoral graduates with a grade of *summa cum laude* expressed significantly higher academic career aspirations in comparison to those with a grade of *cum laude* or a worse grade. This is not quite surprising, since objective chances of having an academic career are also declining with lower grades. Furthermore, published first author articles were indirectly associated with academic career aspirations via scientific self-efficacy beliefs (M2). Interestingly, while articles as co-author were not associated with SSE, they were directly related to academic career aspirations.

In addition, as one would expect, graduates with a position as research associate right after graduation expressed higher academic career aspirations. Again, having a position as research associate during the doctorate was here related to lower academic career aspirations in the models with imputed values.

Looking again at effect sizes, intrinsic motivation before the doctorate and scientific self-efficacy were strongest associated to the intention to pursue an academic career. The indirect individual effects of effort and ability attributions on academic career aspirations were rather small.

Interim Conclusion—Successful Doctorate

Scientific Self-Efficacy. Within the here considered subsample of subjectively successful doctoral graduates, ability and effort attributions were significantly related to scientific self-efficacy beliefs. The overall effect of these attributions on self-efficacy was, moreover, comparable to indicators of performance accomplishments, such as contributions to conferences and first author articles. However, attributions to external variables were not related to SSE. This might have been a result of the hedonic bias: only a very small fraction of doctoral graduates attributed their success to mostly external factors.

In addition, intrinsic career interest was significantly and positively related to self-efficacy. A plausible explanation might be that intrinsically motivated doctoral students learn more during the doctorate and choose academically more demanding projects, since their motivation to do research reaches beyond "only obtaining the doctorate".

Interestingly, respondents who were research associates within the doctorate had lower self-efficacy beliefs. While this result seems counterintuitive at first sight, doctoral graduates who have been research associates during the doctorate may have a more realistic view of the academic system/academic career. Additionally, the work circumstances during the doctorate could be an inhibiting factor to long-term academic career aspirations. Especially in life sciences, doctoral candidates often work full time, have a high work-load that is not related to their doctorate, and are paid a part-time job. This was apparent from the qualitative study (cf. Chapter 10) as well as the quantitative data: doctoral graduates indicated to have averagely worked 47 hours per week whereas the contractually defined hours of work averaged at 39 hours. Another interesting result was the negative effect of children on scientific self-efficacy. This might indicate that junior scientists bearing the responsibility of childcare expect a negative influence on their research performance. But since important information with

respect to childcare and, most importantly, age of children was missing (see Hunter &, Leahey, 2010) this result has to be interpreted cautiously.

Academic Career Aspirations. Scientific self-efficacy was significantly associated with academic career aspirations and, moreover, was the variable with the highest correlation with the intention to pursue an academic research career. Additionally, ability and effort attributions were indirectly associated to academic career aspirations by self-efficacy. However, these indirect effects were rather small, as were the indirect effects of performance accomplishments (first author articles and conference attendances). Thereby it is argued, that objective performance outcomes and attributions together form mastery experience within the doctorate. Performance and the interpretations of performance seem to both contribute to self-efficacy beliefs, which in turn influence the intention to pursue an academic research career.

While external attributions were not related to SSE, attributing doctoral success to a benevolent grading was positively and directly associated to academic career aspirations. An explanation to the positive association of benevolent grading and academic career aspirations could be that experiencing benevolence within the academic system results in a positive attitude and affect towards academia. Doctoral graduates might feel joy and gratitude over the received evaluation—as gratitude might be experienced if a positive outcome is attributed externally (e.g., Weiner 1985, 2000). In this respect, not all external attributions of success must be negative in their consequence.

While first author publications were indirectly related to academic career aspirations, via their effect on self-efficacy, articles as a co-author were directly related to the intention to pursue an academic research career. The effect could be a result of networking: having collaborated with other researchers may have led to job opportunities. Moreover, a positive collaboration experience, i.e., positive experience of the academic workplace might have as well strengthened the wish to stay in this environment.

In accordance with the results with respect to self-efficacy, having been a research associate during the doctorate was negatively related to the intention to further pursue academic research. As discussed above, since this was not an issue of collinearity, being a research associate during the doctorate might result in a more realistic assessment of the academic career and could, therefore, be demotivating with respect to continuing the academic career track. This result is also in line with research showing a decline in academic career interest over the course of the doctorate (Hauss et al., 2015; Sauermann & Roach, 2012). Judging from the open comments received in the survey, it does not seem uncommon for life sciences

doctoral candidates who conduct their doctorate on positions as research associates, to complete their doctorate unpaid and even to continue research unrelated to the doctorate. [30]

To address the hypothesis that effects of attributions on academic career aspirations would be mediated by self-efficacy, it can be said that this applied to ability and effort attributions, but not attributions to a benevolent grading. Arguing that the association of benevolent grading and academic career aspirations might be a result of affect, it makes sense that this effect was not mediated by expectancy. The importance of expectancy and affect for motivation is also stressed by Weiner (1985, p. 548): *"Expectancy and affect […] are presumed to guide motivated behaviour".* All in all, the results support the idea of an interrelatedness of causal attributions and self-efficacy, and a mediating effect of self-efficacy between attributions and level of aspiration. However, due to the cross-sectional analysis the direction and causality of the found relationships has to be interpreted with caution, as will be discussed later on.

Path Model—(Rather) Unsuccessful Doctorates

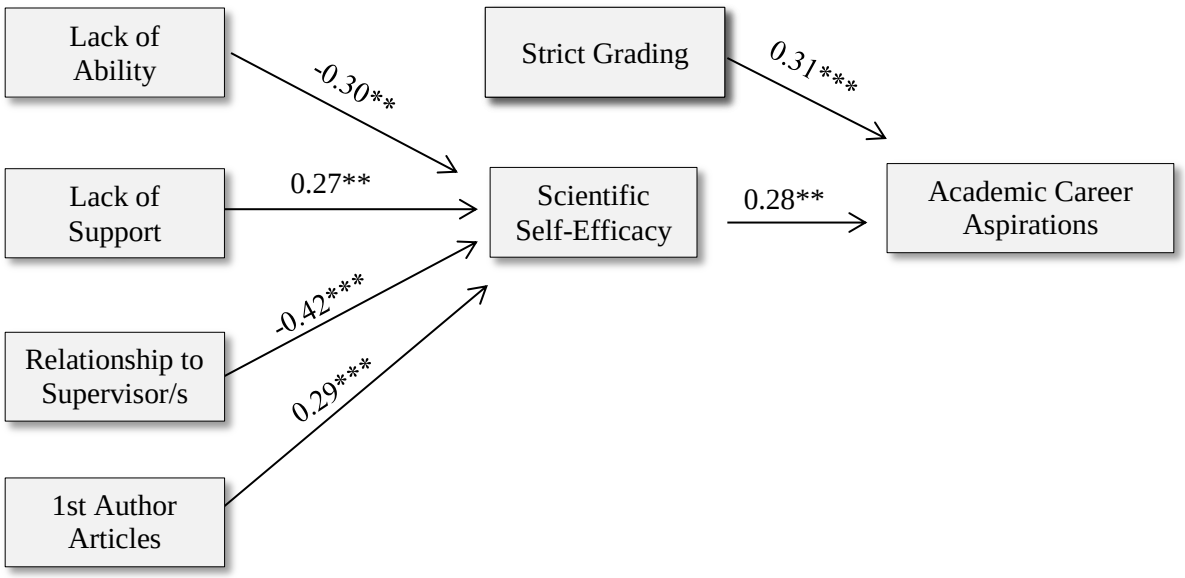
In the next section, the postulated hypotheses with respect to subjectively unsuccessful doctorates were examined. First of all it has to be noted that the sample size of doctoral graduates who indicated that their doctorate was not as successful was comparably smaller with N=143 (49 life scientists and 94 medical graduates). Moreover, the majority of the group indicated their doctorate had been "only partly successful" (N=117) and a few indicated it was "rather unsuccessful" (N=26). Despite the lower confidence with the doctorate within the subsample—which was, moreover, reflected by averagely lower grades, lower self-efficacy beliefs and fewer publications—most of these doctorates were not totally discontent with the outcome of their doctorate, and since everyone received their title, no person in this sample completely failed. Just as in the subsample of subjectively successful doctorates, a path analysis (regression analyses with the MICE data) was run using the same variables and control variables. Since, again, results were very similar—whether complete case analyses, FIML or MICE were used. Therefore the results of complete cases analysis are depicted here.

[30] We received comments such as: "Die Finanzierung der Promotion ist eine Sauerei sondergleichen. Ausnahmslos jeder in meinem Bekanntenkreis hat auf ALG I gearbeitet, weil kein Geld mehr vorhanden war (ich meine nicht das Schreiben der Arbeit, sondern Forschungsarbeit!)" (ALG I=Arbeitslosengeld), "Ich bin nicht sicher ob dies Teil der Umfrage ist, aber ich wollte anfügen, dass es leider immer noch die Praxis ist, Doktoranden in der Biologie nur für 3 Jahre Arbeit im Labor zu bezahlen. Die eigentliche Doktorarbeit muss danach oft mit Unterstützung durch Arbeitslosengeld geschrieben wird. Besonders stressig ist dies in ≪Stadt≫, wo es nach Einreichen der Arbeit bis zum eigentlichen Abschluss teils mehr als ein halbes Jahr dauert. Eine Zeit in der man nur schlecht nach einem neuen Job suchen kann, da man den Abschluss noch nicht sicher hat."

The results from the analyses with imputed values will be referred to in the text. Their tables are, furthermore, found in the attachment (Appendix, Tables 29 and 30).

Table 7 shows the results from multivariate path analysis with direct effects on scientific self-efficacy (M1), direct effects on academic career aspirations (M2) and indirect effects on academic career aspirations (M3). These are described separately in the following. Beyond that, the results with respect to the main variables—attributions, performance indicators, self-efficacy, and academic career aspirations—are illustrated in Figure 6.

Figure 6: Path Model, Attributions to Failure, Scientific Self-Efficacy and Academic Career Aspirations



Legend: Selected results from Table 7 are illustrated. +p<0.10; *p<0.05; **p<0.01; ***p<0.001

Effects on Scientific-Self Efficacy (see Table 7, M1). In support of ***hypotheses 4a***, the analyses (with and without imputed values), revealed a negative and significant association between ability attributions and scientific self-efficacy. While lack of effort was hypothesized to be positively related to SSE—since one can easily adapt this behavior and expend more effort in the future—no relationship was apparent here.

Among the external factors, attributing failure to a lack of support was, in accordance with the hypothesized relationships, positively and significantly related to self-efficacy beliefs. Only in the regression analysis with imputed values, attributing a rather unsuccessful doctorate to a strict grading was positively associated with SSE, however, only at the 10 percent level. No effect was apparent in complete case analysis and the FIML path model.

Contrary to the hypothesis, attributing a rather unsuccessful doctorate to a bad relationship with the supervisor was negatively related to SSE. Since only some of the external variables were pointing into the hypothesized direction, and some were not, ***hypotheses 4b***—which states that in case of "failure" effort and external attributions are related to higher self-efficacy beliefs—is rejected.

Moreover, conference attendances and published first author articles were positively and significantly related to SSE. Having a research job after graduation was only related to SSE in the regression analysis with imputed values, and there, only significant at the 10 percent level. A surprising result of this analysis was that graduates with a grade of *cum laude* or worse expressed significantly higher self-efficacy beliefs than graduates with a higher grade. It was suspected, that this could be a result of uneven grade distributions between medical and life science graduates. A look on grade distribution between the fields, for this subsample of subjectively unsuccessful doctorates, revealed that there were 72 life scientists in the grade category of *cum laude* and worse but only 8 medical graduates. The paradoxical effect of grades on SSE was, hence, a result of medical graduates' higher grades. Since medical graduates also expressed lower levels of SSE, higher grades were ironically related to lower SSE.

With respect to group differences, in this subsample of subjectively unsuccessful doctorates, not only female doctoral graduates expressed lower self-efficacy beliefs in comparison to the reference category of male life scientists, but also male medical graduates expressed significantly lower self-efficacy beliefs.

Comparing the magnitude of effects on self-efficacy beliefs among independent variables, the effects of the individual attributional variables were in the range of effects of performance accomplishments (first author articles and conference attendances). Considering the combined effect of attributions, one could come to the conclusion that these even exceeded those of performance indicators in the subjectively unsuccessful sample.

Table 7: Path Model with Academic Career Aspirations (ACAs) as Dependent Variable and Scientific Self-Efficacy as Mediator Variable, Subjectively Unsuccessful Doctorates

	M1			**M2**			**M3**		
	Direct effects on SSE			Direct effects on ACAs			Indirect effects on ACAs		
Variables	ß	SE	p	ß	SE	p	ß	SE	p
SSE				0.28	0.13	0.028			
Ability	-0.30	0.07	0.000	0.14	0.10	0.139	-0.08	0.039	0.056
Effort	-0.03	0.07	0.715	0.06	0.09	0.473	-0.01	0.022	0.719
Lack of Support	0.27	0.08	0.000	0.05	0.10	0.646	0.08	0.029	0.066
Strict evaluation	-0.01	0.08	0.922	0.31	0.09	0.001	-0.00	0.017	0.922
Bad relationship	-0.42	0.08	0.000	0.11	0.11	0.305	-0.12	0.040	0.044
High workload	0.06	0.08	0.445	-0.11	0.10	0.262	0.018	0.017	0.472
Male medicine*	-0.48	0.12	0.000	0.54	0.15	0.000	-0.14	0.176	0.056
Female medicine*	-0.39	0.13	0.003	0.55	0.16	0.001	-0.11	0.120	0.081
Female life sciences	-0.08	0.09	0.364	0.08	0.11	0.454	-0.02	0.067	0.403
Age	0.04	0.09	0.641	-0.02	0.11	0.847	0.01	0.007	0.649
Duration of Doctorate	0.03	0.10	0.777	-0.09	0.12	0.449	0.01	0.001	0.779
Articles as 1st author	0.29	0.08	0.000	0.24	0.10	0.017	0.08	0.060	0.061
Articles as co-author	-0.08	0.08	0.278	-0.06	0.09	0.542	-0.02	0.018	0.333
Grade: *cum laude***	0.19	0.09	0.031	-0.18	0.11	0.096	0.05	0.065	0.128
No grade**	0.10	0.07	0.135	-0.12	0.08	0.143	0.03	0.107	0.219
Conference attendances	0.39	0.10	0.000	-0.12	0.13	0.339	0.11	0.038	0.058
Children	-0.01	0.08	0.870	-0.01	0.10	0.960	-0.00	0.030	0.870
Research associate during doctorate	0.08	0.09	0.391	0.07	0.11	0.557	0.02	0.057	0.425
Research associate after doctorate	0.03	0.08	0.706	0.25	0.09	0.005	0.01	0.047	0.710
Intrinsic motivation	-0.01	0.08	0.901	0.28	0.09	0.002	-0.00	0.021	0.901
Constant	-0.17	0.79	0.826	-0.46	0.94	0.621			
N	85								
R^2	0.68			0.55					
Overall R^2	0.85								

Legend: *Reference category: male life scientists, **reference category *summa/magna cum laude*. Standard errors (SEs) and standardized coefficients rounded to the second, p-values to the third decimal place.

Direct and Indirect Effects on Academic Career Aspirations (see Table 7, M2 and M3). Taking a look at academic career aspirations, it is first of all notable that, in support of ***hypothesis 1***, SSE was again significantly and positively related to the expressed intention to pursue a career in academia (M2). With respect to attributional patterns, attributing failure to a lack of ability was indirectly and negatively related to academic career aspirations in complete case analyses and the FIML model. In both cases the effects were significant at the 10 percent level.

Surprisingly, attributions to a lack of ability were positively related to academic career aspirations in the FIML model, when SSE was controlled for. This effect was, however, not apparent in complete case analysis and the regression analysis and might be a result of biased estimation in the FIML model, which can occur due to the non-continuous and not normally distributed variables. The results are in support of ***hypothesis 5a***, which claims a negative indirect effect of ability attributions on academic career aspirations via self-efficacy beliefs for subjectively rather unsuccessful doctorates. Consistent with the result regarding self-efficacy (M1), attributing an unsuccessful doctorate to a lack of effort was not positively associated with academic career aspirations.

With respect to the variables referring to external attributions, attributing failure to a lack of supervision was indirectly related to academic career aspirations in the complete case analysis; however, this effect was only marginally significant and not significant in the models with imputed values, suggesting no effect on academic career aspirations. Attributing failure to a strict evaluation of the doctorate was directly, positively and significantly related to academic career aspirations (M2). This effect was also significant in both analyses with imputed values. Beyond that, attributing failure to a bad supervisory relationship was negatively related to academic career aspirations via self-efficacy (indirect effect): This effect was significant in the complete case analysis and the FIML model. Due to the mixed results with respect to external attributions, and no effect of effort attributions in the here conducted analyses, ***hypotheses 5b***—which states that attributing failure to external causes or a lack of effort is associated with increased aspirations—has to be rejected.

Moreover, as in the previous analyses, significant and positive influences on academic career aspirations could be shown for having a research job right after graduation and intrinsic research motivation as a reason to start the doctorate. Similar to the subjectively successful subsample, male and female medical students had, under control of scientific self-efficacy, even higher academic career aspirations in comparison to male life scientists (M2).

With respect to the magnitude of effect sizes, the analyses suggested intrinsic research motivation before the doctorate and scientific self-efficacy to be the strongest influence on academic career aspirations. The indirect effects of performance accomplishments and attributions, which were mediated by SSE, were rather small and comparable in their effect sizes.

Interim Conclusion—Unsuccessful Doctorates

Scientific Self-Efficacy. For the group of subjectively unsuccessful doctorates, as expected, attributing failure to a lack of ability was significantly and negatively related to SSE. With respect to effort and external attributions, the results were only partly in accordance with the assumptions: attributing a rather unsuccessful doctorate to a lack of support was, as expected, positively related to SSE. Contrary to expectations, but in accordance with the results from the subjectively successful graduates, attributing failure to a bad relationship with (the) supervisor(s) was negatively related to SSE. As already discussed, this might be an effect of the bad relationship itself, resulting in negative affect towards academia. The result might as well indicate that a bad relationship to the supervisor involves unconstructive feedback, which has a negative influence on self-efficacy. This interpretation is, furthermore, also suggested by the results of the qualitative study (Chapter 10).

In addition, attributing failure to a strict evaluation of the doctorate was directly and positively related to academic career aspirations—and not as expected indirectly via an increase in self-efficacy. While thinking one was evaluated strictly might not be related to higher self-efficacy beliefs, it might increase motivation via defiance or wanting to prove oneself.

Attributing failure to a lack of effort was not related to scientific self-efficacy. Not putting all effort into the doctorate might be a reflection of lower self-efficacy before the doctorate. It might as well be an indicator for unpleasant circumstances during the doctorate, such as a demotivating supervisor.

Academic Career Aspirations. The fact that effort attributions were also not related to academic career aspirations can be also logically explained: If a person actually decided not to put all effort into the doctorate at some point, the interest in pursuing an academic career was probably diminished during the doctoral phase or even beforehand. Moreover, attributing an

unsuccessful doctorate to lack of effort but aspiring to an academic career, would probably induce cognitive dissonance.

Intrinsic research motivation and scientific self-efficacy were the variables with the strongest relations to academic career aspirations. While indirect effects of attributions on the intention to pursue an academic career appeared to be rather small, as those of performance indicators, they appeared to equally contribute to the explanation of scientific self-efficacy.

8.5 Discussion

Sociocognitive Variables. The conducted analyses point to an importance of cognitive processes in the formation of academic career aspirations in the early academic career. The importance of scientific self-efficacy as regards influencing one's goals, also in an academic career setting, could be replicated and support the findings of previous studies (Berweger & Keller, 2005; Estrada et al., 2011). In addition, the results of the study suggest that causal attributions can be a source of self-efficacy beliefs and might be equally important juxtaposed to performance. Moreover, it seemed that causal attributions to failure had a stronger association to self-efficacy in comparison to causal attributions to success. This makes sense, since continuing an academic career path after an experience of failure should generally be perceived as riskier.

Due to the cross-sectional design, however, it cannot be concluded that these relationships were causal and their directions cannot be finally ascertained. Whereas it is rather assumed that higher self-efficacy beliefs result in higher academic career aspirations, it might be that people who aspire to an academic career express stronger self-efficacy beliefs in order to reduce cognitive dissonance. The same logic applies to effects of attributional variables and all effects in the conducted analyses. However, with respect to attributions and scientific self-efficacy the by Bandura (1977) suggested mutual influence between causal attributions and self-efficacy can be empirically supported (Stajkovic & Sommer, 2000). Hence, it may be true that former scientific self-efficacy influenced attributions which affected subsequent self-efficacy.

Furthermore, not all attributional effects on academic career aspirations were indirect and mediated by scientific self-efficacy: for instance attributions to a strict or benevolent evaluation of the dissertation were directly related to the intention to pursue an academic career. The mediation in these cases might have been on the affective side, as has been argued

for the case of a benevolent grading. In case of strict grading the attributions might have not raised the expectancies of one's capabilities, but triggered a higher aspiration as a response of defiance: thinking that the supervisor evaluated one's work not adequately might have induced an attitude of "now more than ever". These results suggest that external factors to which one attributes achievements can vary significantly from each other. Beyond that, the results suggest that affective reactions might sometimes weigh heavier than "rational calculations of success probabilities".

Gender Differences. With respect to expected gender differences, results varied with field of study. While there were no gender differences within the life sciences regarding scientific self-efficacy beliefs or academic career aspirations, female medical graduates had significantly lower scientific self-efficacy beliefs and stated significantly lower academic career aspirations than their male counterparts. Differences in academic career aspirations between medical female and male doctoral graduates were no longer significant after controlling for scientific self-efficacy beliefs. While there were no gender differences within the life sciences, the question remains unanswered why female medical graduates had lower scientific self-efficacy beliefs even under control of objective success indicators. One possible explanation might be that female physicians perceive a higher difficulty to combine patient care with teaching and research. The "threefold burden" in academic medicine (research, patient care and teaching) might discourage female physicians more from pursuing research than male physicians, since women mostly carry a higher family workload (Althaber et al., 2011; Hanika, 2015; Kunadt, 2014; Reimann & Alfermann, 2014). Another plausible explanation might be, as has been pointed out earlier, that there were unobserved differences with respect to the quality of the doctorate or previous research experience between male and female medical doctoral graduates. These qualitative differences could be for instance, the journals in which articles were published and the amount of co-authors. While it can be only speculated here, these are factors future research might want to consider analyzing.

In addition, self-efficacy beliefs should be followed over a longer period of time. A German panel study with physicians (Abele, 2006) has shown that there were no gender differences in vocational self-efficacy until after the second state examination, but after three years of labor market experience, female physicians expressed lower self-efficacy beliefs than male physicians. This effect stayed significant when only full-time working physicians were included.

Interestingly, in the here conducted analyses, the number of children had a negative effect on scientific self-efficacy beliefs and was, thereby, indirectly related to lower academic career aspirations. While children might lower career aspirations in other career fields as well, the academic career might be perceived as more difficult to combine with a family, demanding all energy and focus of the researcher (Beaufaÿs, 2015). Since important aspects of family and childcare, as well the age of the children were not available (Hunter & Leahey, 2010), conclusions cannot be made.

Differences between Fields of Study. Overall, medical and life science graduates were stating lower interest in pursuing an academic career in comparison to life science graduates. Furthermore, male as well as female medical graduates had significantly lower academic career aspirations in comparison to life scientists (with female physicians having even lower academic career aspirations, as already discussed above). Differences in academic career aspirations were even reversed when scientific self-efficacy was introduced into the analyses: this means that medical graduates who expressed the same amounts of SSE had even higher academic career aspirations than life science graduates.

Nevertheless, this result has to be interpreted cautiously. One cannot assume that when SSE is increased among medical students/graduates, they will be more likely to pursue an academic career. It might just be the case that the medical doctoral graduates, who expressed higher scientific self-efficacy beliefs and academic career aspirations, were more motivated to acquire research skills in the first place, when starting the doctorate.

8.6 Limitations and Outlook

Time Horizon and Opportunity Structures. Since more or less initial aspirations and motivations were analyzed, it remains open how stable these are. Initial aspirations could quickly change together with contextual factors, as job availability, family burden or new job experiences. Hence, it remains open to what extent initial aspirations are related to actual career outcomes. As already noted, it is certain that opportunity structures limit the extent to which aspirations can be realized in early as well as later career stages. Speaking of opportunity structures, for life science graduates, aspirations might be a poorer predictor for behavior, because of worse career opportunities outside of academic research. Life science graduates might end up in the academic career track despite having favored to pursue another career. On the contrary, medical graduates have excellent career prospects as clinically working physicians—in this case, academic career aspirations might be actually more in line

with behavior, i.e., taken career paths. However, long-term, a higher percentage of those medical and life sciences doctoral graduates pursuing academic research after the doctorate will probably (have to) drop out of academia.

Methods. Another limitation of the study is the forced choice operationalization of attributions, not measuring actual attributions of respondents. Results, therefore, might be biased and a qualitative study would be fruitful for gaining more insights into the actual attributions with respect to doctoral success and failure. A qualitative approach is also beneficial to differentiate more on the success level, since graduates who indicated their doctorate was successful, probably might have experienced both successful and not as successful moments during their doctorate. The same applies to graduates who indicated their doctorate was rather unsuccessful. In that way, attributions could be assessed more detailed with respect to different success and failure experiences during the doctorate. Furthermore, the present study did not include measures of underlying dimensions of causal factors (locus, stability, controllability, globality). For this reason, it cannot be concluded if assumed underlying dimensions of causal factors accounted for the observed relations.

As already discussed, due to the cross-sectional design, the data has to be interpreted very cautiously with respect to causality and causal direction. It cannot be ruled out that graduates, who aspire to an academic career after the doctorate, attribute success more internally and state higher self-efficacy beliefs, and not the other way round—that attributional patterns and SSE lead to higher intentions to pursue an academic career. A longitudinal panel design, starting from the beginning of the doctorate with several measurement points within the course of the doctorate, would be ideal to tackle this problem (Brüderl, 2010).

Outlook. Future studies should analyze *how* causal attributions affect self-efficacy beliefs and motivation: do effects occur due to underlying dimensions of causal factors, which would mean that it is a "rational" process driven by expectancies of success—or is there, a mechanism on the affective side, as suggested by some of the results? It would be, for instance, plausible to assume that emotions linked to attributions, like pride [which is predicted when attributing success internally (Weiner, 1985)], are also influencing one's career aspirations.

Another factor that would be important to look at is how supervision can shape attributional patterns. As already described, studies from Schunk and colleagues (Schunk, 1982, 1984; Schunk & Gunn, 1986) show effects of attributional feedback on self-efficacy and

performance. Moreover, intervention studies on reattribution training also suggest the possibility to enhance performance by attributional feedback (e.g., Ziegler & Heller, 2000). Supervisors might have an important role in the formation of scientific self-efficacy in junior scientists by giving feedback: conveying to their students to have or not to have the abilities needed to pursue academic research professionally. To address these issues, the role of causal dimensions will be approached in the next study (Chapter 9). Moreover, within the qualitative study in Chapter 10, the role of the supervisor and affective reactions will be explored.

9. Study 2—Attributions to Causal Dimensions, Self-Efficacy Beliefs and Academic Career Aspirations

Summary

The following study explored the relationship of causal attributions, self-efficacy and academic career aspirations among medical and life sciences doctoral graduates, who received their doctoral degrees between 2014 and 2015.[31] Unlike Study 1, which measured causal attributions via the importance ratings of causal factors (see Chapter 8), in Study 2, an instrument measuring underlying dimensions (locus, controllability, stability and globality) of the assumed main cause for doctoral success/failure was applied. This study was based on the hypothesis that attributing success to a cause perceived as stable in its influence on academic success would, all else being equal, be associated with significantly higher scientific self-efficacy beliefs (SSE). Vice versa, the opposite was expected for subjectively unsuccessful graduates. Moreover it was expected, that by their relation to SSE, stability attributions were indirectly related to academic career aspirations. The path analyses conducted were supportive of the suggested relationships. Consistent with previous results (Chapter 8), medical doctoral graduates were found to have significantly lower SSE in comparison to life science graduates, as well as significantly lower academic career aspirations. Controlling for SSE differences in academic career aspirations was no longer significant.

[31] Participating universities: Ludwigs-Maximilians-Universität München, Technische Universität München, Universität Würzburg, Friedrichs-Alexander-Universität Erlangen-Nürnberg, Universität Regensburg, Universität Witten-Herdecke, Rheinische Friedrich-Wilhelms-Universität Bonn, Universität zu Köln, RWTH Aachen, Ruhr-Universität Bochum, Heinrich-Heine-Universität Düsseldorf, Technische Universität Dresden, Universität Duisburg-Essen Universität.

9.1 Introduction

The goal of Study 2 was to further explore the effect of causal attributions on scientific self-efficacy beliefs and the intentions of doctoral graduates in medicine and life sciences to pursue an academic career. In Study 1, it was shown that causal attributions, measured as the importance ratings of causal factors, were linked to academic career aspirations either directly or indirectly by scientific self-efficacy. Since in Study 1 attributions were measured via the importance ratings of predefined causal factors, the role of underlying dimensions (locus, stability, controllability, globality) (Abramson et al., 1978; Weiner, 2010) remained open. While Weiner, in his early versions of attribution theory, allocates dimensions to the central causal factors he focuses on (e.g., ability is assumed to be stable, internal and not controllable) (Weiner, 1972; Weiner et al., 1971; Weiner, Heckhausen, & Meyer, 1972), this practice has been critiqued due to the *"fundamental attribution researcher error"* (Russel, 1982). This error designates that dimensional perceptions of causal factors may vary between respondents. Nonetheless, for different reasons, studies have further used the methodological approach of measuring attributions with respect to causal factors (e.g., ability, effort, luck, etc.) and overall have found support for expected effects. Ability attributions have been repeatedly shown to have an especially positive effect on various dependent variables after success (Curdes, 2003; Hsieh & Schallert, 2008; Kiefer & Shih, 2006; Schunk, 1986; 1884). Also, a cross-cultural study found support for the presumed underlying causal dimensions of the most common causal factors (ability, effort, task difficulty and luck) (Schuster et al., 1989).

