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Motivation, students, and the classroom environment

Exploring the role of Swedish students' achievement goals in chemistry

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Till Edith och Sigrid. Ni är viktigast.

"The only true wisdom is in knowing you know nothing"
Socrates

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Abstract

The overarching aim of this thesis is to deepen the knowledge about students' achievement goals in chemistry and how they relate to students' epistemic beliefs (beliefs about knowledge) and to their perceptions of classroom goal structures (instructional practices that emphasize certain achievement goals). Achievement goals are defined as the purpose behind students' engagement in achievement behavior. They are important components in students' motivation and influence students' success and well-being in school. This thesis primarily focuses on two types of achievement goals: mastery and performance goals. Students with mastery goals define success in relation to prior performances and the task at hand and they strive to develop their competence. Students with performance goals define success in relation to others and they strive to demonstrate their relative competence. To study students' achievement goals, questionnaire data and responses on a chemistry test were collected from Swedish and German students in Grades 5-11 and analyzed through statistical methods.

The results show that it was possible to statistically differentiate between two different performance goals (striving to outperform others and avoid being outperformed by others) in the German data, but not in the Swedish. This challenges the universality of achievement goal models. Regarding the relationship between achievement goals and epistemic beliefs, the results indicated that sophisticated epistemic beliefs correlated with mastery goals and naïve beliefs correlated with performance goals. These relationships varied over time, especially in the transition from lower to upper secondary school, which therefore is an interesting time point to study further. The interaction between achievement goals and classroom goal structures was studied by using them as joint predictors of students' autonomous motivation and performance on the chemistry test. The most important predictor for high autonomous motivation and high test scores was strong mastery goals. This effect was enhanced when students also perceived strong mastery structures in the classroom. Conversely, mastery goals were less beneficial if students pursued performance goals simultaneously. There were also differences in the interactions between achievement goals and goal structures over school years. Together, the results imply that teachers should support students' mastery goals through striving to create classroom environments with strong mastery structures.

In conclusion, this thesis highlights the complexity of achievement goals and their relations to other aspects of the educational context. This shows the need for future research to take, for example, the universality of achievement goal models and the importance of interaction effects into consideration.

Publications

Article I

Hofverberg, A., & Winberg, M. (2020). Challenging the universality of achievement goal models: A comparison of two culturally distinct countries. *Scandinavian Journal of Educational Research*, *64*(3), 333-354. doi:10.1080/00313831.2018.1544170

Article II

Winberg, T. M., Hofverberg, A., & Lindfors, M. (2019). Relationships between epistemic beliefs and achievement goals: Developmental trends over Grades 5–11. *European Journal of Psychology of Education, 34*(2), 295-315. doi:10.1007/s10212-018-0391-z

Article III

Hofverberg, A., & Winberg, M. (2020). *Interplay between chemistry students' achievement goals and goal structures: Do they need to match?* Manuscript submitted for publication

Article IV

Hofverberg, A., & Winberg, M. (2020). *Are mastery structures beneficial for everyone? The interaction between mastery structures and achievement goals in Grades 6-10*. Unpublished manuscript

The two published articles are published as Open Access articles, which permits unrestricted use, distribution, and reproduction.

Contribution in each article

All of the above articles are co-authored with other researchers. To decide which researcher should be considered for authorship, we followed the recommendations by the International Committee of Medical Journal Editors (ICMJE; http://www.icmje.org/recommendations/). In all four articles, I have engaged in collecting data, planning the articles, reviewing relevant literature, designing analyses, interpreting results, and writing the final manuscript. A more detailed description for each article follows.

In Article I, I was responsible for planning the article and running analyses as well as writing the background and methods section. The result and discussion

sections were written together with Winberg, and both authors reviewed and edited the manuscript. In Article II, me and Lindfors planned the article and conducted the initial literature review. We also wrote the background, in part separately and in part together. Furthermore, I conducted preliminary analyses, although the final analyses were conducted by Winberg. The results were written primarily by me and Winberg. All three authors were active in writing the discussion, as well as in reviewing and editing the whole manuscript. Both Article III and IV were planned by me and Winberg together, although I had the main responsibility for planning the analyses and reviewing the relevant literature. Like in Articles I and II, the results were interpreted by both authors together, and the discussions were written in close collaboration.

In all four articles, the main author has had the main responsibility for final editing and the submission procedure.

Svensk sammanfattning

Det övergripande syftet med denna avhandling är att bidra med kunskap om elevers *achievement goals* och deras samspel med elevers kunskapssyn och de målstrukturer eleverna uppfattar i klassrummet. Achievement goals beskriver mål som individen strävar efter i prestationssituationer (t.ex. i skolan), alltså varför man engagerar sig i dessa prestationssituationer. Man kan tänka sig att många olika typer av mål kan fungera som drivkraft i prestationssituationer, men achievement goals utgör lite mer specifikt mål som är relaterade till hur kompetens definieras och utvärderas. Jag har valt att använda ett antal engelska termer, till exempel achievement goals, då jag anser att de svenska översättningar som förekommer är mer eller mindre vilseledande. Även de engelska termerna kan vara missvisande i vissa avseenden, men dessa är så pass etablerade att de kan användas utan större missförstånd.