Causal Dimensions: Theory and Findings

Before introducing the research hypothesis of the current study, the theoretical and empirical foundations already presented in the previous chapters (Chapters 2, 5, and 7) shall be briefly recaptured. According to Weiner and colleagues (Weiner, 1979, 1985, 2000; Weiner et al., 1971), success and failure can be attributed to different causal factors such as effort, luck and task difficulty. The cause one assumes as important in having led to a specific performance outcome can be further differentiated on several causal dimensions. Whereas Weiner suggested three dimensions as essential (locus, controllability and stability), globality is another dimension that can be thought of as relevant within the framework of causal attributions (Abramson et al., 1978; Seligman et al., 1979).

Since stability refers to the future persistence of an assumed causal factor, this dimension is, according to Weiner, most potent in its influence on motivation. Following the theory,

attributing success to a stable factor will lead to an increase in future success expectancies, and thereby positively affect motivation and motivated behavior (such as persistence) (Weiner, 2000). Consequently, attributing failure to a stable factor leads to higher expectancies of failure, and is thereby negatively associated to motivated behavior. Furthermore, the globality dimension depicts beliefs in higher "causal generality across situations" (Weiner, 2010, p. 34) and should, therefore, be relevant to expectancy across situations.

In the example of the doctorate, for instance, a medical graduate may believe that aptitude is the most important factor in the achievement of his doctorate. Furthermore, he might think that this aptitude is specific to the task of writing a dissertation, and that it is not generalizable across other situations in research. Attributing doctoral success to aptitude would, therefore, not automatically lead to higher success expectancies with respect to an academic research career. If aptitude was perceived as specific to the situation of the doctorate and not as generalizable to academic research, one would not necessarily expect high success chances with respect to a career in this domain.

Whereas Weiner (1985, 2000, 2010) argued that locus and controllability are not related to expectancy but rather influence motivation via affect, studies found associations to expectancy among all of the dimensions discussed: for instance, Stajkovic and Sommer (2000) can support a relationship of internal attributions (locus) to self-efficacy. Moreover, controllability has been repeatedly linked to expectancy (Stiensmeier-Pelster & Heckhausen, 2006).

Critique of Causal Dimensions—Behavioral Efficacy

The concept/logic of the commonly used dimensions presented here has been critiqued by Dickhäuser and Stiensmeier-Pelster (2002), who argued that it is not the stability of a cause which determines expectancy, but rather the perceived stability of a cause's effect, i.e., the prevailing effect of the cause on one's behavioral efficacy (free translation of the term "*Verhaltenswirksamkeit*"). Imagine that a doctoral graduate attributes failure to the personality of the supervisor: although the supervisor's personality is stable, it would not influence the graduate's career success in the event that s/he has another boss after graduation. The personality of the supervisor would then be irrelevant for the graduates' behavioral efficacy.

The irrelevance of the classical causal dimensions behind a causal factor is, moreover, experimentally demonstrated by the authors. Subjects of the experiment were asked to open a

computer file from a disc. The file was unable to be opened due to either an irreparable damage (condition A) or a lack of computer-related skills (condition B). Whereas the cause in condition A (a damaged disc), was perceived as stable, it did not affect respondents' expectancies to being able to open such files in the future. In condition B (lack of skills necessary to open the file), the expectancy of future success was lower: even though the cause in condition B is less stable and more controllable than in condition A, one would have to put in more time and effort in order to acquire the needed skills (ibid.). In condition A, the cause was stable, yet, was irrelevant to future behavior, as one could simply store files in other locations, etc. These results suggest that research findings which indicate effects of conservative measures of causal dimensions might stem from their overlap with the perceived stability of the cause's future effect/perceived behavioral efficacy. One can also imagine that a measure of perceived stability would, in many situations, perfectly overlap with a measure of perceived stability on behavioral efficacy—for instance, in the case of ability as causal factor.

9.2 Hypotheses

Based on the theoretical arguments and empirical evidence presented by Dickhäuser and Stiensmeier-Pelster (2002), it is assumed that only a cause's perceived stable influence on future academic career success (short: perceived stability) is related to scientific self-efficacy and academic career aspirations. Under control of perceived stability, it can be expected that other dimensions (controllability, globality, locus) will not be significantly related to scientific self-efficacy or the motivation/intention to pursue an academic career.

Scientific Self-Efficacy and Academic Career Aspirations

Hypothesis 1: Scientific self-efficacy is positively linked to academic career aspirations: higher levels of expressed scientific self-efficacy are related to higher levels of expressed academic career aspirations.

Attributions to Success and Scientific Self-Efficacy

Hypothesis 2a: Perceiving the cause that assumedly led to the success as stable in its impact on future outcomes within academic research, is related to higher scientific self-efficacy.

Hypothesis 2b: Under control stability, other causal dimensions are not associated with scientific self-efficacy.

Attributions to Success and Academic Career Aspirations

Hypothesis 3: In the case of a subjectively successful doctorate, perceived stability is significantly and positively linked to academic career aspirations. This relationship is indirect and mediated by scientific self-efficacy.

Attributions to Failure and Scientific Self-Efficacy

Hypothesis 4a: Perceiving the cause that assumedly led to the unsuccessful doctorate as stable in its impact on future outcomes within academic research, is related to lower scientific self-efficacy.

Hypothesis 4b: Under control of stability, other causal dimensions (controllability, locus, globality) are not related to scientific self-efficacy.

Attributions to Failure and Academic Career Aspirations

Hypothesis 5: In the case of a subjectively unsuccessful doctorate, perceived stability is significantly and positively linked to academic career aspirations. This relation is indirect and mediated by scientific self-efficacy.

Group Differences

The hypotheses with respect to group differences are adjusted on the basis of results from Study 1 (Chapter 8). Since there were no hints of existing attributional differences between disciplines and gender, no hypotheses were formulated in this regard. Also, gender differences in scientific self-efficacy and academic career aspirations were expected to occur exclusively in the field of medicine.

Disciplinary Differences

Hypothesis 6a: Medical graduates express lower academic career aspirations in comparison to life science graduates.

Hypothesis 6b: Medical graduates express lower scientific self-efficacy in comparison to life science graduates.

Hypothesis 6c: Lower academic career aspirations by medical graduates are not significant when controlling for scientific self-efficacy.

Gender Differences

Hypotheses 7a: Female medical graduates express lower academic career aspirations in comparison to male medical graduates.

Hypotheses 7b: Female medical graduates express lower scientific self-efficacy beliefs in comparison to male medical graduates.

Hypotheses 7c: Lower academic career aspirations by female medical graduates can be explained by differences in scientific self-efficacy.

9.3 Method

Sample Description

The sample consisted of doctoral graduates in medicine and life sciences who graduated between April 2014 and April 2015 (second cohort of the E-Prom survey). The graduates were invited by their faculties to participate in the study. Due to a dropout of some faculties, the sample was smaller in comparison to Study 1.[32] All participants were informed of the goals of the study and signed an electronic informed consent. Participants who completed their doctorate before 2014 (N=89) were excluded: due to the relatively long time span between graduation and survey participation for those subjects, events after the dissertation would most probably have a higher relevance for SSE and academic career aspirations. For reasons of comparability, graduates from social sciences/humanities backgrounds (N=11) and graduates dental medicine were excluded. As in Study 1, the distribution of age was similar between respondents from both disciplines, with a mean age of 31.6 in life sciences and 32.4 in medicine. Due to the limited career options in academic research with increasing age, doctoral graduates with an age over 40 (N=10) were not considered.

The final sample contained 281 graduates from life sciences and 407 medical graduates. Both fields had, as expected, a higher percentage of females with 58 percent females in medicine and 55 percent in life sciences. In medicine, the number of female medical graduates seemed to correspond well to the overall gender distribution for medical doctoral graduates (Statistisches Bundesamt, 2015). Again, for the other life sciences, there were no statistics available to deduce the gender distribution's representativity, but comparing these distribution

[32] Participating universities were: Ludwigs-Maximilians-Universität München, Technische Universität München, RWTH Aachen, Ruhr-Universität Bochum, Ludwigs-Maximilians-Universität München, Technische Universität München, Friedrichs-Alexander-Universität Erlangen-Nürnberg, Universität zu Köln, Universität Witten-Herdecke; Universität Würzburg.

statistics to those of Hauss et al. (2015), which study career intentions of doctoral candidates in Germany, the current sample seemed to be a good reflection.

Consistent with the literature and results from Study 1, most life scientists (82 percent) were doing their doctorate within a position as research fellow; but only 5 percent of medical graduates. 26 percent of life scientists and 12 percent of medical graduates indicated having received a scholarship, while 10 percent of life scientists and 25 percent of medical graduates had positions as student research assistants. As in cohort 1 (Study 1, Chapter 8), the majority of medical graduates (65 percent) financially relied on parental support, while only 20 percent of life scientists were financially supported by parents or relatives. Since doctoral students sometimes use multiple sources of funding, for instance when scholarships or positions as research fellows are limited to a period of time within which one cannot finish the degree, those numbers exceed 100 percent.

Operationalization

All dependent and independent variables from Study 1 (Chapter 8) were relevant for the current study and were operationalized accordingly. Otherwise assessed variables are described in more detail hereafter. ***Causal attributions*** were measured the following way: first respondents were asked to choose the main causal factor that was, subjectively, most important in determining the respective success or unsuccessfulness of their doctorate. In addition to common causal factors from attribution theory, a selection of causal factors was derived from the most common answers to the qualitative study, which was conducted with recipients from Study 1 (see Chapter 10). Additionally, an open response option was given (see Appendix, 1.2).

After identifying a main causal factor, respondents were asked to rate that factor with respect to its dimensional properties. Starting with the items from the attributional style questionnaire for adults [Attributionsstilfragebogen für Erwachsene (ASF-E)] (Poppe, Pelster, & Stiensmeier-Pelster, 2005), a scale of causal dimensions was developed. The items from the attributional style questionnaire were reformulated to fit the doctoral/academic career context. Moreover, not the perceived stability of the causal factor, but rather the perceived stability of the factor's behavioral efficacy was assessed and items with respect to globality were added (see Figure 7). The final scale consisted of eight items (two items per dimension) assessed on 7-point semantic differentials. The introductory question to the items was posed in the following way: "Please evaluate the main cause you have chosen with respect to the following features. The cause is something…"

Figure 7: Causal Dimension Scale for Doctoral success[33]

Locus								
that reflects an aspect of the situation	1	2	3	4	5	6	7	that reflects an aspect of myself
totally due to other people or circumstances	1	2	3	4	5	6	7	totally due to me
Controllability:								
The cause is something…								
I **cannot** regulate	1	2	3	4	5	6	7	I can regulate
over which I have **no** power	1	2	3	4	5	6	7	over which I have power
Stability								
In the future when working in academic research, the cause will....								
not be important for my success in academic research	1	2	3	4	5	6	7	be important for my success in academic research
not influence my success in academic research	1	2	3	4	5	6	7	continue to influence my success in academic research
Globality								
The cause….								
influenced just the situation of the doctorate	1	2	3	4	5	6	7	influences all (performance)-situations in academic research
affected only my performance in the doctorate	1	2	3	4	5	6	7	affects my performance in academic research generally

[33] see Appendix, 1.2, for the German version

To assess the reliability of the scale, Cronbach's alpha was computed for each subscale. Results indicated a very good to excellent reliability for the successful doctorates (locus: 0.81; controllability: 0.79; stability: 0.90, globality: 0.82) and for the less successful doctorates (locus: 0.82; controllability: 0.89; stability: 0.82, globality: 0.83). Moreover, for the successful subsample, item means were relatively high, ranging from a minimum of 4.79 to a maximum of 5.65. Conversely, they were lower for the negative situations, ranging from a minimum of 2.57 to a maximum of 3.93 (see Table 8).

Table 8: Evaluation of Causal Dimensions, Subjectively Successful and Rather Unsuccessful Doctorates

	Successful		Rather Unsuccessful	
Variables	M	SD	M	SD
Stability	5.73	1.26	3.87	1.64
Controllability	5.46	1.31	2.71	1.34
Globality	4.87	1.38	2.59	1.13
Locus	5.21	1.57	3.62	1.98

Legend: Dimensional evaluation of chosen main causal factors within the samples of successful (N=273) and rather unsuccessful graduates (N=67), means (M) and standard deviations (SDs) rounded two the second decimal place.

These results are consistent with previous findings and demonstrate the tendency towards self-serving attributions. The scale characteristics were furthermore similar to the ASF-E scale (Poppe, Stiensmeister-Pelster, & Pelster, 2005), which likewise shows a tendency to self-serving attributions. To make sure that there was enough variance between the subjects and among the causal factors, the dimensional assessment of causal factors was compared between causes one would assume to be higher- and lower-rated on all dimensions. For instance, the causal factor of ability was expected to be rated higher on the locus, stability, globality and controllability dimensions than the factor of good supervision. As expected, people who chose ability[34] as the main factor for their doctoral success rated stability, globality, locus and controllability significantly higher in comparison to those who chose good supervision as the main causal factor for their success (see Table 9). Whereas supervision can be seen as a factor that is not at all internal or controllable and the rating of this factor on these dimensions might seem too high despite its contrast to ability, it is very probable that, although respondents had to choose one main causal factor, they also had other

[34] These were respondents who chose either "my own competences, abilities" or "I have a talent for scientific work" as their main reason.

factors in mind. This was also apparent from the open answers, which always incorporated several causal factors or stated that all of the mentioned aspects were important.

Table 9: Dimensional Evaluation of Main Causal Factor, Subjectively Successful Doctorates

	Supervision		Ability		
Variables	M	SD	M	SD	p
Stability	4.93	1.46	6.26	0.78	0.001
Controllability	4.78	1.33	5.72	1.24	0.001
Globality	4.55	1.58	5.86	1.05	0.001
Locus	3.85	1.12	5.50	1.05	0.002

Legend: Dimensional evaluation of doctoral graduates who either chose ability (N=50) or supervision (N=62) as main causal factor. Means (M) and standard deviations (SDs) rounded to the second, p-values to the third decimal place (p-values refer to two tailed t-tests. Ability: "my own competences, abilities" or "I have a talent for scientific work"

Regarding the distinctiveness between causal dimensions, these moderately correlated with each other in the successful sample, the highest correlations arising between locus and controllability (0.57) and controllability and stability (0.54). In the unsuccessful sample, correlations were similar, though controllability and locus had a higher correlation of 0.66.

To assess the dimensionality of the scale, separate ***confirmatory factor analyses*** (CFAs) were run for both subsamples of subjectively successful and unsuccessful graduates. Because CFA may not be suitable for assessing a scale's validity in the early stages of scale development (Byrne, 2006) and the current instrument was newly developed with no former pretesting, the CFA is rather used as a tool to evaluate the general usability of the scale. Moreover, the results can give a first impression about the scale's dimensionality. Since the results should not be dependent on respondents' characteristics, the samples were not restricted to age and year of the doctorate. Three alternative models were tested against each other. The first of these assumed a one-dimensional structure, while the second assumed two dimensions—one for controllability, locus and stability and the other for globality (assuming that the former would reflect the stability of behavioral efficacy and the latter generalizability to other situations). The third and final model assumed a four dimensions structure, as originally proposed. Missing values were estimated via full information maximum likelihood (FIML).

For the sample of rather unsuccessful doctorates, the fit indices and the insignificant chi-square test indicated an adequate fit for the assumed four-factor model (see Table 10). Whereas in small sample sizes power might be too small to detect a misfit, the alternative models with one and two factors yielded significant chi-square tests. In accordance, fit indices

in the alternative models pointed to a bad model fit (Hu & Bentler, 1995). Thus, the confirmatory factor analyses with the subjectively rather unsuccessful doctorates was supportive of a four dimensional construct.

Table 10: Confirmatory Factor Analyses Attributional Dimension, Subjectively (rather) Unsuccessful Doctorates

	M1 (1 Factor)		M2 (2 Factors)		M3 (4 Factors)	
Item	ß	p	ß	p	ß	p
Locus 1	0.82	0.000	0.82	0.000	0.93	0.000
Locus 2	0.68	0.000	0.67	0.000	0.74	0.000
Controllability 1	0.88	0.000	0.88	0.000	0.88	0.000
Controllability 2	0.93	0.000	0.94	0.000	0.96	0.000
Stability 1	0.30	0.016	0.29	0.000	0.88	0.000
Stability 2	0.21	0.110	0.20	0.000	0.84	0.000
Globality 1	0.26	0.003	0.88	0.000	0.97	0.000
Globality 2	0.20	0.108	0.84	0.000	0.77	0.000
N	87			87		87
Model Fit						
Chi^2 <	0.001			0.001		0.380
RMSEA	0.293			0.169		0.028
CFI	0.604			0.761		0.997
TLI	0.445			0.647		0.995

Legend: SRMR not reported because of missing values, standardized coefficients rounded to the second, p-values rounded to the third decimal place.

Within the larger sample of subjectively successful doctorates the one- and two-dimensional models were both showing unsatisfactory fits, according to all evaluation criteria: the fit indices were inadequate and the chi-square value significant. Moreover, factor loadings were low for the both the globality items and the second locus item.

The four-dimensional construct was yielding a better model fit according to fit indices and factor loadings. However, the significant chi-square test and the RMSEA value [which should not be greater than 0.08, according to Hu and Bentler (1995)] both indicated that the model was not performing optimally. Since it was previously hypothesized that locus, globality and controllability would probably also partly capture perceived stability, a model with stability as second order factor/dimension was considered. This model, however, was an even worse fit for both subsamples of subjectively successful and rather unsuccessful doctorates.

Whereas the result of the CFA with the successful sample might indicate that four dimensions may not be optimal in explaining the observed data patterns, it has to be acknowledged that the scale was newly developed and may be improved with respect to formulations and the amount of items. Moreover, the four-factor structure showed the best fit when compared to the alternative models. Thus, in the subsequent analyses, in which attributions were of relevance, the four factors were included separately as independent variables. Future studies, however, should analyze the structure of causal dimensions more deeply.

Table 11: Confirmatory Factor Analyses Attributional Dimension, Subjectively Successful Doctorates

	M1 (1 Factor)		M2 (2 Factors)		M3 (4 Factors)	
Item	ß	p	ß	p	ß	p
Locus 1	0.61	0.001	0.62	0.001	0.86	0.001
Locus 2	0.51	0.001	0.50	0.001	0.84	0.001
Controllability 1	0.66	0.001	0.65	0.001	0.77	0.001
Controllability 2	0.79	0.001	0.81	0.001	0.83	0.001
Stability 1	0.91	0.001	0.93	0.001	0.88	0.001
Stability 2	0.88	0.001	0.88	0.001	0.93	0.001
Globality 1	0.42	0.001	0.88	0.001	0.80	0.001
Globality 2	0.49	0.001	0.81	0.001	0.93	0.001
N	337			337		337
Model Fit						
Chi^2 <	0.001			0.001		0.001
RMSEA	0.265			0.169		0.119
CFI	0.719			0.856		0.950
TLI	0.509			0.731		0.901

Legend: SRMR not reported because of missing values, standardized coefficients (ß) rounded to the second, p-values rounded to the third decimal place

The reliability of the scale assessing ***academic career aspirations*** was, as in Study 1, considered to be good (Cronbach's alpha=0.91). The same applied to the scales assessing *scientific self-efficacy* (Cronbach's alpha=0.92) and *intrinsic research motivation* before the doctorate (Cronbach's alpha=0.08). As in Study 1, a one-dimensional structure for SSE and intrinsic research motivation could be supported by the eigenvalue greater than one criterion, a Scree-plot and a MAP-test (see Appendix, 3.1).

In contrast to Study 1, the current study distinguished ***publications*** that have been peer reviewed or not. Due to a higher importance of peer-reviewed publications, these were chosen as control variables.

In consequence of a technical problem within the survey, very few respondents received the question about their first occupation after the doctorate. While respondents were subsequently asked to participate in a short survey about their first employment, the variable still had a high amount of missing values (over 30 percent). Because of this high missingness and the possibility of the data being MNAR (Allison, 2001; McKnight et al., 2007)—as for instance, there might have been a higher motivation to respond to the second survey for people who stayed in academic research after the doctorate—missing values were not imputed.

Translation. As in Study 1, the survey was professionally translated to English. It must be noted, though, that scales were not translated back into German. Since the number of graduates who responded in English was very low (10.6 percent, N=36), these were not excluded from the analyses. Moreover, excluding the English respondents from the formerly-conducted structural equation models did not yield different results. All analyses were conducted with the statistical package Stata, version 12.

9.4 Results

9.4.1 Descriptive and Exploratory Results

Performance Measures

As in Study 1, a brief overview of the outcomes of the doctorate by field and gender are given here. With respect to the *grade distribution*, as in Study 1, most graduates in medicine and life sciences received a magna cum laude (71 percent in the life sciences and 49 percent in medicine). In contrast to the first cohort, much more medical graduates than life scientists received a grade of cum laude or worse (42 percent vs. 11 percent). Additionally, more life scientists received a *summa cum laude* (19 percent vs. 8 percent). It has to be noted, though, that the sample composition with respect to fields of study differed from the first study: whereas in Study 1, the majority of respondents had a medical background (59 percent), only 40 percent of the present sample were physicians. This was also a result of a dropout of some universities who participated in the first survey but not in the current. Since universities could differ in their evaluation practices, the discrepancies between Study 1 and 2 could result from their dropout.

With respect gender, females had, consistently with Study 1, lower grades in both fields: in medicine, 15 percent of females versus 28 percent of males received a *summa cum laude*, while 12 percent of females and 9 percent of males attained a grade of *cum laude* or worse. In the life sciences eight percent of females and males received a *summa cum laude*, but more females received a grade of cum laude and worse (47 percent vs. 36 percent).

Moving on to *first author publications* it was apparent that life scientists published more during their doctorate than medical graduates. 83 percent of medical graduates had not published an article as first author, but only 34 percent of life scientists. In accordance with Study 1, slightly more females did not publish a first author article in the life sciences (37 percent vs. 31 percent), while a more distinct gender gap was visible in medicine (87 percent vs. 78 percent). Also with respect to *co-authorships* distinctly more medical graduates in comparison to the life scientists had not published as a co-author (77 percent vs. 31 percent). Again, a higher amount of female graduates had no co-authorship, both in life sciences (36 percent vs. 24 percent) and medicine (77 percent vs. 43 percent).

In summary, it can be said that consistently with Study 1, medical graduates published less than life scientists. As in Study 1, female graduates in both fields had fewer publications—with considerably higher differences in medicine—and had slightly lower grades. In opposition to the findings from Study 1, medical graduates in comparison to the life scientists had received lower grades, and not higher ones. Yet, as noted above, the different composition of the samples has to be considered. Therefore, no conclusions can be made about the evaluation practices in those fields at that point.

Intrinsic Research Motivation for the Doctorate

To analyze whether there were significant group differences with respect to intrinsic research motivation before the doctorate, a multivariate regression analyses was carried out (see Table 12). As in Study 1, male and female medical doctoral graduates reported significantly lower intrinsic research interest in comparison to life scientists. Also in accordance with Study 1, there were no significant gender differences with respect to intrinsic motivation.

Table 12: Multivariate Linear Regression Analysis. Dependent Variable: Intrinsic Research Interest Before the Doctorate

Variables	B	SE	p
(Reference category: male life sciences*)*	-0.93	0.13	0.001
Male medicine			
Female medicine	-0.95	0.12	0.001
Female life sciences	0.06	0.10	0.564
Constant	4.04	0.07	0.001
N	327		
Prob > F	0.001		
Adj. R^2	0.25		

Legend: Standard errors (SEs) and coefficients rounded to the second, p-values to the third decimal place.

Subjective Success of the Doctorate

Yet again, the subjective success of the doctorate was the defining variable between a successful and rather not successful doctorate and determined whether attributions to failure or success were subsequently measured in the survey. Therefore, it was assessed which specific characteristics of the doctorate were related to the personal perception of success. For this purpose, as in the previous chapter, a logistic regression analysis was carried out with a dependent binary variable (success vs. failure). Consistent with the previous results, male and female medical graduates were more likely to be in the group of subjectively successful doctorates. Moreover, the number of published first-author articles was significantly related to the personal success perception. Articles published as co-author had no effect. Since the grade *summa cum laude* perfectly predicted success, it was omitted from the regression analysis. Graduates who received the grade *magna cum laude* were significantly more likely to be subjectively successful in comparison to graduates with a grade of *cum laude* or worse. Lastly, the duration of the doctorate was negatively and significantly related to its subjective success.

While the results of Study 1 suggested that medical and life science graduates may differ with respect to their success criteria, a separate analysis was not conducted due to the lower sample size in Cohort 2.

Table 13: Logistic Regression, Dependent Variable: Subjective Success of the Doctorate

Variables	B	SE	p
Male medicine*	2.54	0.79	0.001
Female medicine*	1.27	0.65	0.049
Female life sciences*	-0.02	0.42	0.955
Grade: *summa cum laude***		*omitted*	
Grade: *magna cum laude***	0.98	0.38	0.010
Articles as 1st author	0.80	0.25	0.001
Articles as co-author	0.06	0.10	0.520
Conference attendances	-0.07	0.06	0.211
Research motivation	0.29	0.25	0.248
Duration of doctorate	-0.02	0.01	0.011
Age	-0.01	0.07	0.892
Constant	1.42	2.21	0.520
N	251		
Prob > F	0.001		
Pseudo R^2	0.17		

Legend: *Reference category male life sciences, **reference category *cum laude* and worse. Standard errors (SEs) and coefficients rounded to the second, p-values to the third decimal place.

Group Differences in Causal Attributions

Whereas no group differences in attributional patterns were hypothesized, potential differences were explored in the following section. For this purpose, multivariate regression analyses were carried out, analyzing the relations of group variables (gender and field of study) to each dimension, separately for subjectively successful and rather unsuccessful doctorates.

Causal Attributions to Success (see Table 14). In the successful sample, male medical graduates evaluated the main factor that led to their success as significantly less controllable, stable, global, and internal when compared to male life scientists. Interestingly, female graduates in life science and medicine only had lower ratings on the locus dimension. While it is plausible that medical students attribute their doctoral outcome to less stable, controllable, global and internal factors—since they probably have to rely more on supervision—it is surprising that these differences were only found for the male medical subgroup and not the females, especially since the research literature points to less self-serving attributions by

females. However, one has to keep in mind that male medical graduates, under control of objective success criteria, had a higher chance of perceiving their doctorate as a success. The differences in causal attributions might, therefore, constitute a relativization of this assessment.

Table 14: Group Differences in Causal Attributions, Subjectively Successful Doctorates

	Stability			Controllability			Locus			Globality		
Variables	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Male medicine*	-0.56	0.26	0.034	-0.79	0.25	0.004	-0.93	0.26	0.001	-0.68	0.32	0.033
Female medicine*	-0.11	0.25	0.668	-0.16	0.24	0.517	-1.10	0.26	0.001	-0.07	0.31	0.813
Female life sciences*	0.03	0.20	0.893	-0.28	0.20	0.216	-0.38	0.21	0.068	0.01	0.25	0.955
Constant	5.84	0.15	0.001	5.69	0.15	0.001	5.33	0.15	0.001	5.35	0.18	0.001
N	234			257			247			236		
Adj. R^2	0.01			0.02			0.07			0.03		
P>F	0.155			0.003			0.001			0.006		

Legend: *Reference category male life scientists. Standard errors (SEs) and coefficients rounded to the second, p-values to the third decimal place.

Causal Attributions to Failure (see Table 15). Within the subjectively rather unsuccessful sample, there were no group differences with respect to the evaluation of the dimensional properties of causal factors, neither for gender nor for fields of study. All in all it can be noted that the results do not point to less self-serving attributional patterns by women. Within the successful sample, male medical graduates seem to be less self-serving in their attributions; however, they are more likely to perceive their doctorate as a success under control of objective performance criteria.

Table 15: Group Differences in Causal Attributions, Subjectively Rather Unsuccessful Doctorates

	Stability			Controllability			Locus			Globality		
Variables	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Male medicine*	0.66	0.91	0.472	0.39	0.74	0.60	-0.31	0.58	0.600	-1.1	1.01	0.294
Female medicine*	-0.30	0.68	0.656	0.56	0.50	0.27	0.09	0.44	0.834	0.17	0.77	0.830
Female life sciences*	0.81	0.53	0.527	0.66	0.41	0.11	0.43	0.36	0.238	0.47	0.62	0.450
Constant	3.47	0.41	0.001	2.36	0.32	0.00	2.41	0.28	0.001	3.47	0.48	0.001
N	52			62			59			59		
Adj. R^2	0.02			0.00			0.00			0.00		
P>F	0.250			0.439			0.45			0.45		

Legend: *Reference category male life scientists. Standard errors (SEs) and coefficients rounded to the second, p-values to the third decimal place.

Construct Validity of Scientific Self-Efficacy: What about Other Career Aspirations?