För att förtydliga vad achievement goals är presenteras här de två vanligaste typerna av achievement goals: *mastery goals* och *performance goals*. En individ med mastery goals (ung. bemästrandemål) utvärderar sin kompetens i förhållande till sig själv eller den uppgift som hen arbetar med. Med detta följer en strävan efter att utveckla sin kompetens. En individ som istället har performance goals (ung. prestationsmål) definierar och utvärderar kompetens i relation till andras kompetens, och strävar efter att visa upp denna relativa kompetens för andra. Beroende på om en individ har övervägande mastery goals eller performance goals kommer hen att bete sig olika och känna olika i prestationssituationer. Generellt har tidigare forskning visat att mastery goals medför positiva konsekvenser för elever, medan performance goals kan ha både positiva och negativa konsekvenser. Bland annat tycks performance goals vara kopplade till goda studieprestationer, men också till en ökad prestationsångest.

Det finns gott om studier som visar på en koppling mellan olika achievement goals och till exempel studieresultat, välmående i skolan, studiestrategier och engagemang i skolarbetet. Dock finns det några områden som inte är särskilt väl utforskade. Ett sådant område är förhållandet mellan elevers achievement goals och deras kunskapssyn (epistemic beliefs). Ett annat är samspelet mellan achievement goals och så kallade målstrukturer i klassrummet. Målstrukturer är strukturer i lärarens kommunikation och i klassrummets organisation som uttrycker stöd för någon typ av achievement goal. Därmed brukar man skilja på två typer av målstrukturer, mastery-strukturer och performance-strukturer. Trots att dessa områden inte är väl beforskade är det viktigt att ha kunskap om dessa samspel, eftersom de kan ha stor betydelse för de slutsatser man kan dra om nyttan av achievement goals.

Mitt datamaterial består av enkätsvar och provresultat från svenska elever från årskurs fem upp till andra året på gymnasiet. Till en av de fyra delstudierna har även motsvarande enkätsvar från tyska elever använts. Dessutom har två grupper av svenska elever följts under tre år, och även dessa data har använts till en av delstudierna. För att analysera data har ett flertal statistiska metoder används, bland annat faktoranalys och regressioner.

Resultaten visar att det gick att skilja på två olika typer av performance goals (att vara bättre än andra respektive att undvika att vara sämre än andra) i de tyska elevernas svar. Dessa gick inte att separera i de svenska elevernas svar. Det tycks därför som att modeller för achievement goals inte är universella utan de skiljer sig mellan olika kulturella sammanhang. Därför bör man alltid undersöka vilken achievement goal-modell som är tillämpbar i den grupp där man planerar att utföra en studie.

När det gäller förhållandet mellan elevers kunskapssyn och deras achievement goals framträdde ett generellt mönster. Detta mönster visade att elevernas mastery goals hängde samman med en sofistikerad kunskapssyn (då kunskap ses som något föränderligt, och kunskapsanspråk bör understödjas av bevis), medan performance goals hängde samman med en naiv kunskapssyn (då det bara finns ett korrekt svar till varje given fråga och auktoriteter ses som bärarna av all kunskap). Detta mönster har även visat sig i tidigare studier på området. Dock visar min studie även att det fanns tydliga förändringar av relationerna mellan achievement goals och kunskapssyn då eleverna gick från högstadiet upp till gymnasiet. Dessa förändringar utmanar antaganden om att det ovan beskrivna mönstret är generellt. Förändringarna skulle till exempel kunna bero på att lärmiljön, som förändras kraftigt vid övergången till gymnasiet, påverkar förhållandet mellan achievement goals och kunskapssyn. Denna studie kan inte förklara mekanismerna bakom dessa förändringar, men resultatet antyder att just övergången mellan högstadiet och gymnasiet är en kritisk punkt som bör undersökas närmare i framtida studier.

När det gäller hur elevers achievement goal samspelar med de målstrukturer som de uppfattar i klassrummet, och hur dessa tillsammans kan prediktera elevers provresultat och deras *autonoma motivation* (en typ av motivation som kännetecknas av en känsla av självbestämmande), så visade det sig mastery goals var starkare kopplade till höga provresultat och en stark autonom motivation än vad performance goals, mastery-strukturer eller performance-strukturer var. Studien visade även på interaktioner mellan dessa variabler. Elevernas mastery goals visade sig ha en starkare positiv koppling till båda utfallen om eleverna samtidigt uppfattade en stark mastery-struktur i klassrummet. Därmed fanns det en form av matchningseffekt mellan mastery goals och mastery-strukturer. Dock tycks kombinationen av starka mastery och performance goals vara ofördelaktig.