As in Study 1 (Chapter 8), it was analyzed whether SSE was related to career aspirations other than those in academia. As already noted there, it might be possible that expressed levels of SSE are the result of an underlying trait, which influences aspirational levels in general. Whereas Study 1 supported the context specificity of SSE, the analyses were repeated here. Regression analyses were carried out with SSE and several career aspirations as dependent variables: academic career aspirations, non-academic career aspirations and aspiring to a career in industrial research. Again, aspiring to a career that focuses on patient care was analyzed for the medical group. To see whether SSE would impact medical and life sciences graduate's differently in their career intentions, the analyses were conducted separately for medicine and life sciences,

As in Study 1, a significant relationship between SSE and academic career aspirations was apparent for both fields of study, supporting ***hypothesis 1*** (Appendix, Table 41). With respect to pursuing a career in industrial research, there was no relationship between SSE and aspirations for life scientists, but a significant and positive relationship for medical graduates (Appendix, Table 43). This result is in accordance with Study 1 and reinforces the idea that life scientists may have more differentiated views of academic and industrial research. Furthermore, there was no relationship between SSE and general career aspirations outside of academia (Appendix, Table 42). As noted earlier in Study 1, the absence of a negative relationship may depict the difficult career prospects in academia. As in Study 1, the expressed aspirations to pursue a career outside academia were considerably higher (*M*=3.64,

SD=1.13) than those to pursue an academic career (*M*=2.15, *SD*=1.33). Thus, despite aspiring to an academic career, respondents might not simultaneously exclude other career paths.

For medical graduates, there was no relationship between SSE and aspiring to a career with patient contact (Appendix, Table 44). Moreover, for physicians, a career including patient care was the career item with the highest approval (*M*=4.50, *SD*=0.98). As discussed in Study 1, physician-scientists do often pursue both research and patient care. Therefore, research and patient care do not exclude one another, but are often both required when working at a university hospital. The results support that SSE is context specific. For physicians, SSE may be related more generally to research careers, including industrial research, which again points to the observation that life scientists seem to have more differentiated views of academic and industrial research.

9.4.2 Hypotheses Testing

Group Differences in Scientific Self-Efficacy Beliefs

In this section, the results with respect to gender differences and differences between fields of study with respect to scientific self-efficacy are presented. The results are portrayed in Table 16. The abbreviations M1, M2, etc., designate different statistical models.

Differences between Fields of Study (see Table 16, M1 and M2). A stepwise multivariate regression analysis was carried out to investigate gender and field of study differences with respect to self-efficacy. The results are illustrated in Table 16. Within the analysis it appeared that, without controlling for performance, male and female medical graduates, as well as female life scientists had significantly lower scientific self-efficacy in comparison to male life scientists (cf. Table 16, M1). Lower self-efficacy beliefs for male and female medical graduates persisted under control of grade, published articles and conference attendance, whereas gender differences in the life sciences were no longer significant.

These results are in accordance with those of Study 1 and support ***hypothesis 6b***, which postulates lower SSE for medical graduates. Furthermore, the performance indicators grade, first author articles and conference attendances were positively and significantly related to scientific self-efficacy beliefs.

Gender Differences in Medicine (see Table 16, M2b). To test the hypothesis that female medical graduates have lower self-efficacy beliefs in comparison to male medical graduates

(hypothesis 7b), a multivariate regression analysis was carried out for the subgroup of medical graduates. Whereas on a bivariate level, a two-sided t-test indicated lower female medical graduates lower self-efficacy for female medical graduates (*M*=2.66, *SD*=1.0. vs. *M*=2.28; p=0.063), no differences were apparent when controlling for performance indicators. The result differed from Study 1, in which gender differences in SSE remained significant. It also leads to the rejection of ***hypothesis 7b.***

The insignificant effect of gender among the medical graduates in this sample could, however, be due to the lower sample size. A power analysis revealed a minimum sample size of 89 to detect a medium effect size significant at the 5 percent level and a minimum sample size of 532 to detect a small significant effect (Faul, Erdfelder, Buchner, & Lang, 2009; Faul, Erdfelder, Lang, & Buchner, 2007). When analyzing both cohorts together, results were consistent with Study 1: they showed significantly lower self-efficacy for female medical graduates and no differences in the life sciences (cf. Appendix, Table 45).

Table 16: Stepwise Multivariate Linear Regression: Gender and Field of Study Differences in Scientific Self-Efficacy

	M1 Differences between Fields of Study			**M2** Differences between Fields of Study			**M2b** Gender Differences in Medicine		
Variables	B	SE	p	B	SE	p	B	SE	p
Male medicine*	-0.98	0.15	0.000	-0.59	0.17	0.001			
Female medicine*	-1.35	0.15	0.000	-0.68	0.18	0.000	-0.02	0.23	0.941
Female life sciences*	-0.21	0.12	0.051	-0.00	0.12	0.995			
Grade: *summa cum laude***				0.61	0.18	0.001	0.26	0.72	0.719
Grade: *magna cum laude***				0.23	0.12	0.065	0.27	0.26	0.294
Articles as 1st author				0.11	0.04	0.001	0.21	0.23	0.376
Articles as co-author				0.01	0.02	0.598	-0.08	0.11	0.500
Conference attendances				0.02	0.02	0.142	0.23	0.26	0.059
Experimental dissertation (only medicine)							-0.04	0.12	0.844
Constant	3.63	0.09	0.000	2.96	0.15	0.000	2.14	0.22	0.000
N	314			275			75		
P>F	0.001			0.001			0.001		
Adj. R^2	0.25			0.32			0.13		

Legend: *Reference category male life sciences, **reference category *cum laude* and worse. Standard errors (SEs) and coefficients rounded to the second, p-values to the third decimal place.

Group Differences in Academic Career Aspirations

In the next step, it was tested whether there were gender differences and differences between fields of study with respect to the intention to pursue an academic research career. The results are depicted in Tables 17 and 18.

Differences between Fields of Study (see Table 17, M1 and M2). A multivariate linear regression analysis showed significantly lower academic career aspirations for male and female medical graduates in comparison to life science graduates (M1). After controlling for scientific self-efficacy beliefs, the group differences in academic career aspirations became insignificant (M2). The results support ***hypothesis 6a***, which states that medical graduates have lower academic career aspirations and ***hypothesis 6c,*** which expects no differences in academic career aspirations under control of scientific self-efficacy beliefs. The results are also in accordance with those of Study 1. The replication of these results with the combined samples of Study 1 and 2 are found in the attachment (see Appendix, 4.).

Table 17: Stepwise Multivariate Regression Analysis with Academic Career Aspirations as Dependent Variable, Differences between Fields of Study

	M1			M2		
Variables	B	SE	p	B	SE	p
SSE				0.74	0.08	0.001
(Reference category: male life sciences)						
Male medicine	-0.48	0.24	0.043	0.23	0.23	0.323
Female medicine	-0.92	0.22	0.001	-0.01	0.23	0.951
Female life sciences	-0.27	0.18	0.127	-0.09	0.16	0.588
Constant	2.56	0.13	0.001	2.15	0.13	0.001
N	322			302		
P>F	0.001			0.001		
Adj. R^2	0.04			0.25		

Legend: SSE=scientific self-efficacy. Standard errors (SEs) and coefficients rounded to the second, p-values rounded to the third decimal place.

Gender Differences in Medicine (see Table 18). In order to test for ***hypothesis 7a***, which states that female medical graduates have lower academic career aspirations than male medical graduates, and ***hypothesis 7c,*** which states respectively that these differences will not be significant after including scientific self-efficacy, a further analysis was carried out for medical graduates only. The results depicted in Table 18 show that female medical graduates stated lower academic career aspirations than male medical graduates. This difference was, however, marginally significant. Moreover, the difference turned insignificant after

introducing SSE into the analysis (M2), which previous analyses suggest to be a result of differences in performance during the doctorate.

Table 18: Stepwise Multivariate Regression Analysis: Gender Differences in Academic Career Aspirations within Medical Graduates

	M1			M2		
Variables	B	SE	p	B	SE	p
SSE				0.64	0.11	0.000
(Reference category: male)						
Female	-0.44	0.22	0.051	-0.27	0.20	0.176
Constant	2.08	0.16	0.000	2.35	0.12	0.000
N	99			94		
P>F	0.001			0.001		
Adj. R^2	0.05			0.29		

Legend: SSE=scientific self-efficacy. Standard errors (SEs) and coefficients rounded to the second, p-values rounded to the third decimal place.

Interim Discussion of Exploratory Results and Group Differences

Differences between Fields of Study. Before proceeding to the next analyses regarding relationships between attributions, SSE and academic self-efficacy, the exploratory results and group differences shall be briefly summarized and discussed by also referring to the results of Study 1 (Chapter 8). As previously found for the first cohort of medical and life science graduates, medical graduates were significantly less motivated by intrinsic research interest to attain their doctorate. Medical graduates also expressed lower scientific self-efficacy beliefs in comparison to life science graduates in both cohorts, even under control of grades and published articles. As medical doctoral graduates conduct their doctorate within the regular curriculum, and therefore have little or no previous research experience and expertise, the results are consistent with the expectations implied by the current literature. While there were no perceived differences in attributional patterns in Study 1, which measured causal factors, in Study 2, the male medical graduates appeared to attribute their doctoral success to less stable, global, controllable and internal factors. As already discussed, medical graduates were also more likely to perceive their doctorate as successful, even when controlling for performance measures. Therefore, male medical graduates might just have relativized their judgment by expressing attributions that are less self-serving.

Furthermore, in accordance with the research literature and the results of Study 1, medical graduates had lower academic career aspirations than life science graduates; though, when controlling for scientific self-efficacy, academic career aspirations were even higher among

medical graduates. This could mean that medical graduates with the same levels of SSE were especially motivated to attain research skills before the doctorate. However, it might be also the case that those who had a positive work environment that allowed them to learn and, hence, develop higher levels of SSE, would also be more open minded about a research career. Whether the relationship between SSE and academic career aspirations is causal, and if and to what extent it may be a result of another unobserved variable, cannot be assessed here.

Gender Differences. In accordance with Study 1, there were no significant gender differences with scientific self-efficacy when controlling for performance. There were further no gender differences in academic career aspirations. In contrast to Study 1 gender differences within the field of medicine seemed to have resulted from actual differences in performance, and were not significant when controlling for performance.

Moreover, female medical graduates had lower academic career aspirations than male medical graduates. Again, this difference was no longer significant when controlling for SSE. As already extensively discussed, the results of Study 1 might have occurred due to unobserved heterogeneity. However, the lower sample size and power of the current study must be taken into account as well. When analyzing both samples together, the results were consistent with those of Study 1 (Appendix, Table 45).

Path Models—Attributions, Scientific Self-Efficacy and Academic Career Aspirations

In order to test the hypothesized relationships between attributions, self-efficacy and academic career aspirations, multivariate path models were conducted separately for subjectively successful and unsuccessful doctorates, with scientific self-efficacy as the mediator variable and academic career aspirations as the dependent variable.

Item Nonresponse/Missing Values

Due to the sample splitting in subjectively successful and unsuccessful doctorates the sample size was considerably reduced for the path models. Analogous to Study 1, the path models were therefore run with complete cases and multiply imputed data. The analyses of missing values suggested no significant differences between the subsamples with missing values and the subsamples without missing values.

As in Study 1, two imputation methods were used—FIML (full information likelihood estimation) and MICE (multiple imputations with chained equations) (Chapter 8). Whereas

FIML is implemented for path models/structural equation modeling (SEM) in Stata, version 12, it can lead to biased results for non-continuous and non-normal data (as is the case here). MICE is considered to be a better imputation method for non-continuous and non-normal data, although it is not implemented for SEM in the statistical package used here. The multiply imputed data with MICE were, therefore, analyzed with three regression analyses, resulting in a limited possibility to test for indirect effects (Rucker et al., 2011). Due to low missingness (lower than ten percent on each variable), a number of ten imputations were chosen. Because problems with perfect prediction occurred with a specification of ordinal logistic regression, predictive mean matching was specified for ordinal variables (Vink et al., 2014). As recommended, the dependent variables, SSE and academic career aspirations were used in the imputation models, but not in the estimation model (Young & Johnson, 2010).

Path Model—Successful Doctorates

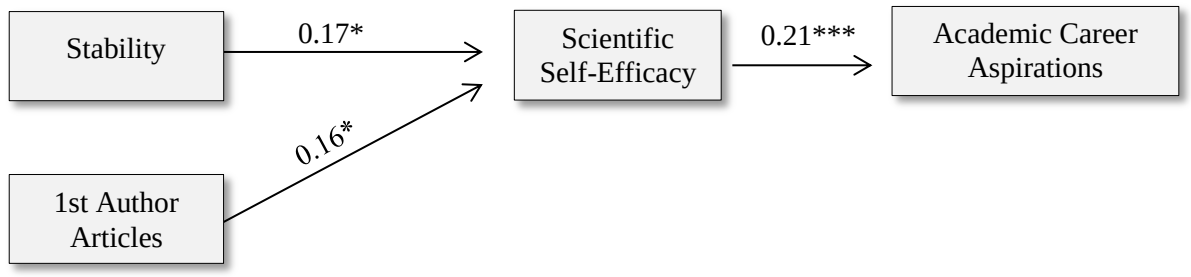
In order to test the hypothesized relationships between attributions to success, scientific self-efficacy and academic career aspirations, a multivariate path model was conducted with scientific self-efficacy as a mediator variable and academic career aspirations as the dependent variable. The path models were conducted with complete case analyses and multiply imputed values, using FIML and MICE. Since the path models were just identified and all possible paths were estimated, no overall fit indices can be calculated (Thomas & Mathieu, 1994). Analogous to Study 1, effects of the psychological constructs (attributions, self-efficacy, intrinsic motivation) were interpreted as significant if in at least two of the three estimation methods a p-value not greater than 0.10 was attained. For the other sociodemographic measures, effects were interpreted as significant if at least two of the three applied methods indicated p-values not greater than 0.05.

In the first computation of the model, an unexpected result appeared. While stability was, as expected, positively and significantly related to SSE, globality was—unexpectedly—significantly and negatively related to SSE. These opposed effects occurred, although, both measures were positively correlated to each other. Since such results can indicate problems with multicollinearity, variance inflation factors and a correlation matrix of the estimated coefficients were computed. The negative correlation of the stability, controllability and globality coefficients, despite a positive correlation between those variables, indicated problems with multicollinearity. Therefore controllability and globality were omitted from the analyses. As a consequence, ***hypothesis 2b***, which proposes there would be no significant effect for the other dimensions after controlling for perceived stability, could not be tested.

The results of the analyses with complete cases and imputed data were very similar, specifically with respect to the central variables of attributions and self-efficacy. Therefore, results of the complete case analysis are depicted here (Table 19). The tables of the results which were obtained with imputed data are found in the appendix (Appendix, 3.3).

Table 19 shows the results from multivariate path analysis with direct effects on scientific self-efficacy (M1), direct effects on academic career aspirations (M2) and indirect effects on academic career aspirations (M3). Additionally, the results with respect to the main variables—attributions, performance indicators, self-efficacy, and academic career aspirations—are illustrated in Figure 8.

Figure 8: Path Model, Attribution to Success



Legend: Selected results from Table 19 are illustrated. +p<0.10; *p<0.05; **p<0.01; ***p<0.001

Effects on Scientific Self-Efficacy (see Table 19, M1). Within all analyses (complete case, FIML, MICE), the stability dimension was positively and significantly related to SSE, supporting ***hypothesis 2a***. No effect of locus was found here. With respect to performance outcomes, the number of first-author published articles was significantly and positively associated with SSE. As in previous analyses, a higher intrinsic research motivation to attain a doctorate was also positively and significantly related to SSE.

Furthermore, male and female medical graduates had lower levels of SSE. These effects were marginally significant (p<0.10) in the complete case analyses, and moreover significant within the FIML path model and MICE regression (p<0.05) (Appendix, 3.2). Since attributions were controlled in these models, previously found differences in attributional patterns by male medical graduates were no potential explanations for their lower self-efficacy beliefs. The grade of the doctorate was not related to scientific self-efficacy.

With respect to the magnitude of effects, it was notable that intrinsic motivation, as in Study 1, had the strongest association to SSE. Except for differences between fields of study, the attribution to a stable factor and first author articles were the next strongest variables.

Table 19: Path Model with Academic Career Aspirations (ACAs) as Dependent Variable and Scientific Self-Efficacy as Mediator Variable, Subjectively Successful Doctorates

	M1 Direct Effects on SSE			**M2** Direct Effects on ACAs			**M3** Indirect Effects on ACAs		
Variables	ß	SE	p	ß	SE	p	ß	SE	p
SSE				0.21	0.08	0.007			
Stability	0.17	0.06	0.010	-0.05	0.07	0.516	0.04	0.02	0.066
Locus	-0.03	0.07	0.664	-0.03	0.07	0.634	-0.01	0.01	0.668
Age	0.05	0.07	0.475	-0.07	0.08	0.380	0.01	0.01	0.490
Female life sciences	0.02	0.07	0.756	0.07	0.08	0.353	0.00	0.04	0.758
Female medicine	-0.22	0.09	0.018	0.09	0.10	0.394	-0.05	0.10	0.080
Male medicine	-0.19	0.09	0.038	0.19	0.10	0.047	-0.04	0.09	0.104
Duration of doctorate	-0.03	0.07	0.695	-0.04	0.07	0.586	-0.01	0.00	0.698
Articles 1st author	0.16	0.08	0.038	0.12	0.08	0.153	0.03	0.01	0.104
Articles co-author	0.02	0.07	0.805	0.12	0.08	0.119	0.00	0.01	0.806
Grade: *summa cum laude***	0.05	0.10	0.601	0.06	0.11	0.580	0.01	0.07	0.608
Grade: *magna cum laude***	-0.03	0.10	0.794	-0.07	0.11	0.484	-0.01	0.06	0.795
No grade**	0.06	0.07	0.396	-0.04	0.07	0.588	0.01	0.11	0.419
Conference attendances	0.09	0.08	0.241	0.05	0.08	0.557	0.02	0.01	0.285
Children	0.06	0.07	0.323	0.16	0.07	0.020	0.01	0.03	0.355
Doctorate as research associate	-0.07	0.09	0.436	0.01	0.10	0.953	-0.02	0.06	0.455
Intrinsic motivation	0.25	0.07	0.000	0.29	0.08	0.000	0.05	0.04	0.035
Constant	-0.84	0.97	0.384	2.54	1.03	0.013			
N	171								
R^2	0.39			0.32					
Overall R^2	0.51								

Legend: *Reference category: male life scientists, **reference category *cum laude* and worse. Standard errors (SEs) and standardized coefficients (ß) rounded to the second, p-values rounded to the third decimal place.

Direct and Indirect Effects on Academic Career Aspirations (see Table 19, M2 and M3). In support of ***hypothesis 1*** and consistent with previous results, scientific self-efficacy beliefs were strongly related to the intention to pursue an academic career long-term (M2). In support of ***hypothesis 3,*** the stability dimension was indirectly and positively related to academic career aspirations via self-efficacy beliefs. The indirect effect was significant at the 10 percent level within the complete case analysis and the FIML path model. However, the effect was rather small when compared with other effects. Likewise was the indirect effect of first author articles on academic career aspirations.

Under control of SSE, a higher intrinsic motivation was associated with higher academic career aspirations, as were number of children and being a male medical graduate (significant under complete case analysis, MICE and FIML). The effect of children was here in opposition to their effects in Study 1, where children had a negative effect on SSE and academic career aspirations. In the models with imputed data, the grade *summa cum laude* and the number of co-authored articles were positively and directly associated with academic career aspirations.

Interim Conclusion—Successful Doctorates

Controlling for objective performance measures, sociodemographic variables and intrinsic research motivation, attributing success to causal factors that were perceived as stable in their influence on success in academic research was positively associated with scientific self-efficacy beliefs, which were, furthermore, positively related to academic career aspirations. It seemed that publications as first author and attributing doctoral success to a stable cause equally contributed to respondents scientific self-efficacy beliefs.

By their relation to SSE, perceived stability and performance in the form of first author articles were indirectly associated to academic career aspirations. Yet, these indirect effects—both of stability and first author articles—were rather small. In accordance with Study 1, the strongest associations were found between intrinsic motivation, SSE and academic career aspirations.

Whereas male medical graduates attributed their doctoral success to less stable, internal, global and controllable factors (see Chapter 9.4.1), their lower SSE remained significant when controlling for attributions. Hence, lower scientific self-efficacy beliefs in medical graduates are probably a result of previous research experience, prior to the doctorate, which might have additionally influenced qualitative aspects of the doctorate: not only the observed differences (publications as first and co-author), but also unobserved differences, such as the quality of journals, the difficulty level of the doctorate or work autonomy.

These conflicting results with respect to children, which were positively related to academic career aspirations in the current study but negatively in Study 1, may be explained by additional information, such as children's ages, which were missing here (Hunter & Leahey, 2010).

Path Model—(Rather) Unsuccessful Doctorate

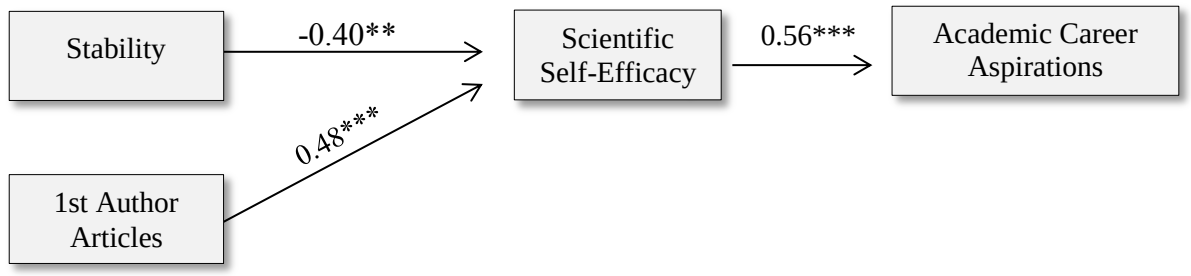
In the next section the postulated relationships between attributions to failure, SSE and academic career aspirations were tested with multivariate path models. It must be noted, that very few respondents indicated their doctorate not being successful (N=65), and of those, most indicated that their doctorate was only partly successful (N=38). Moreover, the majority of this subsample consisted of life scientists (N=47).[35] As in the sample with subjectively successful doctorates, analyses were carried out with complete case analysis, FIML and MICE.

Again, the results with all three methods were very similar. Therefore, the results of the complete case analysis are portrayed here (cf. Table 20), referring as well to the results of the analyses with imputed data (cf. Appendix, 3.2). As in the subsample of subjectively successful graduates controllability and globality were excluded from the analyses due to multicollinearity.

Table 20 shows the results from multivariate path analysis with direct effects on scientific self-efficacy (M1), direct effects on academic career aspirations (M2) and indirect effects on academic career aspirations (M3). Additionally, the results with respect to the main variables—attributions, performance indicators, self-efficacy, and academic career aspirations—are illustrated in Figure 9.

[35] Note that in models with imputed data, missing values on dependent variables are not imputed, therefore N does not correspond to the number of respondents who indicated their doctorate was (rather) not successful.

Figure 9: Path Model, Attributions to Failure



Legend: Selected results from Table 20 are illustrated. +p<0.10; *p<0.05; **p<0.01; ***p<0.001

Effects on Scientific Self-Efficacy (see Table 20, M1). As expected, attributing an unsuccessful outcome of the doctorate to a cause that is perceived as stable was negatively and significantly related to SSE, within complete case FIML and MICE analysis. The results support ***hypothesis 4a.*** Again, because of multicollinearity ***hypothesis 4b*** could not be tested; however, there was no association between locus and SSE.

With regard to performance outcomes, none of the observed variables was associated with scientific self-efficacy. This could be a result of the low sample size and, moreover, lower performance outcomes in the subjectively unsuccessful subsample. Merely the graduates who did not receive their grade yet had lower scientific self-efficacy beliefs, however only in complete case analysis.

In accordance with previous results, female medical graduates expressed lower SSE. Also consistent with previous results, higher intrinsic research motivation before the doctorate was associated with higher SSE. As in Study 1, respondents who were research associates during the doctorate had significantly lower SSE. With regard to effect size, intrinsic motivation had the strongest association to self-efficacy beliefs.

Table 20: Path Model with Academic Career Aspirations (ACAs) as Dependent Variable and Scientific Self-Efficacy as Mediator Variable, Subjectively Unsuccessful Doctorates

	M1 Direct Effects on SSE			**M2** Direct Effects on ACAs			**M3** Indirect Effects on ACAs		
Variables	ß	SE	p	ß	SE	p	ß	SE	p
SSE				0.56	0.13	0.000			
Stability	-0.40	0.15	0.006	0.21	0.14	0.129	-0.23	0.08	0.029
Locus	0.03	0.19	0.885	0.05	0.15	0.751	0.02	0.11	0.885
Age	0.23	0.21	0.274	-0.27	0.17	0.103	0.13	0.05	0.295
Female life sciences*	0.09	0.23	0.702	0.04	0.19	0.829	0.05	0.34	0.703
Female medicine*	-0.57	0.19	0.003	-0.20	0.18	0.284	-0.32	0.55	0.022
Male medicine*	-0.25	0.21	0.229	-0.18	0.17	0.291	-0.14	0.54	0.254
Duration of doctorate	0.19	0.27	0.485	0.04	0.22	0.853	0.11	0.01	0.493
Articles as 1st author	0.03	0.23	0.894	0.48	0.18	0.006	0.02	0.25	0.894
Articles as co-author	-0.07	0.19	0.722	-0.08	0.15	0.572	-0.04	0.08	0.724
Grade: *cum laude***	-0.05	0.15	0.745	0.06	0.12	0.619	-0.03	0.22	0.746
no grade**	-0.55	0.20	0.007	-0.05	0.19	0.789	-0.31	0.63	0.030
Conference attendances	0.19	0.21	0.359	-0.38	0.16	0.019	0.11	0.04	0.374
Children	-0.14	0.18	0.445	0.35	0.14	0.015	-0.08	0.20	0.455
Doctorate as research associate	-0.58	0.19	0.002	-0.37	0.18	0.037	-0.33	0.36	0.020
Intrinsic motivation	0.32	0.17	0.069	0.16	0.15	0.277	0.18	0.18	0.104
Constant	-1.29	2.21	0.561	4.67	1.76	0.008			
N	33								
R^2	0.57			0.73					
Overall R^2	0.81								

Legend: *Reference category: male life scientists, **reference category *cum laude* and worse. Standard errors (SEs) and standardized coefficients (ß) rounded to the second, p-values rounded to the third decimal place.

Direct and Indirect Effects on Academic Career Aspirations (see Table 20, M2 and M3). Consistent with previous results and in support of ***hypothesis 1,*** scientific self-efficacy beliefs were once again significantly related to academic career aspirations. Furthermore, the stability dimension was indirectly associated with academic career aspirations via self-efficacy, in both complete case analysis and the FIML path model. In accordance with previous analyses, intrinsic motivation was significantly and positively related to academic career aspirations, indirectly as well as directly. This association was significant in the FIML path model and the regression analysis with imputed values.

With respect to performance outcomes, first author publications were directly related to higher academic career aspirations in complete case analysis and the FIML path model. Conference attendances were only linked to higher academic career aspirations in the FIML model, and there, only at the 10 percent level. Likewise, lower academic career aspirations by graduates who had not received a grade yet, were only significant in complete case analysis.

Being a female medical graduate was indirectly associated with lower academic career aspirations. This effect was significant in both models with imputed values. In addition, having been a research associate during the doctorate was negatively associated with academic career aspirations. This effect was significant in complete case analysis, MICE, and in the FIML path model. The number of children was, as in the previous results of this study, positively and directly related to academic career aspirations in FIML and complete case analysis, however negatively in the MICE regression analysis.

With respect to effect sizes, it was notable that the indirect attributional effect on academic career aspirations seemed to be relatively large in comparison to the previous results. Scientific self-efficacy and intrinsic motivation were, as before, most strongly related with the intention to pursue an academic research career.

Interim Conclusion (rather) Unsuccessful Doctorates

Within the subsample of subjectively (rather) unsuccessful doctorates the association between SSE and academic career aspirations could be further supported. Moreover, as expected, attributing failure to a factor that was perceived as stable in its impact on future academic career outcomes was associated with lower SSE and was thereby indirectly linked to reduced academic career aspirations. Whereas the indirect effect of the stability dimension on academic career aspirations was very small in the successful sample, it was relatively large within the sample of unsuccessful graduates.

This result might indicate that attributions have a higher impact on motivation after the experience of an unsuccessful event. The result is also consistent with Study 1, in which attributions to failure seemed to have a higher impact on self-efficacy. The experience of unsuccessful doctorate, as suggested by previous research (cf. Chapter 2.1), might have also induced more thinking about the reasons behind the failure and, whether one should continue nonetheless. Logically, when having experienced failure, the risk for future failure is probably perceived as higher.

Another interesting result was that again, graduates who were research associates during the doctorate expressed lower scientific self-efficacy beliefs and academic career aspirations. This effect was significant for the unsuccessful graduates and could reflect that they also encountered difficulties within their work environment.

9.5 Discussion

Sociocognitive Variables. The results of the here conducted analyses are in line with those of Study 1 and support the assumption that achievement related cognitions are significantly related to the intention to pursue a career in academic research, even when controlling for personal preference and various performance indicators. For the subjectively successful doctoral graduates of medicine and life sciences, attributing success to a factor that is perceived as stable, in regard to its influence on career success in academic, was associated with significantly higher scientific self-efficacy. The strength of the association was in addition comparable with the effect of first author publications—which was the only performance variable significantly associated with SSE. While the stability dimension was indirectly related to higher academic career aspirations (mediated by SSE), this effect was very small, as was the indirect effect of publications.

For graduates who perceived their doctorate as rather unsuccessful, the opposite was found: attributing failure to a factor perceived as stable was associated with significantly lower SSE,

and was thereby indirectly associated to significantly lower academic career aspirations. Moreover, the direct effect on SSE and the indirect effect on academic career aspirations were relatively large in comparison with other variables. These effects were also relatively large in comparison to those in the successful sample. This could indicate, as previously noted, that causal attributions might specifically impact one's motivation after an unsuccessful event. This makes sense, since the risk to continue is, irrespective of underlying causes, probably higher after an experience of failure than after success.

Additionally, the relationships between stability, SSE and aspirations, were significant under the control of various objective performance measures, intrinsic motivation, and under the use of complete case analyses and two analyses in which missing cases were imputed.

Whereas controllability and globality were omitted from the analyses due to multicollinearity, the results of confirmatory factor analyses suggested that a four-factor structure (locus, control, stability, globality) was more appropriate for the scale of attributional dimensions than a one or two-factor model. As the scale was newly developed, future improvements in wording and/or adding a third item to each dimension, may yield better results.

In addition, it was found that internal variables were rated higher on all causal dimensions in comparison to external factors, exemplified by the comparison of the dimensional perception of ability and supervision. These results were seen as an indicator for the general usability of the scale.

Gender Differences. With respect to gender, no differences were found in regard to attributional patterns. Whereas female graduates from life sciences and medicine had significantly lower scientific self-efficacy beliefs in comparison to their male counterparts, these differences were no longer significant when controlling for achievement variables of the doctorate, such as grade and published articles. The results with respect to life scientists are in line with Study 1, in which no significant gender differences for scientific self-efficacy were found. However, with respect to medical graduates, the results deviate from Study 1, among whom gender differences remained significant, even after the inclusion of control variables. As already discussed, these results might have occurred due to the diminished power with the smaller sample size in Study 2, or they may be a result of unobserved heterogeneity in Study 1 (such as qualitative differences in the doctorate, or previous research experience).

In accordance with Study 1, the female medical graduates had lower academic career aspirations in comparison to male medical graduates. When introducing scientific self-efficacy into the analysis, this difference was no longer significant. The result indicated that

female and male medical graduates with the same levels of scientific self-efficacy beliefs did not significantly differ with respect to their intentions to pursue an academic research career. Furthermore, there were no gender differences with respect to the intention to pursue an academic research career in the life sciences sample. This result was also consistent with Study 1.

Differences between Fields of Study. Medical doctoral graduates expressed significantly lower research interest before the doctorate and had significantly lower levels of SSE. The latter, moreover, remained significant after the inclusion of several performance measures of the doctorate. In accordance with results from Study 1, medical graduates also expressed significantly lower academic career aspirations.

With respect to attributions, successful male medical doctoral graduates attributed their doctoral success to less stable, global, controllable and internal factors. These attributional patterns probably reflect that medical doctoral graduates are less experienced when starting the doctorate, and hence, may need more supervision. Additionally, male medical graduates were more likely to classify their doctorate as success. Hence, they might have relativized their initial evaluation with their expressed attributions. When controlling for SSE, there were no significant differences within medical and life sciences graduates with respect to the intention to pursue an academic research career long-term.

The results of the here conducted study support that life sciences and medical graduates do not differ in their intent to pursue a research career after the doctorate, when self-efficacy beliefs are at the same level. Whereas, as already discussed in Chapter 8, it cannot be concluded that an increase in self-efficacy beliefs among medical doctoral graduates would necessarily lead to an increased research career interest, it has to be acknowledged that medical studies in Germany contain much less research content in comparison to other natural sciences and life sciences studies (Wissenschaftsrat, 2014; Chapter 4). A better research training would, most probably, not only lead to higher scientific self-efficacy beliefs in medical graduates (Bakken et al., 2010) and maybe to a higher interest in pursuing research professionally, but would contribute to a next generation of evidence based working clinicians.

9.6 Limitations and Outlook

The associations shown among attributions, SSE and academic career aspirations within both Study 1 and Study 2, support the idea that cognitions juxtaposed with performance outcomes shape career aspirations within a domain of an insecure career outcome. Due to the cross-sectional study design, yet, a causal link cannot be inferred.

In addition, within both studies only attributions with respect to a final overall assessment of the doctorate could be measured. Yet, the doctorate is a period which consists of successes and failures, situations in which causal attributions can be either helpful or hindering in the maintenance of motivation—until the doctorate is completed. Emotions that are linked to causal attributions will most probably also play a role with respect to motivation during the doctorate and affect the intention to continue one's academic career path after its completion. Cognitive processes during the doctorate and emotional responses could not be taken into account in Studies 1 and 2. Data of a qualitative study, conducted with respondents of the first cohort of E-Prom, has therefore been analyzed in order to shed light on these aspects. Whereas the qualitative data cannot be used in order to test for a causal link, they may very well contribute to the validity of the attributional construct in the context of the early academic career.

10. Study 3 – Causal Attributions during the Doctorate

Summary

The goal of the present study was to analyze attributions and motivation within a qualitative framework. Twenty-eight doctoral graduates in the fields of medicine and life sciences, who previously participated in Study 1, were interviewed within qualitative, structured telephone interviews. The interviews focused on the development of research skills, research interests, and experiences within the doctorate. The results suggest that self-serving causal attributions were important for maintaining one's motivation throughout the course and until the completion of the doctorate. This specifically applied to doctoral graduates who reported difficulties with their supervisors. These difficulties were, moreover, mainly associated with the feedback and communicative style of the supervisors in general. Additionally, for research-oriented doctoral students who had a negative relationship with their supervisor, self-serving attributions seemed to help maintain academic career interest after the completion of the doctorate. In addition, the results pointed at a general importance of feedback in the formation of a positive ability concept.

10.1 Introduction

In the first two studies (Chapters 8 and 9) the relationship between attributions and motivation (i.e., the intention to pursue an academic research career) was analyzed quantitatively with a forced-choice approach. Both of these studies supported a relationship between causal attributions of doctoral success or failure, scientific self-efficacy and the intention to pursue an academic research career long-term. The present study, however, explores this topic by analyzing qualitative interview material. The interviews were conducted with medical and life sciences doctoral graduates who participated in Study 1. In order to gain/acquire insight into specific aspects that cannot be assessed quantitatively, a qualitative approach was used as described in the following sections.

Validation through Triangulation

One aim of the qualitative approach was to potentially support the relevance of causal attributions as a motivational factor for doctoral candidates (Jick, 1979). Since respondents had to answer to predefined sets of questions and categories in the quantitative studies, it was possible to support a concept that—in reality—may not be of any significance. Within the

qualitative framework, respondents were able to give candid answers to far more openly formulated questions, without having to restrict themselves to predefined categories. Therefore, it was expected that if participants made causal attributions in success and failure situations, they would express them without the need for the interviewer to ask questions specifically targeted towards attributions. A free expression of such cognitions would support the relevance of causal attributions in the early academic career setting and increase the certainty that the previously obtained results of Studies 1 and 2 were not just methodological artifacts.

Causal Attributions and Motivation during the Doctorate

Since the doctorate is conducted during a longer period of time and includes discrete moments of successes and failures with motivational ups and downs, another goal of the qualitative study was to assess causal attributions with respect to the final evaluation of the doctorate (as in Studies 1 and 2) and to gain insight into cognitive patterns and their influence on motivation during the doctorate. Beyond the relationship of attributions and expectations, which was extensively examined in Studies 1 and 2, the qualitative approach was seen as an opportunity to explore the role of affect. As discussed in Chapter 2.1, causal attributions are also linked to a variety of emotions, which are, in turn, linked to motivation.

The Role of Supervisors and Feedback

The relationship between the supervisor(s) and the doctoral candidate was also of interest as feedback is one mechanism through which attributional patterns can be influenced (e.g., Schunk, 1984; Liden & Mitchell, 1985). Especially during the doctorate, a time in which junior researchers might not be as secure about their capabilities and/or future careers, feedback from the supervisor(s) could have a significant impact on causal attributions, self-concept, and self-efficacy beliefs of doctoral candidates.

Lastly, the study was used as the basis for instrument development; that is the selection of main causal factors given in Study 2.

10.2 Method

Sample

Within the qualitative study, twenty-eight of the quantitative survey respondents from Study 1 were interviewed. Figures 10 and 11 give an overview of the interviewed respondents, which included twenty-five doctoral graduates and four advanced medical doctoral students. While the advanced doctoral students were originally meant to be trial interviews, they were included in the analyses because not only were these respondents able to retrospectively talk about the doctorate, but the interview guidelines had already been finalized when they were conducted.

Apart from the four advanced doctoral students in medicine, the selection of interviewees in both fields was made according to their response patterns in the quantitative study: respondents with higher and lower amounts of intrinsic research motivation and scientific self-efficacy were chosen, as were graduates who indicated to either aspire to a career in academia or not. Moreover, respondents who corresponded to the assumption that those with higher research interest before the doctorate and scientific self-efficacy would be employed in research after graduation were chosen.

In order to critically reflect on the previous results of Study 1 and 2, and avoid bias towards the author's assumptions, respondents who did not correspond to those expectations were also chosen. These were subjects who either rated low on research interest and self-efficacy yet were employed in research, or who rated high on the same parameters but were not employed in research. These apparent "inconsistencies" were easy to clarify in the interviews: researching physicians were employed as assistant physicians and not research staff (interviews 21 and 12). Therefore, these were falsely classified as *not researching* before the personal interviews. In other cases, the employment situations did not match the occupational wishes of respondents (interviews 25, 9, 24). Furthermore, there was one physician-scientist who indicated lower research interest and was offered the possibility to do one year of full-time research before starting their medical specialist training (interview 20). This was taken as an opportunity to "try-out research" despite the wish for a clinical career in the long run.

In Figure 10, an overview of the group of *medical graduates*, which also includes answers with respect to the central constructs of Study 1, can be found. Eight of the interviewed medical graduates were female and six male. The doctoral students in medicine were between 22 and 25 years old; doctoral graduates were slightly older, between the ages of 27 and 33, with the exception of one female physician who was 39 years old. Apart from two participants

who started their doctorates after the completion of medical school (interviews 18 and 11, cf. Figure 6), all interviewees began their doctoral candidacies during the course of their regular studies. Moreover, except for one physician who was additionally holding a PhD (interview 12), all medical respondents achieved the title "Dr. med".

While three physicians were already specialists at the time of the interview (interviews 11, 12, 27), the other physicians were either already in or about to enter specialist training. With respect to career field, five physicians (three male and two female) were working exclusively in academic medicine at the time of the interview (interviews 18, 21, 8, 20, 12). However, one of the female physicians was about to leave academia and start specialist training (interview 18), while the other intended to limit her research stay to one year and focus on clinical work afterwards (interview 20). Furthermore, one of the male physicians was also preparing to leave academic research in the near future (interview 8).

In Figure 11, an overview of the group of *life sciences graduates*, which also includes answers with respect to the central constructs of Study 1, can be found. Among the interviewed life sciences graduates, six were female and five were male. Respondents in the life sciences group were aged between 28 and 40 years. Most of the interviewed life sciences graduates had conducted their doctorates within positions as research assistants; others had financed their doctorates with scholarships while still being integrated into a department by participating in research projects.

Whereas the majority of the doctoral graduates in the life sciences were employed in academic research after the doctorate, three were working in industry with little or no research relatedness (interviews 7, 9, 10), and one was working in a scientific publishing house (interview 23). Furthermore, one female doctoral graduate was conducting research for a public institution from a lower-paid administrative position rather than a position as research associate (interview 25). One male graduate entered the postdoc phase only because he was not able to find a position outside of academic research (interview 24). All-in-all, in comparison to medical graduates, the life sciences graduates were more often relying on inadequate transitional occupations while they searched for adequate employment. In one case, that meant jumping from one temporary contract to the next (interview 25).

Before the interviews, all participants were informed about the goals of the study and signed an informed consent before these were conducted. They also received a compensation of 30 Euros after the interview was conducted.

Figure 10: Interviewees, Medical Doctoral Graduates

Interview	Gender	Age at Interview	Graduation	Job at Time of Interview	Desired Long-Term Career Whish	Subjective Success of Doctorate*	Intrinsic Research Interest*	Scientific Self-Efficacy*
11	w	39	2014	Currently unemployed	Open to research and patient care	4	3,7	2,3
19	w	28	2014	Resident, full time clinician	Patient care	4	1,3	2,6
27	m	33	2013	Specialist in shared practice, full time clinician	Patient care	2	1,7	1
21	m	29	2014	Resident at university hospital, full time researcher	Research	5	5	4
8	m	32	2013	Researcher at other research institution	Research/ Industrial Research	5	5	4
18	w	33	ns	Researcher at university hospital - about to enter residency	focus on patient care, open to some research	ns	4,7	4,1
17	w	32	2014	Resident at university hospital, full time clinician	Patient care	4	2,3	2,3
20	w	28	2013	Resident neurology, temporarily full time research	Focus on patient care, open to some research	4	3,7	3
22	w	27	2013	Resident at clinic, full time clinician	Patient care	5	1	1
12	m	31	2013	Postdoc at university hospital, currently only research	Research and patient care	5	4,3	4,4
1	w	25	submitted in 2013	Student	Uncertain, more patient focused, research an option	4	4,7	1,2
2	m	23	/	Student	Focus on patient care, open to some research	5	4,3	3,9
5	m	22	/	Student	Patient care	3	5	2,1
3	w	22	/	Student	Focus on Patient Care, open to some research	4	4,3	2,3

Legend: *Subjective success of the doctorate, intrinsic research interest and scientific self-efficacy derived from quantitative survey. Also see Study 1, Chapter 8, ns=not specified.

Figure 11: Interviewees, Life Sciences Doctoral Graduates

Interview	Gender	Age at Interview	Graduation	Job at Time of Interview	Desired Long-Term Career Whish	Subjective Success of Doctorate*	Intrinsic Research Interest*	Scientific Self-Efficacy*
4	m	31	2013	Research at university	Research at university	5	4,3	5
24	m	32	2013	Research at university (was not preferred though	Research at university	3	5	1,4
14	w	29	2014	Research at university	Research at university	4	4,3	2,4
13	w	28	2014	Research at university	Research at university	4	5	4,9
7	w	32	2014	Pharma Industry (no research)	Pharma Industry (no research)	4	4,7	2,4
16	m	30	2014	Research at university	Research at university but not yet determined	3	2,7	3
9	m	31	2014	Software Engineer	Uncertain, misses research	5	4,7	3,3
25	w	33	2013	Administrative job, public research	Open minded, academic research is an option	2	5	1,7
26	w	30	2014	Industrial research	Industrial research	3	5	2,9
23	w	31	2014	Scientific publishing house	Same area, but higher rank aspired	3	4,7	ns
10	w	29	2013	Industry, no research	Same area, but higher rank aspired	2	4,7	3,2
6	m	33	2013	Research at university	Research at university	4	5	2,1
15	w	28	2013	Research at university	Research at university	5	3,7	3,3
28	m	40	2013	Research at university	Industrial Research	5	4,8	4,8

Legend: *Subjective success of the doctorate, intrinsic research interest and scientific self-efficacy derived from quantitative survey. Also see Study 1, Chapter 8, ns=not specified.

Data Collection

Structured, guided telephone interviews were conducted between October 2014 and November 2015. Guided interviews were used because the main interest of the qualitative study was a deeper understanding and interpretation of the insights gained within the quantitative Study 1. Therefore, the topics were clearly defined ahead of the interviews. Moreover, the guideline was modelled based on the recommendation of Helfferich (2005): starting with broad introductory questions for each topic in order to allow respondents to answer openly, followed by narrower questions in the case of ambiguities or the need for more information on details. Conducting the interviews via telephone—and not face to face—was a practical decision that was necessary since the respondents were living throughout Germany.

The interview was guided according to the academic biography of respondents, starting with their choice of field of study and ending with their occupational position and career intentions for the future. Focusing on the whole episode of the doctorate, the main topics of the interview guideline were interest in research, development of research-related skills, experiences with supervisors, the immediate work environment during the doctorate, labor market entry, and occupational preferences and wishes. With the exception of one question that was used for the instrument development of Study 2, there were no further questions in the guideline that specifically targeted causal attributions. This strategy was pursued since spontaneously expressed attributions—rather than forced ones—would support the validity of the construct.

The questions posed for the instrument development resembled those of the quantitative surveys: first, respondents were asked if they perceived their doctorate as successful or not; then, why they perceived the doctorate as un-/successful (criteria for success); and, lastly, which factors were mainly contributing to the successful or (rather) unsuccessful outcome/s in their opinion. These stated causal factors were subsequently used to complete the list of main causal factors in Study 2. The interview guideline was piloted with three employees of the *Institut für Didaktik und Ausbildungsforschung in der Medizin, Munich,* and four advanced doctoral students from medicine.

Analysis

Data Preparation The interviews were recorded and transcribed verbatim. Vocal phenomenon, such as laughing and pauses, were noted in box brackets. Names, places, and other details that could have revealed the identity of the respondent were anonymized by superficial descriptions (e.g., inserting ≪German city≫ for Munich; see Liebig et al., 2014).

Coding Scheme The transcribed interviews were then analyzed according to structured content analysis (Mayring, 2010) with a previously developed coding scheme, in which each category and subcategory was defined and explained using anchor examples. A deductive content analysis was used since, against the background of preexisting studies and the insights attained in Study 1, the present study's goal was rather to better understand, interpret, complete, and—in the best case—support previous results rather than to inductively explore the topic or to create a new theory for which a grounded theory approach would be suitable (Corbin & Strauss, 1990).

The first draft of the coding scheme was deductively developed by the author and adapted after trial coding and joint discussions with two additional independent raters. Within the process of trial coding, additional inductively gained categories were integrated into the coding scheme. Moreover, the coding rules and anchor examples were further adapted in case any ambiguities arose. Categories that were overlapping and not distinct enough were summarized into one category. The coding scheme was finalized when no further relevant categories were found. Moreover, the interrater agreement, a crucial device for evaluating the utility and quality of content analysis (Lombard, Snyder-Duch, & Brakken, 2002), was used to indicate the need for further adaption of the coding scheme.

Interrater Agreement and Main Relevant Categories Cohen's Kappa was chosen to assess interrater agreement (Cohen, 1968). As it corrects for agreement by chance, Cohen's Kappa is considered as a conservative measure (Lombard et al., 2002). Twenty-five percent of the interview material was double-coded by the author and a second rater with the final coding scheme. During this process, every sentence was individually coded. Since the qualitative study was conducted within a joint project and included several, differing research questions, not all codes were relevant for the research question of the current study. Hence, these were

not interpreted and not included in the final computing of interrater reliability.[36] The final coding scheme of the current study comprised 207 categories and subcategories.

Since the proportional agreement between raters can only be calculated with the used program (MAXQDA) for one interview at a time, a mean of the individual values from all interviews was computed. Consensus between raters was defined as when ninety percent of the respective sentence was coded equivalently by both raters (Weiß, Schramm, Hillert, & Kiel, 2013). Once achieved, the mean value of proportional agreement over all interviews was then adjusted for chance agreement, resulting in a final value of 0.73. In cases of a conservative indicator of interrater agreement, such as Cohen's Kappa, the value attained here is considered satisfactory (Lombard et al., 2002; Landis & Koch, 1977). While the complete coding scheme is found in the appendix of this work, the superordinate categories with primary relevance to the research questions are listed here. These were:

- research interest before the doctorate
- research interest during the doctorate
- work autonomy within the doctorate
- adequate support during the doctorate
- problems with supervisor(s)
- being perceived as a (junior) scientist
- moments of success during the doctorate
- moments of failure during the doctorate
- subjective success of the doctorate
- causal attributions to success or failure
- emotions (e.g. pride, joy, frustration)

[36] These codes referred to the amount of publications and the publication process, networking, criteria for choosing the respective dissertation project, perception of the writing process, and way of access to the dissertation project.

10.3 Results

Discounting and Augmentation Principle

Within the interviews the use of the discounting and augmentation principle by the interviewees was very salient (Kelley, 1971, 1972). These principles shall be briefly introduced here. The discounting principle states that a possible cause for an effect is dismissed or reduced in its probability when simultaneously another or several other plausible causes exist as an explanation for the effect. Furthermore, an assumed cause is perceived as plausible, or more likely, when it covaries with the observed effect, i.e., if the assumed cause and effect occur together over time.

Examples for discounting were present in situations in which participants experienced negative feedback, usually within a negative relationship to the supervisor or other colleagues. When negative experiences were made or failure was experienced, as for example by negative feedback from the supervisor, respondents tended to attribute those negative experiences to the supervisor's personality. By attributing negative experiences externally, they furthermore discounted their ability/their own person's responsibility. Observing the same behavior of the supervisor with other work colleagues was, moreover, supporting this attributional pattern (see also next section, "Coping with negative situations"). Whereas it seemed that participants were using the covariation principle to make correct causal attributions, it cannot be evaluated here if there had been any biased perceptions that were guided by the motivation to preserve self-esteem. However, there were also situations in which respondents were using the discounting principle in a negative way: for example, one respondent stated her paper had been published in a journal that was not meeting her standards, therefore discounting the moment of success as such.

Respondents made also use of the augmentation principle. The augmentation principle is respectively described by Kelly (1971, p. 12) as such: *"If for a given effect, both a plausible inhibitory cause and a plausible facilitative cause are present, the role of the facilitative cause is producing the effect will be judged greater than if it alone were present as a plausible cause for the effect"*. A facilitative cause is a cause that makes the occurrence of an effect more likely whereas an inhibitory cause makes it less likely. It is expected that the presence of an inhibitory cause leads to a higher evaluation of the facilitative cause, thus, the facilitative cause is augmented in its importance for the occurrence of the respective event (Kruglanski, Schwartz, Maides, & Hamel, 1978). To give an example, ability is a facilitative cause for succeeding within the doctorate and getting a high grade. When, furthermore, an

inhibitory cause is perceived, such as a high workload and little time for the doctorate, the facilitative cause "ability" is even augmented in its importance.
One respondent for example stated that his supervisor was strict and very rarely giving high grades. Therefore, he was very confident and proud of the grade he attained. Although this was not explicitly stated, the respondent seemed to augment his ability as a cause of success due to the presence of the inhibitory cause "strict supervisor". Furthermore the attained grade was augmented in its validity as an indicator of success, as can be inferred from this interview section:

> Interviewer: Und denken Sie jetzt rückblickend, dass die Promotion erfolgreich war? (interview 28, male life scientist, section 256)
> Respondent: […] von der Note her sehr erfolgreich, weil ich ja ein Magna cum, ein uneingeschränktes Magna cum laude bekommen habe. Die Wortwahl meines Profs werde ich nie vergessen." (section 257) "Und weil ich ihn ja kenne seit vier Jahren, in den vier Jahren, weiß ich auch wie anspruchsvoll er war. Und deshalb wusste ich, dass das dann natürlich umso wertvoller war für mich. Das war jetzt nicht nur eine normale oder glatte Eins, sondern für mich war's schon 'ne Eins plus und ein super Kompliment, dass alles gut geklappt hat. Weil ich ja wusste, dass er auch durchaus äh mit seinen Einsen eben nicht so inflationär umgeht. (section 259)

Another example of the augmentation principle is a respondent who reported having perceived the rather sober feedback from his supervisor as "great moments". Because he perceived his supervisor as someone who generally does not compliment others, small gestures were perceived as successful moments which were giving the respondent a sense of accomplishment.

> Interviewer: Und Sie hatten jetzt noch angesprochen, dass die Akzeptanz von Kollegen auch so 'ne Rolle gespielt hat, dass Sie sich auch als Teil der Gruppe gefühlt haben. Also auch vielleicht als Nachwuchswissenschaftler oder Wissenschaftler. Hat auch für Sie das Feedback von Ihrem Doktorvater für Sie eine Rolle gespielt, dass Sie sich da kompetent gefühlt haben? (interview 21, male physician, section 292)
> Respondent: Definitiv. Wenn der mir die ganze Zeit das Gefühl gegeben hätte ich wär ein Idiot, dann hätte ich das wahrscheinlich nicht so lange ausgehalten. (section 293, 294)

> Interviewer: Können Sie da irgendwie eine konkrete Situation nennen. Sie hatten da gerade das Beispiel mit der Kollegin, die dachte, dass Sie Naturwissenschaftler sind und nicht Mediziner? (section 295)
>
> Respondent: Jetzt ein Beispiel in dem Zusammenhang mit meinem Doktorvater. Ähm, er geizt gerne mit Lob, und wenn er dann hin und wieder doch mal gesagt hat gut gemacht, oder mir gesagt hat, die Publikation ist jetzt durch und ist akzeptiert und wird veröffentlicht. Das waren tolle Momente. (sections 296-298)

As described, the augmentation and discounting principle were mainly related to the preservation and the reinforcement of motivation and self-esteem. The augmentation principle, which in the present case mostly implied an internal attribution of success, was furthermore going hand in hand with positive emotions and pride. While some respondents explicitly stated to be proud (interviews 1, 17)[37], this was not the case in all interviews in which the feeling of pride has to be declared as interpretations of the raters (interviews 9, 21, 8). With the context of emotions, the statements of a female physician were specifically interesting: she stated not being interested in continuing research after the doctorate, however, was sure that she would always decide again for to conferring the doctorate any time. When asking for the reason why, she said that the feelings accompanying this accomplishment were so good, that one would want to experience them again:

> Interviewer: Okay. Und Sie hatten ja vorhin gesagt, das würde mich jetzt noch interessieren, das Sie aber auf jeden Fall nochmal promovieren würden, wenn Sie, also auch jetzt mit dem Wissen, dass Sie darüber haben. Was sind so die Gründe dafür, oder wie kommen Sie zu dieser Einschätzung? (interview 17, female physician, section 200)
>
> Respondent: [Pause] Ich glaube einfach, das Gefühl, was man dann, dass man was geschafft hat – oder, dass man was erreicht hat. Das ist einfach so gut, dass man das nochmal gerne haben würde [Lachen]. (section 271)

While positive emotions and pride were occurring together with internal attributions, within this qualitative approach, outcome-generated and attribution generated emotions (cf. Chapter

[37] For instance it was stated that "Ich finde meine Arbeit sehr schön [Lachen] und bin einfach stolz darauf, dass ich das so gemacht habe" (interview 1, section 164), and "Ja, doch, also, also natürlich ist man stolz darauf, dass man sowas geschafft zu haben, also das schon" (interview 17, section 170).

2.1) cannot be distinguished. In order to test whether attributions independently of the positive outcomes influenced emotional responses, a quantitative approach would have to be applied.

Coping with Negative Work Situations

Self-Serving Attributions. For doctoral graduates who reported a lot of negativity within their work environment, which was mainly induced by their supervisor(s), attributions were acting as a protective factor with respect to self-esteem and motivation to continue one's doctorate or one's academic career after the doctorate.

Doctoral graduates who experienced difficulties with their supervisors could maintain their motivation by not attributing the supervisor's behavior and his/her negative feedback to themselves, but to the supervisors' personality. The attribution to the supervisor, and not to the self, was often related to social comparison: stating that everyone else experienced the same difficulties with him or her. For example, not being valued and encouraged by one's supervisor was accompanied by the remark, that this supervisor did not acknowledge anyone, thereby discounting the validity of the supervisor's judgement and discounting oneself as a reason for the supervisor's behavior:

> Interviewer: Und wenn Sie mir das alles so erzählen, dann wurden Sie wahrscheinlich auch nicht von dem Betreuer als Nachwuchswissenschaftlerin wahrgenommen, würden Sie das so sagen? (interview 25, female life scientist, section 40)
>
> Respondent: Ja, aber er hat auch schlecht, also es ist halt dieser eine Professor, der hat auch schlecht über die Postdocs geredet, das heißt, wir hatten dann mal so Kurspraktikanten, das war die ≪Frauenname≫, das ist eine Postdoc, mit der habe ich im Zimmer gesessen und ich wir hatten Kurs, wir hatten jeweils eine Kurspraktikantin, Kursstudentin bekommen und da haben wir uns zusammen gesetzt mit den zwei Studenten, ich die ≪Kurspraktikantin≫, und der Professor. Und der Professor hat dann in der Person von seinen Wissenschaftlicher Mitarbeitern geredet, also wir waren ja eigentlich anwesend, dass wir es so in etwa nie hinbekommen zu publizieren. Wo ich dachte, er kann doch nicht vor Studenten uns schlecht machen, wenn er so über uns denkt, genau, entweder sagt er es uns ins Gesicht, aber das hat er ja auch nicht […]. Dieser Professor hat wirklich keinen als Wissenschaftler oder Nachwuchswissenschaftler wahrgenommen. Weder Studenten, die ambitioniert waren, (unverständlich) noch die Doktoranden, die vorhanden waren, […] Also es war der Chef an sich, der halt wirklich keinen anerkannt hat. (section 41)

Furthermore, positive experiences outside the work-environment which were attributed internally served as a confirmation of one's capabilities. As one interviewee stated, experiencing positive results in the laboratory from experiments that he diligently planned himself, were helping him to see *"[…]that after all one actually does not do anything wrong". (Original: "[…] dass man ja eigentlich doch nichts falsch macht", interview 6, section 256).*

Another graduate who suffered from a negative relationship to the supervisor reported positive feedback from a talk at a scientific conference. The positive feedback was augmented in value by the fact that it had been received by many from the audience, and additionally by a person who had been overly critical towards other researchers before. This positive experience boosted her motivation by positive affect and was helpful as well in discounting the negative feedback from the supervisor.

> Interviewer: Ok, ja. Und hat Ihnen das in irgendeiner Weise weiter geholfen, dass Sie da wöchentlich in der Arbeitsgruppe was präsentieren sollten? (interview 25, female life scientist, section 94)
>
> Respondent: […] Und das war auf jeden Fall hilfreich, dass man ständig einen Vortrag halten musste. Und ich habe damals am ≪Forschungsinstitut≫ den Abschlussbericht Vortrag halten dürfen und da war das, die ganzen Kooperationspartner da, wo ich wusste, das sind keine Biologen, also ich habe mich dann schon so vorbereitet auf das Publikum. Und die Vorträge die vor mir waren, die wurden von einer Frau, ich weiß nur den Namen nicht mehr, verredet. Also Sie hat dann schon dazwischen gefragt und ja und hat kritisiert und warum habt ihr das nicht vorher gesehen. Und bei meinem Vortrag da saß diese Frau auch nur da und hat genickt und gelächelt und dann war zwischendrin die Diskussionsrunde und danach nochmal. Und die Leute sind dann auch auf mich zugekommen und haben gesagt, Sie haben so einen tollen Vortrag gehalten, wer sind Sie eigentlich, woher kommen Sie. Das gab mir dann nochmal so eine Bestätigung ok, ich kann auch Leuten, die ich nicht kenne, also brauch man wahrscheinlich noch weniger Angst haben, aber auch fachfremdes Publikum konnte ich dahingehend so ansprechen, dass die alles verstanden haben und die Diskussion nach meinem Vortrag war einfach nur bombastisch. Also das lernt man durch das ständige Vortrag halten und das muss auch sein. Also gerade wenn man wissenschaftlich arbeitet, Ergebnisse erzielt, man muss es einem Publikum zeigen, um halt, wenn man Betriebsblind ist, neue Anregungen zu kriegen. (section 95)

Interviewer: Und jetzt nachdem Sie dann so beschrieben haben, dass das ganze Feedback auch von Ihrem Doktorvater immer so negativ war, war das irgendwie auch nochmal so ein schönes Erfolgserlebnis, dass man irgendwie noch von einer anderen Seite bestätigt bekommt, dass man doch das irgendwie auch ganz gut kann und so. (section 96)

Respondent: Richtig, es liegt nicht an dir selber, sondern es ist immer nur jemand möchte, dass du das denkst. Aber ich sehe es nicht, warum man Leute klein halten muss. Weil rein theoretisch wenn ich Chef wäre, würde ich ja wirklich meine Gruppe und meine Mitarbeiter auch fördern und motivieren. Und ein motivierter Mitarbeiter, das ist klar, arbeitet lieber doppelt so viel als ein demotivierter. Das sind Sachen, die sind uns klar. (section 97)

Self-Impeding Attributions. Whereas most of the doctoral graduates who experienced negative situations did not attribute these internally, there was one case of a female life sciences graduate who had difficulties with the subject of her doctorate. Although she expressed that this problem was related to the subject itself, she also made internal attributions, stating that she should have dealt differently with the situation, among other things, by being more proactive with the problem by demanding support, by changing the subject earlier, etc. These internal attributions coincided with statements that can be interpreted as guilt or remorse. At the same time though, she was defending her own behavior.

Interviewer: Und würden Sie sagen, also war die Promotion jetzt rückblickend sinnvoll für Sie? (interview 23, female life scientist, section 144)

Respondent: Es war schon sinnvoll, aber ich würde viele Dinge anders machen. In dem Sinne, dass ich zum Beispiel jetzt denke, dass es viel zu viel Zeit war, die ich investiert habe […]. Es ist aber schwer, wenn man halt so mittendrin ist, dass zu sagen [...]. Das ist halt wirklich schwierig, wenn man selber drin ist […]. (section 145)

These elaborations were consistent with the quantitative survey, where the respondent stated that her doctorate was only in part successful and, moreover, attributed "failure" also to a lack of ability (see Figure 12).

After experiences of frustration, that were in part internally attributed, the respondent came to the conviction that she was lacking certain characteristics that she thought of as important for

academic research. She defined those characteristics as creativity and courage in the sense of risk taking, such as investing in projects which may not yield the wished outcome.

> Interviewer: Also nur aus den gesundheitlichen Gründen, oder auch einfach, weil es Ihnen keinen Spaß gemacht hat? (interview 23, section 80)
> Respondent: […] Ja, also da sind es die gesundheitlichen Aspekte, dann ist es halt auch diese Frustration dahinter, dass da halt so oft Dinge nicht funktionieren, nicht klappen. Dann ist es auch, man muss halt eigentlich, wenn man da weiter machen möchte, ist es ja nicht mehr so, dass einem unbedingt jemand sagt, ok, das ist jetzt dein Projekt, mach das, sondern man muss da selber seine Chancen sehen, Risiken eingehen und da [unverständlich]. Also mir fehlt einerseits die Kreativität und auch der Mut. Man braucht glaub ich auch für eine akademische Karriere einiges an Mut, dass man sagt, ok ich ziehe das jetzt durch und ich mache auch mal ein risikoreiches Projekt und entweder scheitere ich oder ich habe halt damit den Durchbruch und das fehlt mir. (section 81)

Out of this self-perception, the respondent came to the conclusion that her skills would have been sufficient for a postdoc, but that she was lacking the personality traits to succeed in academic research in the long-term:

> Interviewer: Ok, und wie haben sich so Ihre wissenschaftlichen Kompetenzen während der Promotion entwickelt? (interview 23, female life scientist, section 82)
> Respondent: Ich würde jetzt mal sagen positiv. Also ich habe schon das Gefühl gehabt, dass ich viele Kompetenzen erworben habe, dass ich durchaus, wenn ich gewollt hätte noch einen Postdoc hätte machen können. Ob es für eine weitere akademische Karriere gereicht hätte, weiß ich nicht, weil wie gesagt mir da gewissen Charaktereigenschaften fehlen oder auch Kreativität und so. (section 83)

Moreover, when looking again at section 81 of the interview, the role of emotions and the ability to cope with negative emotions becomes apparent. The respondent describes academic research as a field in which frustration is often elicited when things are not working out as they were supposed to. Being prone to react with frustration and attributing small failures and setbacks internally may contribute to a rushed surrender.

Feedback and Ability Concept

As already hinted at, it appeared from the interviews that feedback, especially from the supervisor, was one important source of causal attributions that was either supporting or hindering a positive ability concept and motivation. Positive feedback from the work-environment was linked to respondents' being confident in their abilities and positive affect (such as pride) and a high work motivation during the doctorate. A very nice example of the importance of feedback was a medical graduate who reported that a work colleague had mistaken him for a natural scientist. From this misunderstanding, he concluded that he apparently had shown that he may as well work as a natural scientist. Hence, he attributed the colleague's comment internally.

> Interviewer: Und rückblickend, wie erfolgreich würden Sie Ihre Dissertation oder Promotion einschätzen, aus subjektiver Sicht? (interview 21, male physician, section 265)
> Respondent: Ähm, ist hervorragend gelaufen. (section 266)
> Interviewer: Woran machen Sie das fest? (section 277)
> Respondent: "Ähm, zum einen Vergleich mit Kommilitonen die ich habe. Also ich denke, dass die wenigsten Medizindoktoranden auf dem Niveau publiziert haben. Zum anderen daran, dass ich von Naturwissenschaftlern relativ bald als Ihresgleichen akzeptiert worden bin.
> Das war mir am Anfang auch nicht so klar, dass irgendwie sehr viele Biologen, Biochemiker, Chemiker, die Mediziner halt nicht, dass die halt nicht wirklich ernst genommen worden sind. Einfach, weil die halt einen ganz anderen Wissensstand haben und auch halt ausbildungsbedingt eine weniger gute Leistung erbringen können. Und das hat sich bei mir anders dargestellt, oder ich war mal sehr erfreut, dass eine Mitarbeiterin nach mehreren Jahren erst mich irritiert gefragt hat, ob ich denn Mediziner bin. Und das war dann für mich schon eine Art von Kompliment. Dann habe ich gezeigt, dass ich wie ein Naturwissenschaftlicher arbeiten kann. (sections 268-275)

Moreover, the experience of feeling valued and believed in by the supervisor, and also to be taken seriously as a (junior) scientist, was linked to direct positive feedback from the supervisor but also to his/her style of communication: communicating at eye level, showing interest in the students' ideas and taking them seriously. Additionally, the freedom to work

independently on one's research project while still receiving the needed amount of support was associated with the feeling of being perceived as a (junior) scientist.

However, it has to be noted that the perceived optimal balance between working autonomously and being guided varied between respondents and situations. Medical graduates usually needed more support within their doctorate. Furthermore, the need for support was naturally also dependent on the subject of the doctorate and the personality of the doctoral student.

Conversely, feeling rather controlled than supported according to one's needs was never perceived as something positive. Supervisors who controlled every step of their doctoral students and did not show interest and appreciation of the candidates' ideas elicited a rather negative ability concept in those doctoral students. A low level of independence seemed hindering with respect to respondents' development as a researcher and their ability concept:

> Interviewer: Ok. Und wie haben Sie so die Promotionsphase in Bezug auf die Betreuung erlebt? (interview 15, section 86)
>
> Respondent: Sehr engmaschig und sehr strukturiert."(section 87)
>
> Interviewer: Hatten Sie das Gefühl, dass Sie da selbstständig auch arbeiten können oder war das auch durch starke Vorgaben bestimmt?"(section 88)
>
> Respondent: Durch starke Vorgaben, ja. (section 89)
>
> Interviewer: War das für Sie in Ordnung oder hätten Sie sich vielleicht mehr Selbstständigkeit auch gewünscht? (section 90)
>
> Respondent: Auf der einen Seite, so hab ich's geschafft innerhalb von anderthalb Jahren zu promovieren. Und wenn ich meine eigenen Interessen hätte durchsetzen wollen, hätte ich mit Sicherheit länger gebraucht, sagen wir es so. Also auf der einen Seite hätte ich natürlich lieber gemacht was mehr mein Interesse gewesen wäre und vielleicht ein bisschen mehr auf eigene Faust vorgegangen. Aber so hat's halt schneller geklappt, weil ich einfach das gemacht habe, was mein Chef von mir gefordert hat. (section 91)
>
> Interviewer: Ok. Und hatten Sie das Gefühl, während der Promotionsphase, dass Sie als Nachwuchswissenschaftlerin wahrgenommen werden, also von Ihrem Doktorvater oder auch generell von Ihrem Arbeitsumfeld? (section 92)
>
> Respondent: Ja. [Pause] Doch. (section 93)
>
> Interviewer: Woran würden Sie das fest machen? Oder gab es vielleicht Situationen, in denen Sie sagen, da haben Sie sich jetzt als Nachwuchswissenschaftlerin wahrgenommen gefühlt? (section 94)

Respondent: Ja. Wenn öfter mal irgendwas kam, auch aus anderen Abteilungen, mit Fragen, wo meine Meinung angefragt wurde. (section 95)

[…]

Interviewer: Und jetzt in Bezug auf Ihren Doktorvater? (section 98)

Respondent: [Pause] Dass ich als mündige Nachwuchswissenschaftlerin [Lachen] Das ist jetzt eine schwierige Frage [Lachen] Das Verhältnis ist jetzt nicht so das Beste [Pause] Ich glaub mündig bin ich seinen Augen eh nicht, also von daher [...] (section 99).

Interviewer: Also Sie glauben, Sie werden von Ihrem ehemaligen, also von Ihrem Doktorvater, jetzt auch nicht als Nachwuchswissenschaftlerin oder Wissenschaftlerin wahrgenommen. (section 100)

Respondent: Ne, glaub ich nicht. Als der verlängerte Hebel; der macht was er will [Lachen]. (section 101)

Interviewer: Ok. Und woran merken Sie das, oder...? (section 102)

Respondent: [Pause] Es ist wenn ich eigene Ideen habe, dass das halt abgewiegelt wird und dass halt gesagt wird, Sie machen jetzt das und [Pause] ja. (section 103)

These results are in line with self-determination theory (Deci & Ryan, 1978, 2000), which posits that autonomy—which "*involves acting with a sense of volition and having the experience of choice*" (Gagné & Deci, 2005, p. 333)—and feelings of competence are important predictors of intrinsic motivation. Moreover, consistent with the presented results, an autonomy-supportive climate in the classroom has been linked to student's perceived competence (Trouilloud et al., 2006).

Another example for a negative communicative style was a supervisor who feed backed his student to be "stupid":

Interviewer: Alles klar, ich verstehe. Wie haben Sie denn Ihre Promotionsphase von der Betreuung erlebt? (interview 6, male life scientist, section 86)

Respondent: Sehr schlecht [Lachen]. (section 87)

Interviewer: [Lachen] Möchten Sie das noch weiter ausführen? (section 88)

Respondent: Also meine direkte Betreuerin würde ich fachlich nicht so hoch einschätzen. Also ich habe eher vor mich selber hingewurstelt, mehr oder weniger. Und von der Professorin, da kam auch keine konstruktive Kritik, wenn dann nur wirklich schlechte Kritik. Aber, da wurde auch mal gesagt, ja du könntest das machen

> und das machen. Ja, dann macht man das und zweifelt das schon vorher an, warum man das den so machen soll. Und dann macht man das tatsächlich so, wie sie sich's wünscht und nachher kommt dann bei den Ergebnissen "Ja, warum hast du denn das gemacht? Bist du blöd oder was?" Da, denkt man "Häh". Ja, also. So nach dem Motto. Also, die Betreuung war sehr schlecht. (section 89)

This was related to low motivation and the feeling that, rather than being seen as (junior) scientist, he was being misused as cheap labor:

> Interviewer: Oder Sie haben ja gerade gesagt, dann kam so was wie "Bist du blöd, oder was?" Also hatten Sie denn auch das Gefühl, dass der, dass die emotionale Unterstützung vielleicht dann auch nicht so optimal war? (interview 6, section 97)
> Respondent: Ja, also Motivation war null. Absolut. Also da könnte man depressiv werden. Ehrlich gesagt waren auch zwei von unserem Lehrstuhl in Behandlung, weil, wie heißt das, also nicht direkt Depression, aber Burnout. Die waren weg [...]. (section 274)
> Interviewer: Ähm, hatten Sie dennoch das Gefühl, dass Sie als Nachwuchswissenschaftler wahrgenommen wurden? (interview 6, section 107)
> Respondent: Ne, das würde ich verneinen. [kurze Pause] Eher als billige Arbeitskraft [Lachen]. (section 108)

Attributions to Doctoral Success/Failure

When asking for the causes/reasons that led to success or failure within the doctorate, respondents were all in all making more self-serving attributions. Failure was mostly attributed to a lack of support, unfair evaluation and lack of resources. Only in one case a respondent who experienced problems with the subject of her doctorate draw the conclusions that her strengths actually lie elsewhere (interview 23, see also previous section *"self-impeding attributions"*). In subjectively successful doctorates, the most often mentioned causal factors were effort, endurance, motivation and good supervision. Furthermore, when making internal attributions, respondents often made very general and vague statements that could not be directly interpreted as ability or effort attributions:

> Interviewer: Und was denken Sie, war jetzt der wichtigste oder der ausschlaggebende Faktor oder auch mehrere Faktoren dafür, dass das so erfolgreich verlaufen ist, dass Sie dieses Ziel erreicht haben? (interview 6, male physician, section 142)
> Respondent: Eigentlich die wissenschaftliche Qualität der Arbeitsgruppe würde ich sagen […] Klar, man selbst trägt natürlich auch noch irgendwie dazu bei wenn man das gut umsetzt, […]. (section 143)
> Interviewer: Genau, oder was für Sie jetzt die ausschlaggebenden Faktoren dafür waren, also ganz subjektiv gesehen. (section 247)
> Respondent: Ich meine, dass es überhaupt geklappt hat und so weiter. Das ist es halt, ich bin ja abhängig von meinem Chef. Dadurch, dass er mir das alles ermöglicht hat […]. Und natürlich eben, ja klar, ist es auch ein Faktor, dass ich es geschrieben habe und, dass ich mich da reingehängt habe. (section 248)

This was especially obvious in a case, in which the respondent made strong attributions to his abilities as a researcher, yet, avoided explicitly and clearly stating it. Instead the respondent circumscribed this as:

> Interviewer: Was war denn Ihrer Meinung nach der ausschlaggebendste Faktor dafür, dass Ihre Dissertation so erfolgreich war? (interview 677, male life scientist, section 402)
> Respondent: Ja, das weiß ich. Ich glaube, also die Beurteilung habe ich dann am Ende eben nicht gelesen, durfte ich natürlich nicht. Aber ich glaube es war vor allen Dingen dieses Sideprodukt, was da halt abgefallen ist. Und vor allen Dingen dann wie ich dieses Sideprodukt sozusagen aufgearbeitet habe und wie ich das dann an den Mann gebracht habe bzw. dann in Publikationen verwickelt, verwurstelt habe. Und das hat glaube ich meinem Arbeitsgruppenleiter ziemlich imponiert. Und dass ich immer so selbständig arbeiten konnte, dass ich immer für fast jede Lösung, äh für jedes Problem eine Lösung hatte, insofern mir es halt möglich war. Und das hat er glaube ich immer sehr gerne gehabt und sehr gerne gesehen. (sections 403-404)

Whereas it cannot be definitely assessed what the reasons behind this phenomenon were, it may be related to social desirability.

While respondents in the qualitative interviews did not always mention internal and external factors when being openly asked about the factors that led to their success or failure, all in all,

the answers from the quantitative survey were in line with those from the qualitative (see Figure 12).

Some respondents differed in their perception of success in the qualitative survey: they reported that their doctorate was successful in the qualitative survey, however not in the quantitative. This was mostly related to changing their perspective and standards: while not having achieved what they originally aspired to—which was mostly attributed to external conditions—having achieved their title despite the presence of external obstacles was seen as success and attributed internally (interviews 16, 23, 26, 4, 25) (see also next section). Also having achieved a position one was confident with, finally led to a more benevolent evaluation of their doctorate (interview 23). Moreover, one respondent (interview 11) indicated in the quantitative survey that her doctorate was successful, however was more critical and indecisive in the qualitative interview. While this was not directly stated by the respondent, this assessment might have been also a result of her employment situation—facing the expiration of her working contract and joblessness.

Furthermore, two physicians differentiated between personal and scientific success (22 and 21). For one of these (interview 22), these success indicators were standing in opposition to each other: while the doctorate was successful to her personally, she would not have evaluated it as successful in scientific terms. Another life science graduate (interview 24) stated that his doctorate was scientifically successful; however, not being able to find a job outside of academic research was a reason to rate down his doctorate. The inability to find a job outside of academia was attributed to external factors—to the academic system that does not provide an adequate training to enter labor market positions outside of academia and trains too many people in comparison to available jobs.

Figure 12: Subjective Success of the Doctorate and Attributions in Qualitative and Quantitative Interviews

Interview	Success-qualitative	Success - quantitative	Ability attribution	Effort attribution	External support	Supervisor-relationship	Evaluation (benevolent/ strict)	Workload (high/low)	Attribution in qualitative interview
21	**successful**	**5**	**4**	**5**	**5**	**5**	**ns**	**1**	Luck with external conditions (supervision) and a lot of effort
8	**successful**	**5**	**3**	**5**	**5**	**5**	**1**	**4**	Especially supervision
18	**successful**	**5**	**4**	**5**	**5**	**5**	**5**	**4**	Good supervision and not to surrender
22	**personally, not scientifically**	**5**	**5**	**5**	**3**	**4**	**5**	**2**	Higher internal attribution, especially endurance
12	**successful**	**5**	**4**	**5**	**5**	**5**	**2**	**4**	own ideas and available resources (laboratories)
16	**successful**	**3**	**2**	**1**	**2**	**3**	**3**	**1**	Failure (not having achieved a higher grade and publications) attributed to supervisor. Having made it despite those obstacles is attributed to internal factors.
15	**successful**	**5**	**4**	**4**	**3**	**4**	**4**	**4**	Structure given by supervisor and a lot of effort
28	**successful**	**5**	**4**	**4**	**5**	**5**	**2**	**3**	Endurance and "fighting" - which was indirectly supported by supervisor
11	**rather not**	**4**	**3**	**5**	**4**	**4**	**3**	**1**	Success (having attained the title) is attributed internally, the not optimal result is attributed to high work load in clinic
19	**successful**	**4**	**4**	**3**	**4**	**5**	**2**	**4**	Especially the clear instructions from the supervisor
17	**successful**	**4**	**4**	**4**	**5**	**5**	**3**	**3**	Endurance and motivation
20	**successful**	**4**	**4**	**5**	**5**	**4**	**1**	**3**	Especially own effort and some luck with the results and supervision
22	**successful**	**4**	**4**	**4**	**5**	**4**	**ns**	**4**	Effort and supervision - a little higher emphasis on effort

continued

Figure 12: Subjective Success of the Doctorate and Attributions in Qualitative and Quantitative Interviews

Interview	Success-qualitative	Success - quantitative	Ability attribution	Effort attribution	External support	Supervisor-relationship	Evaluation (benevolent/ strict)	Workload (high/low)	Attribution in qualitative interview
24	**successful**	**4**	**2**	**3**	**4**	**2**	**3**	**1**	Scientifically successful, however, not finding a job outside academia is seen as failure, which is attributed to the academic system which trains to many people only for academia.
14	**successful**	**4**	**4**	**5**	**4**	**2**	**2**	**3**	effort and supervision - a little higher emphasis on effort
13	**successful**	**4**	**4**	**5**	**5**	**4**	**2**	**4**	Own motivation
10	**successful**	**4**	**4**	**5**	**4**	**4**	**1**	**2**	Success is attributed to endurance and supervision, before death of supervisor. Afterwards, supervision is bad and results not as good, which is attributed on the described situation.
6	**successful**	**4**	**4**	**5**	**4**	**4**	**3**	**3**	motivation/ endurance
4	**successful**	**3**	**5**	**5**	**5**	**5**	**1**	**5**	Emphasis on scientific environment and also own contribution
7	**successful**	**3**	**4**	**5**	**5**	**1**	**1**	**2**	Especially own effort
26	**successful**	**3**	**2**	**1**	**1**	**1**	**1**	**1**	A lot of effort and some luck with results. Not optimal publication results were attributed to the project, and positive results despite project's limitations to own contribution.
23	**successful**	**3**	**4**	**1**	**4**	**1**	**1**	**1**	Bad outcomes, such as duration, attributed to supervisor. Having made it to endurance and "not giving up".
9	**successful**	**2**	**5**	**3**	**5**	**4**	**4**	**4**	Especially own contributions
25	**successful**	**2**	**1**	**1**	**4**	**5**	**3**	**1**	Failure is attributed to supervisor. Having made it despite the supervisor relationship to effort, endurance, not giving in.

Note: Doctoral students who did not complete their doctorate yet were not included here (interviews 3, 1, 5 and 2), ns= not specified.

Attributions and Defining a Successful Doctorate

As implied by the section referring to the occurrence of the discounting and augmentation principle, attributions also contributed to the definitions of success and failure. Respondents who, for example, had higher aspirations with respect to the outcome of their doctorate than what they actually achieved (usually grade, publications and duration of the doctorate), perceived their doctorate as a success despite not having achieved their goals when hindering factors were present. In such cases, the criterion of a successful doctorate was often redefined by the graduates as "having made it despite these obstacles" or "having been able to endure it" (no direct citation). In the case of a medical doctoral graduate, studying simultaneously was referred to as a hindering factor that was associated to an even higher confidence in the outcome of the doctorate:

> Interviewer: Jetzt so alles in allem, wie erfolgreich würde Sie Ihre Promotion bewerten? (interview 21, male physician, section 202)
> Respondent: Ja, also ich denk mal so im wissenschaftlichen Sinne war, glaub ich, die Arbeit ist in Ordnung. Für mich auch gut genug veröffentlicht worden. Es geht jetzt immer noch besser. Ähm, aber ich denke für eine Arbeit die man parallel zum Studium durchführt mit einer kurzen Unterbrechung, finde ich das absolut ausreichend. Und ich bin persönlich sehr zufrieden. (sections 205-209)

Furthermore, hindering factors also gave achievements a higher value. For example more value was attached to a given grade when the supervisor was judged to be very strict, or a publication was attached with a higher value when the journal quality was assessed as high, thus, making publishing itself a more difficult endeavor. Interestingly, not only failure, but also success was discounted when a positive outcome was linked either to an external factor, such as to the supervisor, or to an overly long period of time in which it was achieved.

Another aspect that was related to the perception of success was time. As has been noted in the previous section, while some of the interviewed respondents had initially expressed in the quantitative survey that their doctorate was not or only in part successful, they had altered their opinion at the time of the qualitative interview: once more time had passed and the respondents had moved on with their lives, found jobs etc., they tended to evaluate the outcome of their doctorate less strictly. However, this might as well be a result of social desirability and its higher presence in the personal interview than in the online surveys.

Apart from attributions being related to the perception of a successful doctorate, the most frequently mentioned criteria for defining the doctorate as more or less successful, were attained grade and published articles. Duration was also a criterion, but was more frequently linked to discontent or discounting success. Moreover, it was interesting that, despite the highly debated topic of grade inflation (Hornbostel, 2012; Jaksztat et al., 2012), grade still seemed to be an important factor of satisfaction with the outcome of the doctorate for many respondents. Only two life science graduates (respondents 25 and 24) mentioned, that grade was not meaningful, stating that most graduates had received the same grade and most supervisors do not make use of the whole spectrum of grades. Another aspect that was often mentioned with respect to defining one's doctorate as successful was social recognition. This social recognition could be in the form of verbal feedback, e.g., from the supervisor or attendants of a scientific conference, or it could be in the form of perceived social recognition by the scientific community when a paper was published or cited.

Attributions and Motivation to Pursue an Academic Research Career

With respect to attributional patterns and the intention to pursue an academic career, self-serving attributional patterns seemed to strengthen the intent to stay in academic research when respondents were generally interested in doing research and did not reject academic research as a career option from the beginning. There were no cases in which people with no research interest at all, stating they only wanted the doctoral degree (usually medical graduates), were considering continuing the academic career after the doctorate. However, it generally seemed that especially for generally research-interested graduates who had a negative work environment, self-serving attributional patterns were conserving the wish to continue the academic career.

In this regard, there were very interesting instances of two graduates in the life sciences, who both reported highly negative experiences and feedback within the work-environment. Despite their negative experiences, those respondents were still wishing to pursue a career in academia (interviews 25, 6). In contrast to this, other respondents with similar negative experiences were determined to leave academia, despite their initial interest in a research career. It was very apparent, that the two graduates, who still wanted to pursue an academic career, were expressing attributions that were conserving their self-esteem and ability-concept. Conversely, one graduate who was—at least in part—attributing the difficulties she encountered within the doctorate to herself and coming to the conclusion that she did not have

the abilities, or characteristics important to academic research, was deterred from a research career despite a doctorate that was, after all, successful.

Another extremely interesting case was a graduate from life sciences who reported that his doctorate was very successful, and who made very strong internal attributions, talking about how he found a solution to every problem and how others even admired him.

> Interviewer: Würden Sie sagen, dass andere Doktoranden das ähnlich beurteilen würden? (interview 9, male life scientist, section 391)
>
> Respondent: Doch ich denke schon. Also es gab halt viele Leute, die mich bewundert hatten, wobei ich das immer ein bisschen komisch finde, wenn man mich bewundert. Und es gab auch Leute, die versucht haben, mir nach zu eifern […]. Auch mein Arbeitsgruppenleiter redet immer noch in höchsten Tönen von mir, obwohl ich jetzt keine wissenschaftliche Karriere eingeschlagen habe. (sections 392- 396)
>
> Interviewer: Was war denn Ihrer Meinung nach der ausschlaggebendste Faktor dafür, dass Ihre Dissertation so erfolgreich war? (interview 677, male life scientist, section 402)
>
> Respondent: […] Und vor allen Dingen dann wie ich dieses Sideprodukt sozusagen aufgearbeitet habe und wie ich das dann an den Mann gebracht habe bzw. dann in Publikationen verwickelt, […] habe. […] dass ich immer für fast jede Lösung, äh für jedes Problem eine Lösung hatte […]. (sections 403-404)

Despite his wish to continue in research (albeit industrial research), he was not able to find an occupation in this area. Although the respondent found a very good occupation, he continued to reason about why he did not find an occupation within his aspired domain. After two years, he was still considering to look for a position in research, stating that it was hard for him to accept that he was no longer a researcher.

Apparently the success of the doctorate paired with strong internal attributions—which seemed to have been fostered by social recognition—was contributing to the respondent's high identification as a researcher. The fact that he was unable to find the desired research occupation was accompanied, therefore, with a high cognitive dissonance, which the respondent tried to reduce by making social comparisons, such as stating that most of his former colleagues had either bad jobs or no jobs at all.

Interviewer: Sind Sie zufrieden mit der aktuellen Tätigkeit? (interview 9, male life scientist, section 468)

Respondent: […] also am Anfang fand ich das total doof, dass ich jetzt kein Mikrobiologe mehr bin, und dass ich da keinen Job kriege und so. Irgendwann habe ich mich damit abgefunden und ja. […] Ja, aber das ist dann halt sehr ernüchternd und die Leute die halt, die ich kenne, die jetzt fertig mit der Promotion sind machen entweder Jobs, die ich viel langweiliger finden würde, oder sind arbeitslos.“ (sections 469-473)

These social comparisons were supporting the attribution of “failure” (not getting the wanted position) to external causes: the labor market situation:

Interviewer: […] Jetzt noch zum Schluss zu Ihrem beruflichen Werdegang nach der Promotion. Können Sie erstmal grob beschreiben, wie der denn angelaufen ist? (interview 9, male life scientist, section 452)

Respondent: Also als Biologe ist es anscheinend sehr schwer einen Job zu finden, besonders, wenn man ein bestimmtes Thema haben will und wenn man versucht zumindest sich auf eine Region zu beschränken, was ich dann ziemlich schnell aufgegeben habe. Ja, es sind so viele Biologen anscheinend auf dem Markt, dass ich weiß nicht woran das liegt, dass man nie eingeladen wird oder so, oder vielleicht habe ich mich auch immer auf die falschen Stellen beworben, das kann natürlich auch sein […]. (sections 453-455)

Despite his attempts, he was not able to let go of the thought of being a researcher. For his future career he wished to become happy with his current job, a target he would have to work on.

Interviewer: Gibt es sonst noch Wünsche oder Vorstellungen für Ihre berufliche Zukunft? (interview 9, male life scientist, section 508)

Respondent: Ja, dass ich halt mit meinem Job glücklich werde, also da muss ich, glaube ich, noch ein bisschen dran arbeiten. Dass ich so hundertprozentig, genau wie bei meiner Promotion, da konnte ich so richtig dahinter stehen und bei meinem Job dauert das vielleicht noch so ein bisschen. Es ist zwar nah dran, aber wie gesagt. (sections 509-511)

Interviewer: Was fehlt da noch? (section 512).

Respondent: Ja eben, wie gesagt dieses. Eigentlich ich wollte immer als Kind schon Wissenschaftler werden aber inzwischen sprechen da so viele Punkte dagegen, das zu machen, dass ich. Ja und damit kann ich mich noch nicht richtig abfinden, wie Sie sehen. (sections 513-515).

Vicarious Experience and Gender

Moreover, the qualitative interviews pointed to a possible influence of *vicarious experience* on one's beliefs with respect to long-term career chances in academic research. While the respondents were mostly aware of the situation in academic research, seeing other postdoctoral researchers struggle to keep employed seemed to additionally affect doctoral graduates:

Respondent: Ich habe nur jetzt schon versucht da auszusteigen, weil ich sehe, dass es halt extrem schwer ist. Also ich arbeite mit ganz vielen Menschen zusammen, die alle einen Schritt weiter sind, also die am Ende ihres ersten oder zweiten Postdocs sind und die jetzt eigentlich mal auf eine Gruppenleiterstelle aufrücken müssten. Und die gibt es halt nicht. Also die sind halt so rar gesät, dass man die halt fast nicht bekommt. (interview 24, male life scientist, section 189)

Although there were no striking gender differences, it should be mentioned here that some more women mentioned that they did not aspire to a research career, or still be in doubt, due to a higher difficulty to combine family and career in academic research in comparison to other careers. One female life scientist mentioned that—while claiming not to have made this experience herself—women would sometimes still not be taken seriously in her research area: "*Nee, man hat grundsätzlich, manchmal auch noch die Fälle als Frau in der Wissenschaft belächelt wird" (interview 14, section 617).* She also experienced, that female researchers had more difficulties in finding employment in her research area: "…*aber wenn man dann hört, dass bestimmte Stellen, wo Postdocs gesucht werden, wo man dann zwei Alternativen hat zwischen 'ner Frau und 'nem Mann und die Frau fachlich sehr, sehr gut ist, und dann lange überlegt wird, ob dann nicht doch der deutlich schlechtere männliche Bewerber genommen wird, weil die Frau ein Kind hat*."

At last it shall be noted that for most life scientists the job insecurity was the reason most often mentioned against an academic career. The lack of long-term job perspectives was also lamented in the open comment section in the quantitative studies. Especially those medical graduates who had not any research interest, appeared to be less aware of the conditions of an academic research career.

10.4 Conclusion and Discussion

Validity of the Attributional Approach. Altogether it can be stated that causal attributions were spontaneously stated by the interviewed respondents. This was especially apparent in situations in which the interviewees were confronted with difficult situations. The results support the relevance and validity of attributions as motivational factors within the episode of the doctorate.

Causal Attributions and Motivation. Furthermore, it seemed that attributions were related to motivation during the doctorate. Cases in which the doctorate experience was primarily a positive one seemed to further enhance motivation by positive affect, especially pride. Moreover, self-serving attributional patterns seemed to help overcome negative work situations, which were mainly related to a negative relationship with the supervisor. In these cases, attributing negative feedback from the supervisor externally and attributing positive experiences outside this relationship internally were not only helping respondents to endure this period but also to maintain their interest in research and an academic career. One could say that self-serving attributions operated as a coping mechanism in those cases.
Conversely, one doctoral graduate, who attributed difficulties during the doctorate internally, ended up losing interest in a research career, as she expected that her capabilities would not have been sufficient for an academic research career in the long run. While it cannot be finally determined how strong this influence weighted on her decision to drop out of research against other reasons, it was striking that a doctoral graduate with an objectively successful doctorate (interview 23) in comparison to another graduate whose objective outcomes were unsatisfactory (25), came to “transposed” conclusions of their capabilities. These conclusions seemed to be, at least in part, a reflection of their attributional patterns.

The Role of Supervisors and Feedback. Feedback and the communicative style of the supervisor were strongly linked to attributional patterns. It seemed that positive feedback and

a communicative style that included communication at eye level (e.g., showing interest in the doctorates' opinions) supported a positive ability self-concept and a feeling of being a member of the scientific community. In contrast, negative feedback and a lack of trust in the doctoral students' abilities, which was, for instance shown by trying to control every work step, was an irritating and inhibiting factor with respect to motivation. Despite the protective cognitive mechanism displayed by those students who had to deal with negativity at the work place, such experiences did leave their traces, since they were related to frustration at least in those specific moments.

Consequences of negative and positive feedback have been as well supported by other empirical studies. For instance Belschak and Den Hartog (2008) find that negative emotions—such as frustration and anger—mediate the effect of negative feedback on counterproductive work behavior (e.g., to purposefully not carry out the tasks currently required in one's job). Moreover, leadership style has been linked to emotions, which subsequently influenced performance (summarized in Humphrey, 2002).

Vicarious Experience and Career Prospects. In addition, Study 3 pointed at potential influences of vicarious experience and the perception of career options. Seeing other talented postdoctoral researchers struggle due to limited contracts could further discourage doctoral graduates, more than just knowing about career chances in academic research. This result could also be an explanation for the negative relationship between being a research associate during the doctorate and academic career aspirations within Study 1. However, at this point, this is only an idea which has to be further explored in future research. This also applies to the anticipated difficulties to combine family and academic careers, specifically for female doctoral graduates.

Methodological Implications. The study did not only reveal relevant contents for future studies, but it also had a methodological implication: Two of the medical graduates came to different conclusions about the personal and scientific success of their doctorate. Considering that the majority of respondents evaluated their doctorate as successful and most of the respondents that were in the unsuccessful group indicated that their doctorate was only partly successful, asking for scientific success may not only increase item difficulty, but, ensure that the "correct" causal attributions are measured.

10.5 Limitation and Outlook

Whereas the results of the qualitative study point to a link of attributions to motivation by affect next to expectancy, it was not possible to distinguish outcome-generated from attribution-generated emotions. Moreover, it was not always possible to determine the exact emotion, since many respondents described them vaguely as a positive feeling. Therefore, the feeling of pride was sometimes an interpretation of the raters and not always explicitly stated by respondents. In order to analyze the relationship among attributions emotions and motivation, and to distinguish between outcome-generated and attribution-generated emotions, a quantitative approach would be needed. In this regard, it would be interesting to analyze emotions as a potential mediator between causal attributions and motivation next to expectancy. Moreover, the qualitative results suggested that feedback was an important part within the formation of attributions.

These findings are also supported by previous research (Schunk, 1984; Schunk & Gunn, 1986) and specifically studies which support the effectiveness of reattribution trainings (e.g., Ziegler & Heller, 2000). The relationship between feedback, attribution and motivation among doctoral graduates or junior scientists is another interesting topic that future research could look into. Since respondents were more or less at their supervisors' mercy and some professors were apparently either not able or willing to practice a motivating communication style but rather used a destructive one, it may be helpful to provide professors and other supervisors of doctoral students with specific didactical training, or to provide doctoral students other sources of mentoring/coaching. With respect to previous empirical studies, and the results of the here conducted studies, implications concerning attributional feedback, attributions and motivation, could be helpful if implemented into the training of junior scientists.

11. Conclusions and Discussion

The main question of the present dissertation was if and how causal attributions to success and failure were related to scientific self-efficacy beliefs and academic career aspirations in doctoral graduates. Using a critical incidence approach (Vispoel & Austin, 1995), the dissertation contributed to the understanding of scientific self-efficacy beliefs and also the relevance of causal attributions in *"real-life experiences"* (ibid., p. 380). Moreover, self-efficacy was expected to act as a mediator between causal attributions and the intention to pursue an academic career. The hypothesized relationships between causal attributions, scientific self-efficacy, and the intention to pursue an academic career long-term, were

explored quantitatively. Beyond that, a qualitative approach which addressed the possible role of the supervisor, received feedback, and emotional states, was also applied to gain insight into the motivational process throughout the doctorate. When juxtaposed with actual achievement outcomes, the idea that individual interpretations of success and failure are related to self-efficacy beliefs was supported. In addition, self-efficacy beliefs were strongly related to academic career aspirations when controlling for various performance indicators.

Attribution, Expectancy and Motivation. The results of two quantitative surveys, comprised of data gathered from respondents in medicine and life sciences, showed that attributions were related to scientific self-efficacy beliefs, which were defined as the expectancy to be able to successfully conduct courses of actions important to an academic research career. The hypothesized relationships among attributions and scientific self-efficacy were supported using two approaches to measuring attributions: 1) measuring attributions to causal factors and 2) measuring the underlying dimensions of causal attributions.

Within Study 1 (Chapter 8), attributing doctoral success to ability and effort was positively related to scientific self-efficacy beliefs and, thereby, indirectly to academic career aspirations. Conversely, and consistent with the hypothesis, attributing failure to ability was related to lower scientific self-efficacy beliefs. Unexpectedly, attributing success to a benevolent evaluation was not negatively, but positively and directly related to academic career aspirations. This may reflect that the effect of external attributions is not exclusively limited to discounting one's ability.

Attributing success to external factors, such as positive and benevolent relationships within the scientific community, could be related to general positive affect and gratitude. This conception was supported by the qualitative interviews (Study 3, Chapter 10), which suggested that a positive relationship to the supervisor and work environment is an important source of motivation for doctoral students. Consistently, attributing failure to a negative relationship with the supervisor was related to lower scientific self-efficacy.

In conjunction with the results of Study 3, it can be said that this negative relationship probably consisted of negative feedback, which appeared to be counterproductive to self-efficacy beliefs. Conversely, attributing failure to a lack of support was positively related to scientific self-efficacy. Thereby, a lack of support cannot be put on a level with a bad relationship with the supervisor. This makes sense since there could be various reasons for a lack of support, such as: not claiming the needed support, low availability of the supervisor, or the supervisor not being an expert in one's specific research domain, etc. All of these

reasons were mentioned in the qualitative study, in which a low level of support or availability of the supervisor was not always related to a bad relationship or negative communicative style.

When in Study 2 the underlying dimensions of causal factors were measured (Chapter 9), it was shown that perceiving the main cause for doctoral success as stable[38] was positively related to academic career aspirations. Consistent with the hypothesis, perceiving the cause for failure as stable was negatively related to scientific self-efficacy.
According to the effect sizes, causal attributions appeared to be equally important with respect to expressed self-efficacy beliefs than other performance indicators, such as first publications. In addition, attributions to failure seemed to be more relevant than attributions to success.

The *indirect effects* of attributions *on academic career aspirations*, which were mediated by scientific self-efficacy, were rather small. Exceptions to this finding were attributions to failure. In Study 2, the indirect effect of attributing failure to a cause that was perceived as stable was quite noteworthy, likewise was the effect of attributing failure to a bad supervisor relationship in Study 1.
This could mean that attributions of failure have a higher impact on motivation and, to the contrary, might not matter as much when one was successful anyway. It is reasonable to assume that, after failure, the risk of failing in the future is perceived to be higher than after success. Therefore, the evaluation of the assumed underlying mechanism that led to the undesirable outcome and its future relevance may matter more.
This result is also in line with an array of research results which *"provide evidence that, other things being equal, negative events appear to elicit more physiological, affective, cognitive, and behavioral activity and prompt more cognitive analysis than neutral or positive events"* (Taylor, 1991, p. 67). Moreover, as also described in Chapter 2.1., *"[N]egative events elicit more causal attributional activity than do positive events"* (ibid., p. 70). This is plausible, because adapting one's behavior is specifically necessary after an event of failure, in order to prevent failure in the future (ibid.). Beyond that, and unlike in situations of success, in situations of failure people continue to think about causal factors even after having attributed a failure to a cause (see Chapter 2.2). Hence, causal attributions may have been more present and available for graduates who were rather unconfident with the outcome of their doctorate.

[38] Stable with respect to its influence on future academic career success.

In summary, the results support the preliminary hypotheses which were stated in Chapter 5: 1) causal attributions are associated to scientific self-efficacy *(Hypothesis 1)*; 2) higher scientific self-efficacy beliefs are linked to higher academic career aspirations *(Hypothesis 2)*; and 3) causal attributions are indirectly associated to academic career aspirations via scientific self-efficacy *(Hypothesis 3).* A limitation to Hypothesis 3, however, is the magnitude of the effect sizes. As already argued, causal attributions may matter more with respect to academic career aspirations in the case of a subjectively unsuccessful doctorate. In addition, it has to be noticed that self-efficacy and intrinsic motivation were the variables with the strongest correlations to the intention to pursue an academic career.

Feedback, Attributions and Affect. To begin with, it is noteworthy that—supporting the relevance of attributions—interviewees of Study 3 spontaneously stated causal attributions with respect to their experiences during the doctorate. Some of the results of the quantitative analyses had already hinted that the roles of feedback, the supervisor relationship and emotions would become apparent in the qualitative study (cf. Chapter 10).

Positive feedback and a constructive relationship with the supervisor seemed to strengthen positive attributions and a positive ability concept in the doctoral students. Furthermore, an internal attribution of success was related to positive emotions, which seemed to be strengthening motivation. However, within a qualitative approach, it is not possible to distinguish between outcome-generated and attribution-generated emotions.

Another result of the qualitative study was that doctoral students who experienced a lot of supervisor-related negativity seemed to protect their self-esteem with self-serving attributional patterns: attributing negative feedback from the supervisor to their personality and attributing elsewhere experienced success situations internally. Whereas these mechanisms of protecting self-esteem did not spare doctoral students from those moments of frustration when they were confronted with the "difficult supervisor personality", self-serving attributions seemed to be an important part of sustaining motivation during the doctorate and also the motivation to pursue academic research after graduation. All-in-all, the results—specifically from Study 3—hinted at the importance of the quality of the relationship to the doctoral supervisor(s), and not only at the quantity (Hauss et al., 2015).

Gender Differences. The hypothesis that females would express attributional patterns that would be less self-serving than those of their male counterparts was neither supported by the quantitative data nor did the qualitative data suggest gender differences in this respect.

Whereas within the life science graduates, there were no significant gender differences in scientific self-efficacy beliefs, there were significant gender differences within the medical group: female medical graduates expressed lower scientific self-efficacy beliefs in comparison to their male counterparts. These differences remained significant even after the control of various achievement variables in the first cohort (Study 1, Chapter 8).

However, in the second cohort there were no significant differences. When analyzing both samples together, results were aligned with those of Study 1. These deviations between Cohorts 1 and 2 may be a result of unobserved heterogeneity, such as unobserved qualitative differences between female and male medical graduate doctorates or different amounts of research experience. Alternatively, they may have resulted from a lower sample size and power in the second cohort.

In addition, female medical doctoral graduates also expressed significantly lower academic career aspirations in comparison to male medical graduates. This discrepancy turned insignificant when controlling for scientific self-efficacy beliefs. Again, it cannot be concluded that an increase in self-efficacy would likewise lead to increased academic career aspirations in female medical graduates or doctoral graduates in general. The possibility of an unobserved variable, which both influenced self-efficacy beliefs and academic career aspirations, such as a high motivation to research prior to the doctorate, or a "taste for science" (Roach & Sauermann, 2010), has to be considered. While it was attempted to reduce such potential biases by introducing various third variables, such as intrinsic motivation to conduct research before the doctorate, unobserved heterogeneity cannot be ruled out.

Differences between Fields of Study. In all of the studies conducted, differences between doctoral graduates in the life sciences and medicine were apparent. Medical doctoral graduates expressed significantly lower intrinsic research interest as a motivation to pursue a doctoral degree. They, furthermore, had significantly lower scientific self-efficacy beliefs, which were most probably the result of a stronger focus on clinical rather than research education within the regular course of medical studies.

When controlling for scientific self-efficacy beliefs, however, significant pre-existing differences in academic career aspirations between medical and life sciences doctoral graduates were no longer significant: when controlling for scientific self-efficacy, medical graduates had even higher academic career aspirations.

The results support the literature, which laments the lack of physician-scientists and medical students' low interest in research and research careers (summarized in Epstein et al., 2016).

Whereas medical graduates with the same levels of scientific self-efficacy beliefs as life science graduates did not have lower, but indeed expressed even higher academic career aspirations, these self-efficacy beliefs might have been the result of an initial interest in research. Therefore, it cannot be concluded that raising the scientific self-efficacy of medical students, which could be realized by a more intense education in research methods (etc.), would necessarily result in exhibiting a higher interest in academic research careers.

Vicarious Experience. The results of Study 1 and 3 suggest, moreover, a potential negative effect of vicarious experience—seeing others succeed or fail—on the intention to pursue an academic research career. Not only did respondents' open comments in the quantitative study and answers in the qualitative study indicate that the insecure occupational situation in academia was one major demotivating factor from aspiring to an academic career, but, in some of the statistical analyses, being a research associate during the doctorate was negatively related to the intention to stay in academic research.

This result coincided with respondents from Study 3, stating that they were demotivated seeing more advanced postdoctoral researchers struggle to remain employed or move on to the next career step. These results also fit to those of other empirical studies which show that more advanced doctoral students are less interested in research careers (Hauss et al., 2015; Roach & Sauermann, 2010). Blocking-out or downplaying limited career prospects in academic research may be easier when having only heard or abstractly knowing about them, as compared to when these realities are experienced by others close to one. And being a research associate during the doctorate makes it more likely to be exposed to those realities.

Career Aspirations in Academia and Other Domains. While several variables were related with academic career aspirations, such as scientific self-efficacy, attributions, intrinsic motivation and performance measures, aspiring to an academic career did not necessarily mean that other career options were excluded.

Among both quantitative studies, the intention to pursue an academic career was relatively low—more respondents expressed higher intentions to pursue a career outside academic research. For physicians, not surprisingly, the intention for a clinical career was the highest. In the qualitative interviews, it also became apparent that many of the respondents who were currently in academic research and/or could imagine remaining there were also open or interested in other career options. With this respect, a motivating work environment which fosters research competences and self-efficacy beliefs is important; however, unless the

academic work environment does not increase in attractiveness, talented researchers will possibly opt-out when given the opportunity.

12. Limitations and Outlook

***Time Horizon and Opportunity Structures*.** As already discussed, relatively initial post-doctoral career aspirations were analyzed. With this in mind, their predictive power with respect to actual long-term career paths came into question. Whereas initial career intentions are the first step towards pursuing a specific career, opportunity structures limit the realization of career wishes. This not only applies to early, but also advanced career stages.

With respect to opportunity structures, academic careers might end in later phases despite the wishes of researchers. It has to be also kept in mind that medical graduates have excellent career prospects outside of academia. This is, unfortunately, not the case for life scientists. Although this aspect was not analyzed here, some life science graduates might enter the postdoc phase against their desires due to a lack of alternatives. Judging by the open comments of the quantitative surveys[39] and the qualitative interviews, this is an issue future studies should consider. Moreover, as noted in the previous section, it has to be considered that graduates who aspire to, or consider pursuing an academic research career, at the same time do not rule out other career paths.

***Methods and Causality*.** As has already been extensively discussed in the sections on the quantitative studies, the cross-sectional designs do not allow the inference of causal relationships from the correlations that were found. This coincides with the uncertainty of the causal direction of the relationship: whereas it was argued that attributions affect scientific self-efficacy (which in turn affects career intentions), it might also be that career intentions influence scientific self-efficacy and attributions. Against that argument it can be reasoned, that an effect of attributions on self-efficacy is also shown by experimental research (Schunk, 1984; Schunk & Gunn, 1986; Silver et al., 1995; Stajkovic & Sommer, 2000; Tolli & Schmidt, 2008).

With respect to the qualitative study, a quantitative approach may shed light on the suggested relationship between feedback and attributions, as well as between attributions, affect, and motivation. As previously argued, a quantitative approach is necessary in order to distinguish

[39] For instance, one respondent commented: "Viele ‚retten' sich nach ihrer Promotion auf eine Postdoc-Stelle, um nicht ohne Job da zu stehen, sind also schnell in einem Beschäftigungsverhältnis. Der Berufseinstieg in einem Feld, das auch längerfristig eine Perspektive bietet, steht dann allerdings noch aus und fällt wesentlich schwerer."

between outcome- and attribution-generated emotions. Moreover, only within a quantitative approach is it possible to test whether emotions are a mediator between causal attributions and the motivation to pursue academic research after graduation. This also applies to the relationship between feedback and attributions which were hinted at by the qualitative interviews.

Additionally, the qualitative interviews suggested that some respondents—specifically physicians—differentiated between personal and scientific success. This may be especially an issue for doctoral students who never considered engaging in research after the doctorate. As noted earlier, this aspect should be considered in the future when assessing the subjective success of the doctorate: asking respondents whether doctorate was successful in a scientific sense could increase item difficulty and also increase validity, by ensuring that the "correct" causal attributions—with respect to *scientific* success or failure—are measured.

It is also noteworthy that many of the instruments—such as the intrinsic motivation scale, the causal dimensional, and scientific self-efficacy scale—were newly developed and have to be validated by future research. Also the assessed performance measures of the doctorate—grade, publications, conference attendances, and experimental vs. non-experimental research in medicine—may not have accounted for all differences in scientific ability and experience. For instance, medical graduates' lower scientific self-efficacy may have resulted from lower research experience prior to the doctorate. With respect to publications, the quality of the journals in which graduates published and the amount of co-authors were aspects, which were not measured here, however, could have influence respondents' scientific self-efficacy beliefs.

Outlook. Future studies should further explore the important aspects of a good supervisor-doctoral candidate relationship and its impact on academic career aspirations. Furthermore, it would be interesting to analyze how the attributional feedback of supervisors influences their doctoral candidates' self-efficacy and aspirations within and beyond their training. An intervention study with supervisors being trained to give motivating attributional feedback could be integrated into structured doctoral programs—and in the case of positive effects, such trainings could be broadly provided to doctoral supervisors. Alternatively, doctoral students could be provided with external mentoring and training. In this respect it would also interesting to investigate potential benefits of reattribution training.

In addition, future studies could look into the relationship between emotions and motivation of junior scientists. These might consider attribution– as well as outcome-generated and epistemic emotions (e.g., surprise or curiosity) (Pekrun, Elliot, & Maier, 2009).

Whereas the current studies analyzed the motivational effects of attributions for only a short time after the completion of the doctorate, it would be of further interest to analyze attributions and their impact on motivation and performance within the continued post-doctoral academic career. In this respect, it would be interesting to assess the stability of attributional patterns as well. Another issue future studies should examine is the relationship between level of aspiration, self-efficacy, and career success in the initial postdoc career stage (i.e., upon entrance into a postdoc position) and in later ones, in terms of publishing and reaching higher ranking positions. Various studies have shown that self-efficacy is related to self-regulation or motivated behavior, such as persistence, through which achievement is affected (e.g., Relich et al., 1986).

Although the results of the current studies hinted more towards no gender differences the life sciences with respect to academic career aspirations and scientific self-efficacy, future studies should look into the development of these parameters over the long-term course of the career. Work experiences may have a crucial influence on self-efficacy beliefs and career motivation. These may, furthermore, vary between men and women, as Abele's (2006) results suggest: whereas no differences in vocational self-efficacy were found between male and female physician-scientists after the second state examination, they *were* found three years after entering the labor market.

Beyond that, it appeared from the current study that female medical graduates had lower scientific self-efficacy beliefs and lower intentions to pursue an academic research career. Given the female dominance in the medical student population and the concern for a lack of physician-scientists in the future (Epstein et al., 2016), this topic is worth of future research.

It may for instance be possible, that male and female medical students already differ with respect to their interest before entering university. Moreover, male medical students may be encouraged more to research by the, predominantly male, professors. Also difficulties to combine research, teaching, and patient care with family duties may be more of a concern for female physicians.

In addition, the results of the present study consistently showed a lower general interest in research and academic careers in medical doctoral graduates. The collaboration of physician-scientists with scientists from basic life sciences is, however, important to translational research and to bringing new research results from "bench to bedside".

Studies should explore how medical students' and graduates' research interests and self-efficacy beliefs can be strengthened. However, it is noteworthy that doctoral graduates from

life sciences also preferred a career outside of academia. While positive attributions and attributional feedback can be helpful in maintaining motivation, actual career prospects have to possibly change in order to attract junior scientists to academic research. Especially since most graduates cannot only envision one career track, hence, they might leave academia when offered more secure and better-paid jobs outside academic research.

Following the frame selection theory proposed by Esser (2001) and further developed by Kroneberg (2005), aspiration level could also interact with opportunity structures in that higher aspiration levels could be a factor of "blindness" to other opportunities. Conversely, junior researchers with moderate levels of academic career aspirations may be more rational in their career decisions and more open to opportunities offered outside academia.

Another aspect that was suggested as important with respect to academic career aspirations was *vicarious experience:* seeing postdoctoral researchers in one's environment struggle with respect to continuing their academic career—whether this means advancing on the career ladder or just remaining employed—could, more than just knowing about the limited career prospects in academia, further deter junior researchers from continuing academic research. With respect to the decreasing amount of female researchers with higher ranks, vicarious experience could be an even higher discouragement for female doctoral graduates if they infer their career chances by the proportion of postdoctoral female researchers and professors. Likewise, Ceci et al. (2009, p. 247) noted that "*[i]t is also likely that the career status—the prevalence of each sex in different careers and at different levels—affects cultural expectations […]*."

While there was no difference in expressed academic career aspirations of female and male life scientists at this stage, this issue might be relevant with respect to medical students and/or at later career stages.

13. Contributions and Practical Implications

Contributions. The present dissertation supports the role of scientific self-efficacy with respect to the intention to pursue an academic research career within the fields of medicine and life sciences. In addition, by comparing medical and life sciences graduates regarding scientific self-efficacy and academic career aspirations, the study first investigated the assumption that medical graduates have a lower interest in research careers in comparison to graduates from basic life sciences. The evidence attained within the dissertation suggested that, indeed, medical doctoral graduates are less confident in their scientific competencies, that is, express lower scientific self-efficacy, and indeed appear to be not as interested in academic research careers. As has been argued, the reason for lower scientific self-efficacy in medical education may lay in the larger focus on clinical qualification versus research content (DFG, 2010; Wissenschaftsrat, 2014).

Another important result referred to gender differences: female medical graduates had lower scientific self-efficacy and academic career aspirations, however, this was not observed for female graduates in the life sciences. This result also points to the importance of analyzing fields of study separately, since potential discrepancies between fields of study are often neglected.

Beyond that, this study contributes to the minimal research that has been done on *sources of* scientific self-efficacy, focusing specifically on a potential role of causal attributions (Weiner, 1985, 2000). Using the critical incident-method (see Vispoel & Austin, 1995)—measuring causal attributions with respect to an authentic event (the doctorate)—the dissertation further contributes to understanding the relevance of causal attributions in "real life". It was found that performance indicators, specifically first author publications, and attributions were significantly related to scientific self-efficacy. Whereas external attributions of success are often presumed to be negative and attributing failure to external factors is considered positive, the results were more complex: attributing failure to a bad relationship with the supervisor was negatively related to scientific self-efficacy and academic career aspirations (against the hypotheses). In conjunction with the qualitative interviews, a negative relationship with the supervisor appears to be characterized by feedback that inhibits doctoral candidates' self-efficacy. Conversely, the positive correlation between attributing success to a benevolent grading and academic career aspirations may indicate a positive experience regarding the scientific community and gratefulness.

Practical Implications. The practical implications of this study refer to doctoral education generally and, further, to the education of physicians specifically. It appeared that medical doctoral graduates have lower interest in pursuing an academic research career. However, physician-scientists are important players in clinical and translational research (Beisiegel 2009) as they are the "bridge between bench and bedside" (Rosenberg, 1999, p.1621). To foster research interest and scientific self-efficacy in medical students, it may be helpful to integrate more research content within the standard curriculum (Epstein et al., 2016).

Considering the results of causal attributions and hints to the importance of the supervisor, it could be fruitful to instruct doctoral supervisors with respect to "constructive attributional feedback" and/or to provide doctoral candidates with external coaching and mentoring. Given the empirical evidence that reattribution trainings can positively influence motivation (Relich, Debus & Walker, 1986; Ziegler & Heller, 2000), such trainings are another option for doctoral candidates that struggle with their supervisor(s). Needless to say, the proposed steps would have to be further researched, ideally within intervention studies, before broadly implementing them into undergraduate and doctoral education.

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List of Figures and Tables

Appendix

1. Measurement Instruments

1.1 Intrinsic Research Interest as Motivation for the Doctorate

German

Bitte geben Sie für jeden aufgelisteten Grund an, inwieweit dieser auf Ihre Entscheidung für die Promotion zutrifft oder nicht zutrifft.

(5) trifft voll und ganz zu; 4) trifft eher zu; 3) teils teils; 2) trifft eher nicht zu 1) trifft überhaupt nicht zu)

Ich wollte promovieren…

- um allgemein später in der Forschung arbeiten zu können *(Item 1)*
- um fachlich dazuzulernen *(Item 2)*
- um während der Promotion forschen zu können *(Item 3)*
- um mich intensiver mit dem speziellen Thema meiner Promotion zu beschäftigen *(Item 4)*

English

Please state the extent to which each of the reasons listed below applies to your decision for starting a PhD program or not.

(5) completely applies to my situation; 4) somewhat applies; 3) neither; 2) doesn't apply; 1) doesn't apply at all)

I wanted to take a doctoral degree...

- in order to work in research *(Item 1)*
- in order to learn more about my subject *(Item 2)*
- in order to be able to do research while doing my PhD *(Item 3)*
- in order to deal intensively with the specific topic of my doctoral thesis *(Item 4)*

1. 2. Attributions to Success and Failure, Study 1

German

1. Meine Dissertation war ….5) sehr erfolgreich, 4) eher erfolgreich, 3) teils teils, 2) eher nicht erfolgreich, 1) überhaupt nicht erfolgreich

2. a) Filter: sehr erfolgreich, eher erfolgreich:

Für den Erfolg meiner Dissertation waren folgende Faktoren maßgeblich:

5) stimme voll und ganz zu ; 4) stimme eher zu; 3) teils teils; 2) stimme eher nicht zu; 1) stimme überhaupt nicht zu

- Die Unterstützung durch andere Personen, wie z.B. meine(n) Betreuer, andere wie z.B. meine(n) Betreuer, andere Doktoranden, Freunde
- Das gute Verhältnis zu meinem(r) Doktorvater/-mutter und/ oder zu anderen Betreuern
- Meine Fähigkeiten/meine Begabung
- Der hohe Arbeitsaufwand, den ich aufgebracht habe
- Geringe promotionsfremde Belastungen

2.b) (Filter: teils teils, eher nicht erfolgreich, überhaupt nicht erfolgreich).

Folgende Faktoren waren maßgeblich dafür, dass meine Dissertation weniger/nicht erfolgreich war:

5) stimme voll und ganz zu ; 4) stimme eher zu; 3) teils teils; 2) stimme eher nicht zu; 1) stimme überhaupt nicht zu

- Die geringe Unterstützung durch andere Personen, wie z.B. meine(n) Betreuer, andere Doktoranden, Freunde
- Die Strenge Bewertung meiner Dissertation
- Meine Fähigkeiten/meine Begabung
- Das schlechte Verhältnis zu meinem(r) Doktorvater/-mutter
- Der niedrige Arbeitsaufwand, den ich aufgebracht habe
- Hohe promotionsfremde Belastungen

English

1. My doctorate was…5) very successful; 4) rather successful; 3) partly successful; 2) rather not successful; 1) not at all successful

2. a) Filter: very successful, rather successful:

Regarding the success of my dissertation the following factors were essential:

- The support from other people, e.g. my academic supervisor(s), other PhD candidates, friends or family, etc.
- The good relationship with my academic supervisor and/or other supervisors
- My skills/my talent
- My high effort
- The favorable grading of my dissertation
- Low workload besides my doctorate

2. b) Filter: partly successful, rather not successful, not successful:

The following factors where essential in that my dissertation was only partly/ rather not/ not at all successful:

- Little support from other people, e.g. my academic supervisor, other PhD candidates, friends or family
- The bad relationship with my academic supervisor
- My skills/ my talent
- The strict grading of my dissertation
- little effort
- High workload besides my doctorate

1.2 Attributions to Success and Failure, Study 2

German

2.a) Filter: sehr erfolgreich, eher erfolgreich.

Was war Ihrer Meinung nach die Hauptursache die zum Erfolg geführt hat? Bitte wählen Sie die eine Hauptursache aus, die Ihrer Meinung am wichtigsten war für den Erfolg Ihrer Promotion.

Bitte wählen Sie eine der folgenden Antworten:

- Rahmenbedingungen/ Ressourcen (z.B. gute Laborausstattung)
- Von mir aufgebrachter Arbeitsaufwand
- Meine Motivation

- Wissenschaftliches Arbeiten liegt mir
- Gute Ergebnisse / wissenschaftlich verwertbare Ergebnisse
- Meine Kompetenzen / Fähigkeiten
- Gute Betreuung
- Ich hatte Glück
- Andere Ursache, und zwar …

2.b) Filter: teils teils, eher/ nicht erfolgreich:

Bitte wählen Sie die eine Hauptursache aus, die Ihrer Meinung am meisten dazu beigetragen hat, dass Ihre Promotion nicht so erfolgreich war.

Bitte wählen Sie eine der folgenden Antworten:

- Wissenschaftliches Arbeiten liegt mir nicht
- Geringe Motivation
- Schlechte Ergebnisse/ wissenschaftlich "nicht verwertbare" Ergebnisse
- Ich hatte Pech
- Rahmenbedingungen/ Ressourcen (z.B. schlechte Laborausstattung)
- Meine Kompetenzen / Fähigkeiten
- Von mir aufgebrachter Arbeitsaufwand
- Schlechte /unzureichende Betreuung
- Andere Ursache, und zwar….

3. Im Folgenden geht es darum die von Ihnen angegebene Hauptursache hinsichtlich verschiedener Merkmale zu beurteilen.

Lokation

Die Ursache ist…

in anderen Menschen oder anderen Umständen begründet	1	2	3	4	5	6	7	*in mir selbst begründet*
etwas, das einen Aspekt der Gegebenheiten wiederspiegelt	1	2	3	4	5	6	7	etwas, das einen Aspekt meiner Person widerspiegelt

Kontrollierbarkeit

Die Ursache ist…

nicht beeinflussbar durch mich	1	2	3	4	5	6	7	*beeinflussbar durch mich*
etwas, für das ich nichts kann	1	2	3	4	5	6	7	*etwas, für das ich verantwortlich bin*

Stabilität

Wenn ich wissenschaftlich tätig sein werde, wird diese Ursache...

in Zukunft nie wieder meinen Erfolg in der Wissenschaft beeinflussen	1	2	3	4	5	6	7	*auch in Zukunft immer wieder meinen Erfolg in der Wissenschaft beeinflussen*
in Zukunft nie wieder bedeutsam sein, wenn ich in der Wissenschaft erfolgreich bin	1	2	3	4	5	6	7	*in Zukunft immer wieder bedeutsam sein, wenn ich in der Wissenschaft erfolgreich bin*

Globalität

Die Ursache…

war spezifisch in Bezug auf die Situation der Promotion	1	2	3	4	5	6	7	*ist global in Bezug auf (Leistungs-)Situationen in der Wissenschaft*

continued

wirkte sich nur auf die Promotion aus	1	2	3	4	5	6	7	*wirkt sich auch auf andere (Leistungs-) Situationen in der Wissenschaft aus*

English

2. a) Filter: successful, rather successful:

What was in your opinion the main cause for the success of your doctorate? Please choose the main cause, which affected the success of your doctorate the most in your opinion.

- the amount of work I put into it
- I was lucky
- my motivation
- good results / scientifically usable results
- structural conditions / resources (e.g. laboratory equipment)
- I have a talent for scientific work
- my own competencies and abilities
- good supervision
- other cause, please specify

2. a) Filter: partly successful, rather not successful, not successful:

What was in your opinion the main cause for this? Please choose the main cause, which in your opinion had the most influence on your doctorate not being so successful.

- no good/ inadequate supervision
- bad results/ scientifically not usable results
- my own competencies and abilities
- low motivation
- I have no talent for scientific work
- I had bad luck
- structural conditions / resources (e.g. insufficient laboratory equipment)
- the amount of work I put into it
- other cause, please specify

3. Please evaluate the main cause you have chosen in respect to several features. The cause is (something)…

Locus

that reflects an aspect of the situation	1	2	3	4	5	6	7	*that reflects an aspect of myself*
totally due to other people or circumstances	1	2	3	4	5	6	7	*totally due to me*

Controllability

The cause is something…

*I **cannot** regulate*	1	2	3	4	5	6	7	*I can regulate*
*over which I have **no** power*	1	2	3	4	5	6	7	*over which I have power*

Stability

In the future when working in academic research, the cause will....

will not be important for my success in academic research	1	2	3	4	5	6	7	*will be important for my success in academic research*
not influence my success in academic research	1	2	3	4	5	6	7	*continue to influence my success in academic research*

Globality

The cause….

influenced just the situation of the doctorate	1	2	3	4	5	6	7	*influences all (performance)-situations in academic research*
affected only my performance in the doctorate	1	2	3	4	5	6	7	*affects my performance in academic research generally*

1.3 Self-Efficacy Beliefs

German

Jetzt nach der Promotion kann ich…

5) stimme voll und ganz zu; 4) stimme eher zu; 3) teils teils; 2) stimme eher nicht zu 1) stimme überhaupt nicht zu)

- Kooperationen mit anderen Wissenschaftlern aufbauen *(Item 1)*
- Drittmittel für Forschungsprojekte einwerben *(Item 2)*
- ein Forschungsprojekt auf die Beine stellen (Konzeption, Formulierung und Einreichung eines Forschungsprojekts) *(Item 3)*
- Langfristige Forschungsprojekte betreuen und durchführen *(Item 4)*
- Regelmäßig Forschungsergebnisse in Zeitschriften mit Peer Review Verfahren publizieren *(Item 5)*
- eine Habilitationsschrift oder mehrere Publikationen für eine Sammelhabilitation verfassen *(Item 6)*
- wissenschaftliche Anerkennung in der Scientific Community erlangen *(Item 7)*

English

Now that I have my PhD, I am sure I can….
5) completely agree; 4) rather agree; 3) partly agree; 2) rather disagree; 1) completely disagree)

- Collaborate with other scientists *(Item 1)*
- Raise third-party funds for research projects *(Item 2)*
- Mount a research project (doctrine, formulating and handing in a research project) *(Item 3)*
- Supervise and conduct long-term research projects *(Item 4)*
- Frequently publish research findings in articles with peer review process *(Item 5)*
- Compose a habilitation Dissertation or several publications for a collective habilitation *(Item 6)*
- Get scientific recognition in the scientific community *(Item 7)*

1.4 Long Term Career Aspirations

German

Bitte geben Sie bei den folgenden Aspekten an, inwieweit Sie der Aussage zustimmen oder nicht zustimmen.

(5) stimme voll und ganz zu; 4) stimme eher zu; 3) teils teils, 2) stimme eher nicht zu, 1) stimme überhaupt nicht zu).

Langfristig möchte ich...

- Eine Forschungskarriere an einer Universität oder einem Universitätsklinikum machen *(Item 1, Academic Career Aspirations)*
- Eine Professur bekommen *(Item 2, Academic Career Aspirations)*
- Eine Karriere außerhalb der Wissenschaft machen *(Career Outside Academia)*
- in einem privaten Unternehmen forschen *(Career Industrial Research)*
- einer Tätigkeit mit Patientenkontakt nachgehen *(Clinical Research Career)*

English

In the long run, I would like to…

- have a research career at a university or a university hospital (Item 1, Academic Career Aspirations)
- be appointed a professorship *(Item 2, Academic Career Aspirations)*
- have a career outside of science *(Career Outside Academia)*
- do research in a private company *(Career Industrial Research)*
- have an occupation with patient contact *(Clinical Research Career)*

2. Results of Study 1

2.1 Determination of Factors, Exploratory Factor Analysis

1) Scientific Self-Efficacy Beliefs

Table 21: Exploratory Factor Analysis, Scientific Self-Efficacy (Study 1)

	Factor loadings	Uniqueness
Item 1	0.776	0.397
Item 2	0.789	0.378
Item 3	0.861	0.260
Item 4	0.851	0.275
Item 5	0.859	0.262
Item 6	0.789	0.362
Item 7	0.859	0.262
N	545	

Legend: factor analysis, unrotated solution, minimum eigenvalue of factors=1, numbers rounded to the third decimal place

Figure 13: Scree-plot, Scientific Self-Efficacy Beliefs

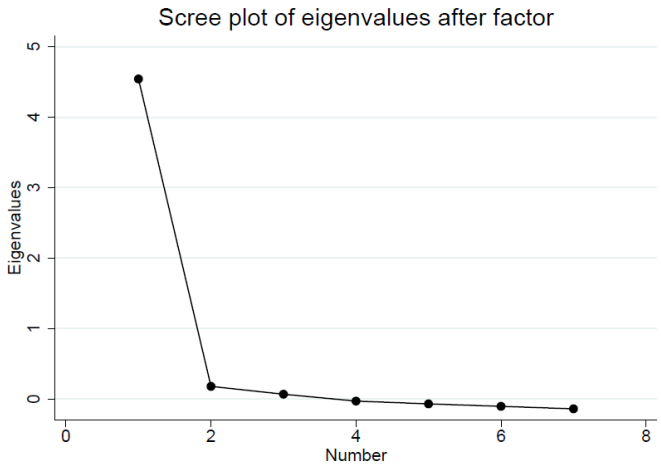


Figure 14: Minimum Average Partial Correlation Test, SPSS Output, Scientific Self-Efficacy

```
Eigenvalues
       5,1007
        ,4673
        ,4466
        ,3441
        ,2776
        ,2216
        ,1421

Average Partial Correlations
                      squared         power4
          ,0000         ,4690         ,2262
         1,0000         ,0508         ,0044
         2,0000         ,0961         ,0266
         3,0000         ,1421         ,0756
         4,0000         ,2637         ,1715
         5,0000         ,4253         ,2969
         6,0000        1,0000        1,0000

The smallest average squared partial correlation is, 0508

The smallest average 4rth power partial correlation is, 0044

The Number of Components According to the Original (1976) MAP Test is 1

The Number of Components According to the Revised (2000) MAP Test is 1
```

2) Intrinsic Research Motivation to Start the Doctorate

Table 22: Exploratory Factor Analysis, Intrinsic Research Interest As Motivation for the Doctorate

	Factor loadings	Uniqueness
Item 1	0.655	0.510
Item 2	0.710	0.495
Item 3	0.810	0.344
Item 4	0.680	0.539
N	574	

Legend: factor analysis, unrotated solution, minimum eigenvalue of factors=1, numbers rounded to the third decimal place

Figure 15: Scree-plot, Intrinsic Research Motivation

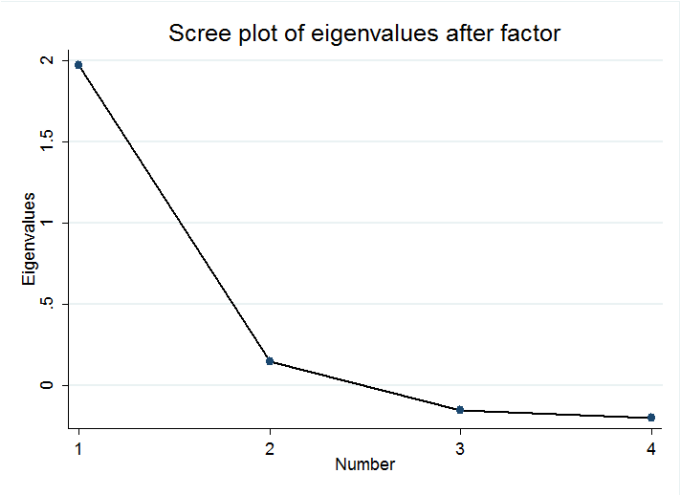


Figure 16: Minimum Average Partial Correlation Test, SPSS Output, Intrinsic Research Motivation

```
Velicer's Minimum Average Partial (MAP) Test:

Eigenvalues
       2,5891
        ,6758
        ,4208
        ,3143

Average Partial Correlations
                       squared         power4
          ,0000          ,2863          ,0900
         1,0000          ,1366          ,0282
         2,0000          ,3371          ,2387
         3,0000         1,0000         1,0000

The smallest average squared partial correlation is
        ,1366

The smallest average 4rth power partial correlation is
        ,0282

The Number of Components According to the Original (1976) MAP Test is
  1

The Number of Components According to the Revised (2000) MAP Test is
  1
```

2.2 Exploratory and Descriptive Results

Attributions

Table 23:Attributional Patterns Subjectively Successful Sample

	Male Medicine		Female Medicine		Male Life Sciences		Female Life Sciences		Total	
Variables	M	SD	M	SD	M	SD	M	SD	M	SD
Ability	3.95	0.67	4.30	0.60	4.30	0.60	4.26	0.64	4.10	0.70
Effort	4.34	0.74	4.27	0.80	4.27	0.80	4.37	0.66	4.34	0.73
Benevolent grading	2.97	1.19	2.52	1.20	2.52	1.20	2.53	1.04	2.74	1.17
External help	4.40	0.78	4.38	0.81	4.38	0.81	4.29	0.89	4.42	0.80
Supervisor relationship	4.23	1.04	4.07	1.18	4.07	1.18	3.90	1.20	4.12	1.11
Little workload	2.20	1.25	2.05	1.16	3.25	1.20	2.98	1.21	2.50	1.29
Internal vs. External	0.77	0.86	0.67	0.87	0.77	0.94	0.89	0.85	0.76	0.87

Legend: Means (M) and standard deviations (SDs) for attributional items rounded to the third decimal place, subjectively successful doctorates

Table 24: Attributional Patterns Subjectively rather Unsuccessful Sample

	Male Medicine		Female Medicine		Male Life Sciences		Female Life Sciences		Total	
Variables	M	SD	M	SD	M	SD	M	SD	M	SD
Ability	2.10	1.17	2.40	0.96	2.24	1.09	2.10	0.10	2.27	1.10
Effort	1.75	1.07	1.870	0.99	1.47	0.72	1.23	0.57	1.67	0.92
Strict grading	2.25	1.33	2.271	1.30	1.65	0.70	2.20	1.22	2.18	1.23
Lack of external support	2.90	1.48	3.014	1.28	2.71	1.26	3.30	1.87	2.97	1.33
Supervisor relationship	2.15	1.42	2.229	1.31	2.41	1.12	2.52	1.55	2.30	1.35
High workload	2.95	1.61	2.671	1.40	1.77	1.20	1.87	1.20	2.42	1.42
Effort/external vs. ability	0.39	1.29	0.037	1.07	0.47	0.10	0.19	0.19	0.10	1.11

Legend: Means (M) and standard deviations (SDs) rounded for the third decimal place, for attributional items, subjectively rather unsuccessful doctorates

Table 25: Gender Differences on three Aspects of Scientific Self-Efficacy, Results of Two-Sided T-Tests, Medicine

	Male			Female			
Variable	M	SD	N	M	SD	N	p
Cooperating	2.46	1.06	114	2.15	0.94	229	0.006
Conducting Research	2.75	1.11	114	2.30	1.14	230	0.001
Visibility	2.68	1.13	113	2.16	1.02	219	0.000

Legend: Means (M) and standard deviations (SDs) rounded to the second decimal place, p-values refer to two tailed t-tests and are rounded to the third decimal place. Cooperating=items 1 and 2 of scientific self-efficacy, conducting research= items 3 and 4, visibility= items 5 to 7. SSE=.

Table 26: Gender Differences on three Aspects of Scientific Self-Efficacy, Results of Two-Sided T-Tests, Life Sciences

	Male			Female			
Variable	M	SD	N	M	SD	N	p
Cooperating	3.29	0.98	83	3.32	0.87	150	0.821
Conducting Research	3.70	0.85	83	3.65	0.92	151	0.710
Visibility	3.42	0.97	81	3.42	0.97	134	0.999

Legend: Means (M) and standard deviations (SDs) rounded to the second decimal place, p-values refer to two tailed t-tests and are rounded to the third decimal place. Cooperating=items 1 and 2 of scientific self-efficacy, conducting research= items 3 and 4, visibility= items 5 to 7.

2.3 Multivariate Results with Imputed Values

Table 27: FIML Path model, Academic Career Aspirations (ACAs) as Dependent and Scientific Self-Efficacy (SSE) as Mediator Variable, Subjectively Successful Doctorates

	M1 Direct Effects on SSE			**M2** Direct Effects on ACAs			**M3** Indirect Effects on ACAs		
Variables	ß	SE	p	ß	SE	p	ß	SE	p
SSE				0.37	0.05	0.001			
Ability	0.09	0.04	0.019	0.00	0.04	0.950	0.03	0.03	0.026
Effort	0.07	0.04	0.052	-0.05	0.04	0.252	0.03	0.03	0.061
External Help	-0.04	0.04	0.238	0.08	0.04	0.029	-0.02	0.02	0.245
Benevolent evaluation	-0.03	0.03	0.425	-0.05	0.04	0.199	-0.01	0.02	0.429
Good relationship	0.06	0.04	0.102	0.00	0.04	0.986	0.02	0.02	0.112
Low workload	0.03	0.04	0.432	0.08	0.06	0.217	0.01	0.02	0.435
Male medicine*	-0.03	0.06	0.619	0.07	0.07	0.297	-0.01	0.07	0.620
Female medicine*	-0.17	0.06	0.010	-0.04	0.05	0.477	-0.06	0.08	0.016
Female life sciences*	0.00	0.05	0.917	-0.04	0.04	0.347	0.00	0.06	0.917
Age	0.10	0.04	0.007	-0.11	0.04	0.005	0.04	0.00	0.013
Duration of doctorate	-0.09	0.04	0.011	-0.05	0.05	0.290	-0.04	0.00	0.017
Articles as 1st author	0.19	0.04	0.000	0.08	0.04	0.053	0.07	0.02	0.000
Articles as co-author	0.04	0.04	0.262	0.11	0.05	0.044	0.02	0.01	0.267
Grade: *summa cum laude***	0.04	0.05	0.419	-0.01	0.05	0.814	0.01	0.07	0.422
Grade: *magna cum laude***	0.04	0.05	0.411	0.01	0.04	0.816	0.01	0.05	0.414
No grade**	0.07	0.04	0.080	0.06	0.05	0.190	0.03	0.09	0.090
Conference attendances	0.16	0.04	0.000	0.00	0.04	0.948	0.06	0.02	0.001
Children	-0.10	0.04	0.011	-0.22	0.05	0.000	-0.04	0.03	0.017
Doctorate as research associate	-0.10	0.05	0.045	0.27	0.04	0.000	-0.04	0.06	0.054
Research associate after doctorate	0.11	0.04	0.002	0.27	0.05	0.000	0.04	0.05	0.006
Intrinsic motivation	0.38	0.04	0.000	0.12	0.51	0.023	0.14	0.03	0.000
Constant	-2.71	0.44	0.000	0.37	0.05	0.000	0.03	0.03	0.026
N	401								
R^2	0.60			0.53					
Overall R^2	0.71								

Legend: *Reference category: male life scientists, **reference category *cum laude* and worse, standardized coefficients and standard errors (SEs) rounded to the second, p-values to the third decimal place. M=Model, SSE=scientific self-efficacy.

Table 28: MICE Regression Analyses, SSE and ACAs as Dependent Variables, Subjectively Successful Doctorates

	M1 Effects on SSE			**M2** Effects on ACAs			**M3** Effects on ACAs		
Variables	B	SE	p	B	SE	p	B	SE	p
SSE							0.61	0.08	0.001
Ability	0.11	0.05	0.032	0.17	0.09	0.050	0.10	0.08	0.235
Effort	0.09	0.05	0.071	0.09	0.08	0.291	0.03	0.08	0.712
Help from others	-0.04	0.04	0.350	-0.06	0.07	0.451	-0.03	0.07	0.636
Benevolent grading	-0.03	0.03	0.303	0.10	0.05	0.041	0.11	0.04	0.014
Good relationship	0.05	0.03	0.111	-0.02	0.06	0.790	-0.04	0.05	0.414
Low workload	0.02	0.03	0.470	-0.02	0.05	0.660	-0.04	0.04	0.393
Male medicine*	-0.10	0.12	0.406	0.27	0.21	0.193	0.35	0.20	0.082
Female medicine*	-0.35	0.12	0.005	-0.03	0.21	0.894	0.20	0.20	0.321
Female life sciences*	-0.01	0.10	0.929	-0.30	0.17	0.072	-0.28	0.15	0.067
Age	0.02	0.01	0.003	0.00	0.01	0.878	-0.01	0.01	0.364
Duration of doctorate	-0.00	0.00	0.023	-0.01	0.00	0.001	-0.01	0.00	0.015
Articles as 1st author	0.13	0.03	0.001	0.04	0.05	0.424	-0.04	0.05	0.380
Articles as co-author	0.02	0.02	0.393	0.08	0.04	0.046	0.06	0.04	0.090
Grade: *summa cum laude***	0.08	0.12	0.505	0.65	0.21	0.002	0.61	0.20	0.002
Grade: *magna cum laude***	0.05	0.09	0.585	0.11	0.15	0.477	0.09	0.14	0.549
No grade**	0.24	0.15	0.121	0.36	0.26	0.176	0.21	0.25	0.397
Conference attendances	0.08	0.02	0.001	0.09	0.04	0.026	0.03	0.04	0.395
Children	-0.14	0.05	0.005	-0.10	0.08	0.204	-0.01	0.07	0.850
Doctorate as research associate	-0.20	0.10	0.042	-0.72	0.16	0.001	-0.59	0.15	0.001
Research associate after doctorate	0.21	0.08	0.004	0.82	0.13	0.001	0.70	0.12	0.001
Intrinsic motivation	0.33	0.03	0.001	0.49	0.06	0.001	0.28	0.06	0.001
Constant	-2.49	0.42	0.001	-0.39	0.72	0.586	1.17	0.71	0.100
N	428			403			428		
P>F	0.001								

Legend: *Reference category: male life scientists, **reference category *cum laude* and worse, 15 imputations. Coefficients and standard errors (SEs) rounded to the second, p-values to the third decimal place. Imputed values of dependent variables not imputed. M=Model, SSE=scientific self-efficacy.

Table 29: FIML Path Model, Academic Career Aspirations (ACAs) as Dependent and Scientific Self-efficacy (SSE) as Mediator Variable, Subjectively Unsuccessful Doctorates

	M1 Direct Effects on SSE			**M2** Direct Effects on ACAs			**M3** Indirect Effects on ACAs		
Variables	ß	SE	p	ß	SE	p	ß	SE	p
SSE				0.20	0.10	0.044			
Ability	-0.20	0.07	0.003	0.14	0.08	0.064	-0.04	-0.04	0.093
Effort	-0.09	0.08	0.259	0.04	0.08	0.612	-0.02	-0.02	0.327
Lack of Support	0.16	0.07	0.027	-0.09	0.08	0.264	0.03	0.03	0.139
Benevolent grading	0.11	0.07	0.123	0.20	0.08	0.011	0.02	0.02	0.223
Bad relationship	-0.24	0.08	0.002	0.04	0.09	0.670	-0.04	-0.05	0.091
Low workload	0.00	0.08	0.992	-0.04	0.09	0.623	0.00	0.00	0.992
Male medicine*	-0.35	0.11	0.001	0.33	0.12	0.007	-0.22	-0.07	0.089
Female medicine*	-0.46	0.12	0.001	0.37	0.15	0.011	-0.21	-0.09	0.079
Female life sciences*	-0.01	0.09	0.949	0.23	0.10	0.020	0.00	0.00	0.949
Age	0.00	0.09	0.957	0.10	0.10	0.297	0.00	0.00	0.957
Duration of doctorate	-0.01	0.10	0.912	-0.24	0.11	0.031	0.00	0.00	0.912
Articles as 1st author	0.20	0.08	0.009	0.16	0.09	0.081	0.07	0.04	0.113
Articles as co-author	-0.10	0.08	0.231	-0.11	0.09	0.201	-0.02	-0.02	0.303
Grade: *summa cum laude***	0.21	0.09	0.018	-0.07	0.10	0.456	0.09	0.04	0.129
Grade: *magna cum laude***	0.11	0.07	0.124	-0.04	0.08	0.589	0.08	0.02	0.222
No grade**	0.18	0.09	0.038	-0.13	0.10	0.186	0.03	0.04	0.149
Conference attendances	0.08	0.08	0.309	-0.03	0.09	0.701	0.02	0.02	0.362
Children	0.01	0.09	0.896	-0.06	0.10	0.513	0.01	0.00	0.896
Doctorate as research associate	0.13	0.07	0.060	0.29	0.08	0.000	0.07	0.03	0.172
Research associate after doctorate	0.12	0.08	0.134	0.35	0.08	0.000	0.03	0.02	0.215
Intrinsic motivation	-0.21	0.76	0.782	-0.70	0.82	0.396	-0.04	-0.04	0.093
Constant	-0.20	0.07	0.003	0.14	0.08	0.064	-0.02	-0.02	0.327
N	126								
R^2	0.57			0.47					
Overall R^2	0.75								

Legend: *Reference category: male life scientists, **reference category *cum laude* and worse, coefficients and standard errors (SEs) rounded to the second, p-values to the third decimal place. M=Model, SSE=scientific self-efficacy.

Table 30: MICE Regression Analyses, Academic Career Aspirations (ACAs) as Dependent and Scientific Self-efficacy (SSE) as Mediator Variable, Subjectively Unsuccessful Doctorate.

	M1 Effects on SSE			**M2** Effects on ACAs			**M3** Effects on ACAs		
Variables	B	SE	p	B	SE	p	B	SE	p
SSE							0.30	0.13	0.023
Ability	-0.17	0.06	0.007	0.09	0.08	0.300	0.12	0.08	0.121
Effort	-0.06	0.08	0.411	0.03	0.11	0.801	0.01	0.10	0.891
Lack of Support	0.13	0.05	0.013	-0.06	0.08	0.417	-0.08	0.07	0.219
Strict grading	-0.18	0.05	0.001	-0.00	0.08	0.965	0.05	0.07	0.509
Bad relationship with supervisor(s)	0.10	0.06	0.063	-0.18	0.08	0.031	-0.18	0.07	0.016
High workload besides doctorate	-0.06	0.05	0.266	-0.03	0.07	0.694	0.00	0.07	0.951
Male medicine*	-0.83	0.26	0.002	0.77	0.39	0.052	1.11	0.37	0.003
Female medicine*	-0.73	0.23	0.002	0.66	0.34	0.057	0.79	0.31	0.013
Female life sciences*	0.02	0.22	0.937	0.39	0.32	0.221	0.30	0.27	0.271
Age	-0.01	0.02	0.731	0.02	0.03	0.480	0.02	0.03	0.511
Duration of doctorate	0.00	0.00	0.491	-0.01	0.01	0.242	-0.01	0.00	0.266
Articles as 1st author	0.31	0.10	0.002	0.28	0.15	0.062	0.20	0.15	0.187
Articles as co-author	0.00	0.06	0.960	-0.11	0.09	0.207	-0.06	0.08	0.457
Grade: *summa cum laude***	0.28	0.16	0.077	-0.15	0.22	0.504	-0.30	0.20	0.155
Grade: *magna cum laude***	0.25	0.22	0.256	-0.24	0.30	0.435	-0.31	0.27	0.254
No grade**	0.11	0.06	0.064	-0.04	0.08	0.575	-0.11	0.07	0.123
Conference attendances	0.06	0.10	0.537	-0.09	0.14	0.540	-0.17	0.12	0.161
Children	0.06	0.17	0.723	-0.04	0.26	0.886	-0.06	0.23	0.798
Doctorate as research associate	0.28	0.15	0.067	0.84	0.21	0.001	0.62	0.19	0.002
Research associate after doctorate	0.07	0.08	0.379	0.35	0.10	0.001	0.30	0.09	0.002
Intrinsic motivation	-0.19	0.71	0.786	-0.62	1.00	0.538	-0.40	0.89	0.657
Constant	-0.17	0.06	0.007	0.09	0.08	0.300	0.12	0.08	0.121
N	128			127			128		
P>F	0.001			0.001			0.001		

Legend: *Reference category: male life scientists, **reference category *cum laude* and worse, coefficients and standard errors (SEs) rounded to the second, p-values to the third decimal place. Missing values of dependent variable not imputed. Numbers of imputations=15. M=Model, SSE=scientific self-efficacy.

2.4 Construct Validity: Scientific Self-Efficacy and Career Aspirations

Table 31: Multivariate Regression Analyses, SSE and Intention to pursue an Academic Career

	Life Sciences			Medicine		
Variables	B	SE	p	B	SE	p
SSE	0.46	0.15	0.003	0.46	0.10	0.001
Female	-0.08	0.19	0.693	-0.17	0.13	0.191
Age	-0.00	0.06	0.961	-0.01	0.01	0.595
Duration of dissertation	-0.01	0.01	0.397	-0.01	0.00	0.046
Articles as 1st author	0.02	0.07	0.820	0.14	0.10	0.166
Articles as co-author	0.04	0.06	0.476	0.03	0.06	0.577
Grade: *summa cum laude**	-0.13	0.47	0.785	0.73	0.28	0.010
Grade: *magna cum laude**	-0.58	0.40	0.151	0.13	0.14	0.348
No grade*	-0.61	0.57	0.281	0.06	0.32	0.857
Conferences	0.02	0.06	0.766	0.05	0.06	0.462
Children	0.31	0.19	0.112	-0.11	0.08	0.180
Research associate during doctorate	-0.53	0.25	0.032	0.14	0.26	0.573
Research associate after doctorate	1.00	0.20	0.001	0.54	0.18	0.003
Intrinsic motivation	0.21	0.12	0.098	0.35	0.07	0.001
constant	1.20	1.74	0.251	1.53	0.56	0.006
N	165			206		
Adj. R^2	0.06			0.26		
P> F	0.053			0.001		

Legend: *Reference category *cum laude* and worse. Standard errors (SEs) and coefficients rounded to the second, p-values to the third decimal place. SSE=scientific self-efficacy.

Table 32: Multivariate Regression Analyses, SSE and Intention to Pursue a Career Outside of Academia

	Life Sciences			Medicine		
Variables	B	SE	p	B	SE	p
SSE	-0.05	0.14	0.724	-0.25	0.13	0.058
Female	-0.13	0.17	0.446	-0.27	0.17	0.114
Age	-0.07	0.05	0.198	-0.02	0.02	0.230
Duration of dissertation	0.00	0.01	0.591	-0.01	0.00	0.155
Articles as 1st author	-0.04	0.06	0.525	-0.18	0.13	0.171
Articles as co-author	-0.00	0.05	0.939	0.03	0.07	0.687
Grade: *summa cum laude**	-0.44	0.42	0.299	-0.33	0.37	0.383
Grade: *magna cum laude**	0.05	0.36	0.900	0.24	0.18	0.185
No grade*	0.13	0.51	0.807	0.95	0.43	0.027
Conferences	0.08	0.05	0.121	0.09	0.08	0.267
children	-0.37	0.17	0.033	0.18	0.11	0.099
Research associate during doctorate	0.44	0.22	0.051	-0.79	0.34	0.020
Research associate after doctorate	-0.52	0.18	0.005	0.52	0.24	0.034
Intrinsic motivation	-0.07	0.11	0.546	-0.04	0.10	0.688
Constant	5.76	1.56	0.001	4.47	0.73	0.001
N	165			206		
Adj. R^2	0.13			0.09		
P> F	0.001			0.003		

Legend: *Reference category *cum laude* and worse. Standard errors (SEs) and coefficients rounded to the second, p-values to the third decimal place. SSE=scientific self-efficacy.

Table 33: Multivariate Regression Analyses, SSE and Intention to Pursue a Career in Industrial Research

	Life Sciences			Medicine		
Variables	B	SE	p	B	SE	p
SSE	0.14	0.16	0.392	0.38	0.09	0.001
Female	-0.06	0.20	0.745	-0.03	0.11	0.804
Age	0.02	0.06	0.696	-0.01	0.01	0.455
Duration of dissertation	-0.01	0.01	0.212	0.00	0.00	0.940
Articles as 1st author	0.10	0.07	0.174	-0.20	0.09	0.022
Articles as co-author	-0.09	0.06	0.148	0.03	0.05	0.524
Grade: *summa cum laude**	-0.81	0.48	0.093	-0.19	0.24	0.423
Grade: *magna cum laude**	-0.26	0.41	0.522	-0.04	0.12	0.765
No grade*	0.35	0.59	0.546	-0.45	0.28	0.112
Conferences	0.03	0.06	0.572	0.05	0.06	0.340
children	0.12	0.20	0.539	-0.13	0.07	0.075
Research associate during doctorate	0.59	0.26	0.022	0.57	0.22	0.012
Research associate after doctorate	0.24	0.21	0.255	-0.11	0.16	0.501
Intrinsic motivation	0.16	0.13	0.210	0.18	0.06	0.006
Constant	2.08	1.80	0.248	1.61	0.48	0.001
N	165			206		
Adj. R^2	0.06			0.26		
P> F	0.001			0.003		

Legend: *Reference category *cum laude* and worse. Standard errors (SEs) and coefficients rounded to the second, p-values to the third decimal place. SSE=scientific self-efficacy.

Table 34: Scientific self-efficacy and clinical career aspirations in medicine

Variables	B	SE	p
SSE	-0.07	0.11	0.541
Female	0.01	0.14	0.927
Age	0.00	0.02	0.925
Duration of dissertation	0.00	0.00	0.154
Articles as 1st author	-0.12	0.11	0.311
Articles as co-author	0.02	0.06	0.733
Grade: *summa cum laude**	0.04	0.30	0.884
Grade: *magna cum laude**	0.02	0.15	0.905
No grade*	0.07	0.35	0.841
Conferences	0.01	0.07	0.935
children	0.18	0.09	0.039
Research associate during doctorate	-0.50	0.28	0.070
Research associate after doctorate	-0.12	0.20	0.537
Intrinsic motivation	-0.03	0.08	0.732
Constant	4.09	0.59	0.001
N	209		
Adj. R^2	0.05		
P > F	0.041		

Legend: *Reference category *cum laude* and worse. Multivariate regression analyses, standard errors (SEs) and coefficients rounded to the second, p-values to the third decimal place. SSE=scientific self-efficacy.

3. Results of Study 2

3.1 Determination of Factors Exploratory Factor Analysis

1) Scientific Self-Efficacy Beliefs

Table 35: Exploratory Factor Analysis, Scientific Self-Efficacy

	Factor loadings	Uniqueness
Item 1	0.765	0.414
Item 2	0.760	0.423
Item 3	0.833	0.306
Item 4	0.831	0.309
Item 5	0.835	0.303
Item 6	0.720	0.481
Item 7	0.842	0.292
N	400	

Legend: Unrotated solution, minimum eigenvalue of factors=1, numbers rounded to the third decimal place

Figure 17: Scree-plot, Scientific Self-Efficacy

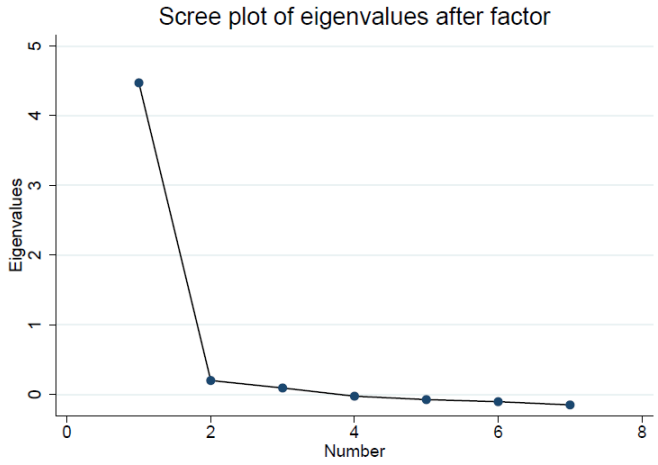


Figure 18: Minimum Average Partial Correlation Test, SPSS Output, Scientific Self-Efficacy

```
Eigenvalues
       4,9058
        ,5531
        ,4713
        ,3560
        ,3063
        ,2378
        ,1697

Average Partial Correlations
                      squared         power4
         ,0000         ,4262         ,1888
        1,0000         ,0505         ,0041
        2,0000         ,0971         ,0236
        3,0000         ,1417         ,0463
        4,0000         ,2651         ,1388
        5,0000         ,4207         ,3170
        6,0000        1,0000        1,0000

The smallest average squared partial correlation is, 0505

The smallest average 4rth power partial correlation is, 0041

The Number of Components According to the Original (1976) MAP Test is 1

The Number of Components According to the Revised (2000) MAP Test is 1
```

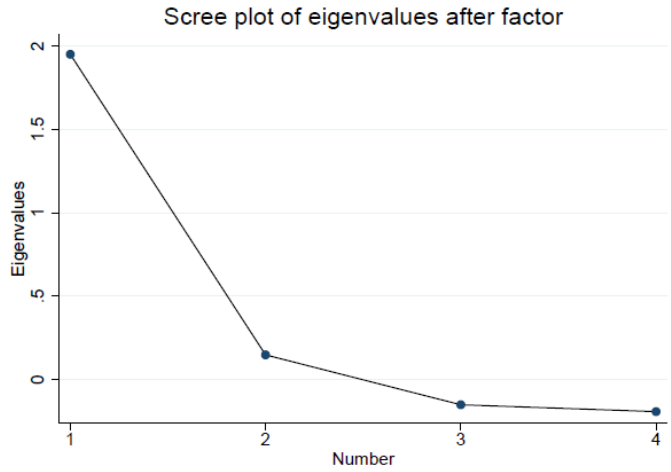
2) Intrinsic Research Motivation to Start the Doctorate

Table 36: Exploratory Factor Analysis, Intrinsic Research Interest As Motivation for the Doctorate

	Factor loadings	Uniqueness
Item 1	0.669	0.552
Item 2	0.673	0.547
Item 3	0.834	0.303
Item 4	0.593	0.648
N	419	

Legend: Unrotated solution, minimum eigenvalue of factors=1, numbers rounded to the third decimal place

Figure 19: Scree-plot, Intrinsic Research Motivation



Minimum Average Partial Correlation Test, SPSS Output, Intrinsic Research Motivation

```
Eigenvalues
       2,5311
        ,7358
        ,4550
        ,2781

Average Partial Correlations
                     squared         power4
         ,0000         ,2693          ,0847
        1,0000         ,1449          ,0316
        2,0000         ,3447          ,2375
        3,0000        1,0000         1,0000

The smallest average squared partial correlation is, 1449

The smallest average 4rth power partial correlation is, 0316

The Number of Components According to the Original (1976) MAP Test is 1

The Number of Components According to the Revised (2000) MAP Test is 1
```

3.2 Multivariate Results with Imputed Values

Table 37: FIML Path Model, Academic Career Aspirations (ACAs) as Dependent Variable and Scientific Self-Efficacy (SSE) as Mediator Variable, Subjectively Successful Doctorates

	M1 Direct Effects on SSE			**M2** Direct Effects on ACAs			**M3** Indirect Effects on ACAs		
Variables	ß	SE	p	ß	SE	p	ß	SE	p
SSE				0.26	0.07	0.000			
Stability	0.12	0.05	0.027	-0.02	0.06	0.753	0.03	0.02	0.056
Locus	-0.02	0.05	0.697	-0.02	0.06	0.677	-0.01	0.01	0.698
Age	0.03	0.06	0.568	-0.02	0.06	0.796	0.01	0.01	0.573
Female life sciences*	0.00	0.06	0.971	0.04	0.06	0.493	0.00	0.04	0.971
Female medicine*	-0.24	0.08	0.003	0.11	0.09	0.214	-0.06	0.10	0.019
Male medicine*	-0.20	0.08	0.011	0.17	0.09	0.052	-0.05	0.09	0.035
duration of Doctorate	-0.08	0.06	0.175	-0.03	0.06	0.609	-0.02	0.00	0.202
1st author articles	0.18	0.06	0.002	0.10	0.07	0.147	0.05	0.01	0.018
Co-author articles	-0.02	0.06	0.745	0.11	0.06	0.073	0.00	0.01	0.746
Grade: *summa cum laude***	0.10	0.07	0.160	0.16	0.08	0.048	0.03	0.07	0.188
Grade: *magna cum laude***	0.05	0.07	0.476	0.01	0.08	0.940	0.01	0.05	0.484
No grade**	0.04	0.05	0.493	-0.04	0.06	0.454	0.01	0.11	0.500
Conference attendances	0.06	0.06	0.305	0.07	0.07	0.303	0.02	0.01	0.323
Children	0.06	0.05	0.268	0.12	0.06	0.031	0.01	0.03	0.288
Doctorate as Research associate	-0.05	0.07	0.530	-0.09	0.08	0.255	-0.01	0.05	0.536
Intrinsic motivation	0.30	0.06	0.000	0.32	0.07	0.000	0.08	0.04	0.003
Constant	-0.52	0.77	0.498	1.70	0.85	0.046			
N	245								
R^2	0.48			0.37					
Overall R^2	0.58								

Legend: *Reference category: male life scientists, **reference category cum laude and worse, coefficients and standard errors rounded (SEs) to the second, p-values to the third decimal place, M=Model, SSE=scientific self-efficacy.

Table 38: MICE Regression Analyses. Dependent Variable: Academic Career Aspirations, Subjectively Successful Doctorates

	M1 Effects on SSE			**M2** Effects on ACAs			**M3** Effects on ACAs		
Variables	B	SE	p	B	SE	p	B	SE	p
SSE							0.37	0.11	0.001
Stability	0.08	0.04	0.041	0.01	0.064	0.822	-0.05	0.07	0.494
Locus	0.00	0.04	0.983	-0.02	0.060	0.796	-0.03	0.06	0.673
Age	0.00	0.02	0.934	-0.01	0.035	0.890	-0.01	0.04	0.680
Female life sciences	0.03	0.11	0.800	0.13	0.186	0.475	0.16	0.19	0.395
Female medicine	-0.44	0.19	0.022	0.11	0.310	0.726	0.31	0.32	0.330
Male medicine	-0.41	0.18	0.031	0.340	0.295	0.251	0.51	0.31	0.095
Duration of Doctorate	-0.00	0.00	0.542	-0.01	0.005	0.131	-0.00	0.01	0.689
Articles as 1st author	0.09	0.03	0.010	0.11	0.049	0.030	0.08	0.05	0.135
Articles co-author	0.00	0.02	0.972	0.05	0.029	0.066	0.05	0.03	0.079
Grade: *summa cum laude***	0.33	0.18	0.073	0.66	0.293	0.026	0.55	0.30	0.062
Grade: *magna cum laude***	0.16	0.14	0.252	-0.04	0.222	0.858	-0.03	0.22	0.880
No grade**	0.44	0.33	0.180	-0.25	0.482	0.609	-0.50	0.53	0.356
Conference attendances	0.02	0.01	0.241	0.04	0.023	0.138	0.03	0.02	0.173
Children	0.08	0.08	0.311	0.31	0.131	0.018	0.25	0.13	0.065
Doctorate as research associate	-0.03	0.14	0.801	-0.30	0.212	0.162	-0.25	0.23	0.269
Intrinsic motivation	0.32	0.07	0.002	0.59	0.115	0.001	0.49	0.12	0.001
Constant	-0.45	0.71	0.531	2.30	1.193	0.055	2.60	1.18	0.029
N	237			231			231		
P>F	0.001			0.001			0.001		

Legend: *Reference category: male life scientists, **reference category cum laude and worse, coefficients and standard errors rounded (SEs) to the second, p-values to the third decimal place, Missing values on depended variable not imputed. M=Model. SSE=scientific self-efficacy.

Table 39: Path Model, Academic Career Aspirations (ACAs) as Dependent Variable and Scientific Self-Efficacy (SSE) as Mediator Variable, Missing Values Imputed with FIML, Subjectively Unsuccessful Doctorates

	M1 Direct Effects on SSE			**M2** Direct Effects on ACAs			**M3** Indirect Effects on ACAs		
Variables	ß	SE	p	ß	SE	p	ß	SE	p
SSE				0.55	0.11	0.000			
Stability	-0.28	0.14	0.044	0.11	0.12	0.330	-0.15	0.06	0.064
Locus	0.19	0.19	0.305	0.19	0.14	0.198	0.11	0.11	0.318
Age	0.04	0.14	0.793	-0.28	0.11	0.010	0.02	0.03	0.794
Female life Sciences	-0.28	0.16	0.086	-0.03	0.14	0.801	-0.15	0.23	0.104
Female medicine	-0.66	0.15	0.000	-0.06	0.15	0.657	-0.36	0.37	0.001
Male medicine	-0.07	0.15	0.623	0.01	0.11	0.915	-0.04	0.35	0.625
duration of doctorate	0.20	0.18	0.282	-0.16	0.13	0.233	0.11	0.00	0.289
Articles as 1st author	-0.15	0.19	0.438	0.28	0.15	0.063	-0.08	0.20	0.449
Articles as co-author	0.02	0.14	0.879	-0.07	0.11	0.537	0.01	0.07	0.879
Grade: *summa cum laude***	-0.03	0.12	0.768	0.01	0.09	0.939	-0.02	0.16	0.769
Grade: *magna cum laude***	-0.26	0.17	0.137	0.02	0.14	0.861	-0.14	0.40	0.152
No grade**	0.17	0.17	0.312	-0.13	0.13	0.307	0.09	0.03	0.327
Conference attendances	0.03	0.13	0.819	0.48	0.11	0.000	0.02	0.13	0.820
Children	-0.30	0.15	0.043	-0.24	0.13	0.057	-0.17	0.22	0.062
Doctorate as research associate	0.39	0.13	0.004	0.33	0.12	0.005	0.21	0.12	0.013
Intrinsic Motivation	0.01	0.15	0.992	0.46	1.15	0.000	-0.15	0.06	0.064
Constant	-0.28	0.14	0.044	0.55	0.11	0.000			
N	57								
R^2	0.51			0.68					
Overall R^2	0.76								

Legend: *Reference category: male life scientists, **reference category cum laude and worse, coefficients and standard errors rounded (SEs) to the second, p-values to the third decimal place, M=Model, SSE=scientific self-efficacy.

Table 40: MICE Regression Analyses. Dependent Variable: Academic Career Aspirations (ACAs), Subjectively Unsuccessful Doctorates

	M1 Effects on SSE			**M2** Effects on ACAs			**M3** Effects on ACAs		
Variables	B	SE	p	B	SE	p	B	SE	p
SSE							0.60	0.20	0.005
Stability	-0.16	0.08	0.070	-0.15	0.10	0.140	-0.02	0.10	0.878
Locus	0.06	0.05	0.222	0.25	0.15	0.113	0.26	0.15	0.103
Age	0.10	0.31	0.749	-0.04	0.06	0.517	-0.08	0.06	0.206
Female life sciences	-1.24	0.47	0.012	0.14	0.38	0.723	-0.05	0.37	0.892
Female medicine	-0.20	0.574	0.735	-1.29	0.54	0.023	-0.74	0.59	0.221
Male medicine	0.01	0.01	0.350	-0.75	0.69	0.278	-0.69	0.63	0.282
duration of doctorate	0.02	0.19	0.908	0.01	0.01	0.416	0.00	0.01	0.751
Articles as 1st author	-0.00	0.11	0.982	0.08	0.25	0.748	0.23	0.29	0.430
Articles as co-author	-0.29	0.29	0.335	-0.09	0.12	0.485	-0.13	0.12	0.271
Grade: *summa cum laude*	-1.56	0.62	0.016	-0.10	0.33	0.561	-0.12	0.33	0.715
Grade: *magna cum laude*	0.02	0.04	0.582	-1.26	0.79	0.119	-0.18	0.78	0.822
No grade	-0.12	0.19	0.553	-0.01	0.06	0.908	-0.02	0.05	0.679
Conference attendances	-0.72	0.33	0.035	0.67	0.22	0.004	0.76	0.23	0.002
Children	0.34	0.20	0.099	-0.14	0.41	0.001	-0.93	0.40	0.027
Doctorate as research associate	-1.32	1.57	0.407	0.62	0.21	0.005	0.36	0.22	0.108
Intrinsic motivation	0.16	0.08	0.070	0.36	0.19	0.071	0.43	0.19	0.027
Constant	0.06	0.05	0.222	-0.15	0.10	0.140	0.60	0.20	0.005
N	56			51			51		
P>F	0.001			0.001			0.001		

Legend: *Reference category: male life scientists, **reference category cum laude and worse, coefficients and standard errors rounded (SEs) to the second, p-values to the third decimal place, Missing values on depended variable not imputed. M=Model, SSE=scientific self-efficacy.

3.3 Construct Validity: Scientific Self-Efficacy and Career Aspirations

Table 41: Multivariate Regression Analyses, Dependent Variable: Academic Career Aspirations

	Life Sciences			Medicine		
Variables	B	SE	p	B	SE	p
SSE	0.40	0.12	0.001	0.21	0.10	0.044
Female	0.12	0.17	0.492	-0.11	0.16	0.503
Age	-0.00	0.04	0.914	-0.02	0.02	0.353
Duration of dissertation	-0.01	0.01	0.252	-0.00	0.00	0.631
Articles as 1st author	0.11	0.05	0.037	0.20	0.17	0.247
Articles coauthor	0.01	0.02	0.736	-0.04	0.07	0.555
Grade: *summa cum laude**	0.77	0.35	0.029	0.06	0.35	0.873
Grade: *magna cum laude**	0.33	0.28	0.246	-0.05	0.18	0.797
No grade*	-0.15	0.45	0.731	0.40	0.35	0.256
Conferences	0.02	0.02	0.463	0.05	0.06	0.468
Children	0.41	0.14	0.003	0.08	0.11	0.451
Doctorate as research associate	-0.26	0.22	0.240	0.64	0.47	0.174
Intrinsic motivation	0.43	0.07	0.000	0.38	0.07	0.001
Constant	0.40	1.35	0.769	1.50	0.65	0.024
N	190			109		
Adj. R^2	0.39			0.50		
P> F	0.001			0.001		

Legend: *Reference category *cum laude* and worse. Coefficients and standard errors rounded (SEs) to the third decimal place, R^2 rounded to the second decimal place. SSE=scientific self-efficacy.

Table 42: Multivariate Regression Analyses, Dependent Variable: Intention to Pursue a Career Outside of Academia

	Life Sciences			Medicine		
Variables	B	SE	p	B	SE	p
SSE	-0.19	0.12	0.107	-0.13	0.14	0.351
Female	-0.34	0.16	0.039	-0.28	0.21	0.186
Age	-0.03	0.04	0.377	0.02	0.03	0.472
Duration of dissertation	0.01	0.01	0.137	0.00	0.00	0.491
Articles as 1st author	-0.13	0.05	0.010	0.20	0.22	0.379
Articles coauthor	-0.00	0.02	0.979	-0.12	0.10	0.221
Grade: *summa cum laude**	-0.50	0.34	0.143	0.13	0.46	0.772
Grade: *magna cum laude**	-0.12	0.27	0.660	0.11	0.24	0.660
No grade*	0.38	0.43	0.377	-0.17	0.51	0.746
Conferences	0.03	0.02	0.199	0.05	0.08	0.548
Children	0.03	0.13	0.847	0.08	0.14	0.561
Doctorate as research associate	0.04	0.21	0.853	0.10	0.63	0.879
Intrinsic motivation	-0.28	0.07	0.001	-0.21	0.10	0.031
Constant	5.70	1.31	0.001	3.45	0.88	0.001
N	190			107		
Adj. R^2	0.19			0.17		
P> F	0.001			0.001		

Legend: *Reference category *cum laude* and worse. Coefficients and standard errors rounded (SEs) to the second, p-values rounded to the third decimal place. SSE=scientific self-efficacy.

Table 43: Multivariate Regression Analyses. Dependent Variable: Intention to Pursue a Career in Industrial Research

	Life Sciences			Medicine		
Variables	B	SE	p	B	SE	p
SSE	0.05	0.13	0.706	0.21	0.09	0.023
Female	-0.16	0.17	0.360	-0.17	0.14	0.204
Age	0.03	0.04	0.519	-0.01	0.02	0.585
Duration of dissertation	-0.00	0.01	0.752	-0.00	0.00	0.580
Articles as 1st author	-0.16	0.05	0.002	0.18	0.15	0.216
Articles coauthor	0.04	0.03	0.151	-0.10	0.06	0.104
Grade: *summa cum laude**	0.57	0.37	0.123	-0.24	0.30	0.420
Grade: *magna cum laude**	0.73	0.29	0.014	-0.20	0.16	0.197
No grade*	0.78	0.47	0.097	-0.15	0.31	0.619
Conferences	0.01	0.02	0.645	-0.05	0.06	0.420
Children	-0.05	0.14	0.714	-0.04	0.09	0.658
Doctorate as research associate	-0.17	0.23	0.448	1.17	0.41	0.005
Intrinsic motivation	0.21	0.08	0.006	0.15	0.06	0.016
Constant	1.46	1.40	0.301	1.94	0.57	0.001
N	191			107		
Adj. R^2	0.08			0.24		
P> F	0.001			0.001		

Legend: Coefficients and standard errors rounded (SEs) to the second, p-values rounded to the third decimal place. SSE=scientific self-efficacy.

Table 44: Multivariate Regression Analyses with Medical Doctoral Graduates. Dependent Variable: Clinical Career Aspirations.

Variables	B	SE	p
SSE	0.11	0.12	0.336
Female	0.47	0.18	0.009
Age	0.01	0.02	0.747
Duration of dissertation	-0.00	0.00	0.635
Articles as 1st author	0.28	0.19	0.141
Articles coauthor	-0.09	0.08	0.250
Grade: *summa cum laude**	-0.17	0.39	0.671
Grade: *magna cum laude**	-0.51	0.20	0.012
No grade*	-0.03	0.39	0.943
Conferences	-0.04	0.07	0.572
Children	0.20	0.12	0.087
Doctorate as research associate	-0.49	0.53	0.355
Intrinsic motivation	-0.10	0.08	0.203
Constant	4.74	0.73	0.001
N	109		
Adj. R^2	0.23		
P> F	0.001		

Legend: Coefficients and standard errors rounded (SEs) to the second, p-values rounded to the third decimal place. SSE=scientific self-efficacy.

4. Analyses with Both Samples

Gender Differences

Table 45: Gender Differences in Scientific Self-Efficacy, Multivariate Regression Analyses by Field of Study

	Medicine			Life Sciences		
Variables	B	SE	p	B	SE	p
Female *(Grade: reference category cum laude and worse)*	-0.26	0.09	0.003	0.07	0.08	0.363
Grade: *summa cum laude**	0.46	0.18	0.009	0.28	0.14	0.044
Grade: *magna cum laude**	0.15	0.09	0.117	0.04	0.11	0.956
Articles as 1st author	0.37	0.07	0.000	0.13	0.03	0.000
Articles as co-author	-0.01	0.04	0.749	0.02	0.02	0.256
Experimental dissertation *(only medicine)*	0.17	0.09	0.066			
Conference attendances	0.11	0.02	0.000	0.03	0.01	0.002
Constant	2.05	0.09	0.000	2.96	0.12	0.000
N	345			389		
Adj. R^2	0.32			0.16		
P> F	0.000			0.000		

Legend: *Reference category cum laude and worse. Coefficients and standard errors (SEs) rounded to the second decimal place, p-values to the second decimal place.

Table 46: Stepwise Multivariate Regression Analysis: Gender Differences in Academic Career Aspirations

	Medicine						Life Sciences		
	M1			M2			M1b		
Variables	B	SE	p	B	SE	p	B	SE	p
SSE *(Reference category:* male)				0.83	0.05	0.000			
Female	-0.45	0.12	0.000	-0.09	0.09	0.345	-0.18	0.12	0.163
Constant	2.18	0.09	0.000	2.35	0.07	0.000	2.46	0.10	0.000
N	458			458			455		
P>F	0.000			0.000			0.000		
Adj. R^2	0.03			0.38			0.18		

Legend: Standard errors (SEs) and coefficients rounded to the second, p-values rounded to the third decimal place. SSE=scientific self-efficacy.

Differences between Fields of Study

Table 47**:** Multivariate Linear Regression: Field of Study Differences in Scientific Self-Efficacy

Variables	B	SE	p
Male medicine*	-0.61	0.10	0.000
Female medicine*	-0.36	0.10	0.001
Female life sciences*	0.11	0.08	0.177
Grade: *summa cum laude***	0.47	0.11	0.000
Grade: *magna cum laude***	0.18	0.07	0.009
Articles as 1st author	0.17	0.03	0.000
Articles as co-author	0.03	0.02	0.173
Conference attendances	0.06	0.01	0.000
Constant	2.58	0.10	0.000
N	740		
P>F	0.001		
Adj. R^2	0.44		

Legend: *Reference category male life sciences, **reference category *cum laude* and worse. Standard errors (SEs) and coefficients rounded to the second, p-values to the third decimal place.

Table 48**:** Stepwise Multivariate Regression Analysis: Field of Study Differences in Academic Career Aspirations

	M1			M2		
Variables	B	SE	p	B	SE	p
SSE				0.81	0.05	0.000
(Reference category: male life sciences)						
Male medicine	-0.27	0.13	0.041	0.39	0.12	0.002
Female medicine	-0.72	0.12	0.000	0.29	0.11	0.014
Female life sciences	-0.18	0.12	0.139	-0.06	0.10	0.604
Constant	2.46	0.09	0.000	0.20	0.08	0.000
N	921			929		
P>F	0.001			0.001		
Adj. R^2	0.03			0.38		

Legend: Standard errors (SEs) and coefficients rounded to the second, p-values rounded to the third decimal place. SSE=scientific self-efficacy.