Vidare fanns det antydningar till att den upplevda skolmiljön påverkade relationen mellan elevernas mastery goals och deras autonoma motivation mer bland de yngre eleverna (årskurs 6-8) än bland de äldre elevernas (årskurs 9-10). Ålderstrenden var nästan tvärtom för provresultaten. Slutsatsen blir att elevernas ålder tycks spela roll för hur klassrumsmiljön interagerar med elevernas achievement goals, men beroende på vilket utfall som studeras så ser mönstret olika ut.

Sammantaget pekar mina resultat på att lärare bör stödja elevers mastery goals i klassrummet genom att skapa lärmiljöer som präglas av mastery-strukturer. I klassrum med starka mastery-strukturer förstärks den positiva effekten av elevernas mastery goals, samtidigt som inte elever med övervägande performance goals missgynnas nämnvärt. Vidare har tidigare forskning visat att mastery-strukturer kan leda till att elever anammar mastery goals i större utsträckning än i andra miljöer. Därmed får man även en indirekt positiv effekt av mastery-strukturer.

Mina studier ger vissa indikationer på hur konstruktiva, motivationsstödjande klassrumsmiljöer kan utformas. Dock tror jag att den förhärskande traditionen inom motivationsforskning behöver förändras för att forskningsresultaten ska komma skolverksamheten till större nytta. Till exempel tror jag att flera olika perspektiv på motivation kan behöva integreras för att på ett bättre sätt fånga komplexiteten som elevers drivkrafter utgör. Dessutom bör forskningen bedrivas mer praktiknära, och i samarbete med lärarna, för att kunna generera realistiska och produktiva rekommendationer om hur elevers motivation kan stödjas i praktiken.

Sammanfattningsvis har min avhandling bidragit med en ökad kunskap om elevers achievement goals och hur dessa mål samspelar med elevernas kunskapssyn och deras uppfattning om klassrummets målstrukturer, samt hur dessa samspel förändras över skolåren.

1. Introduction

How to motivate students. That was what I set out to discover when I started as a doctoral student. With time, I have come to realize that this question is far too complex for me to answer within a single thesis. But even if my studies only contribute with a few pieces to the jigsaw puzzle of students' motivation, every piece adds something to the picture and our understanding of students' motivation grows. What follows is an account of my contribution to the jigsaw puzzle.

In this thesis, I focus on *achievement goals*, particularly in chemistry, which make up a small but important part of the large area of students' motivation. Achievement goals have been shown to influence students' success and well-being in school in many different ways. Therefore, it is important to know as much as possible about the role of students' achievement goals in their school experience. But first, to understand my achievement goal research, it is useful to understand the context in which it is situated. Therefore, the following section will introduce the concept of motivation, what it is, and how it can be conceptualized.

Before you read any further, ask yourself: Are you motivated to read this? In everyday language, you may argue that doing a tedious task, such as reading a long and complicated academic text, is far from motivating. But apparently you are doing it anyway! A motivation researcher would argue that you are motivated, otherwise you would not be reading. If you do something, whatever it is, you are motivated to do it. However, the reason for doing it may vary. The *form* of motivation that is activated is often much more interesting to motivation researchers than the *amount* of motivation. You are motivated to read, but depending on what form of motivation you have, the outcome of your reading will be different.

At this point, a definition of motivation could help us to continue towards understanding what motivation is. According to Schunk, Meece, and Pintrich (2013), the word "motivation" stems from Latin movēre, meaning "to move". Motivation is what gets you moving and what makes you continue to move. However, this is a vague definition that omits what type of activity it applies to and what "moving" entails. We need a more precise definition in order to operationalize motivation and make it a topic of research. Schunk et al. (2013, p. 5) define motivation as "the process whereby goal-directed activities are instigated and sustained." From this short definition, three important aspects of motivation emerge. First, motivation is a process. More specifically, motivation is an internal process of the human mind. As an internal process, motivation can only be observed indirectly through individuals' behavior, including how they choose to answer questionnaire items. Second, motivation concerns goal-directed

activities. This means that motivation always has a direction in the sense that the individual strives towards or away from something. Third, motivation provides the activation to start moving towards a goal, but is also important for persistence in goal pursuit. For you, as reader of this thesis, this motivation process made you pick up the book and open it, but also continue reading this far to reach some sort of goal. Even though motivation is an internal process, and thus not possible to measure directly, one can infer that you are motivated from the fact that you continue reading. One may also get certain clues about what form of motivation that is activated from your reactions, such as a smile or frown, at this point. There is also a purpose, or a goal, behind your reading. For example, you may wish to know more about achievement goals, look for references for your own research, or be able to show off with a tricky question at the defense of this thesis.

In short, motivation provides both direction and energy for human behavior (Ryan, 2012). To understand the mechanics of the process that leads to this direction and energy, motivation researchers have presented several complementing and partly overlapping theories, such as achievement goal theory, self-determination theory, attribution theory, and expectancy-value theory (for an overview of motivation theories in education, see e.g., Schunk et al., 2013). *Achievement goal theory*, which is central in this thesis, aims to explain the directional component of motivation, that is, the purpose behind engagement in achievement behavior.

As I will discuss in Chapter 2, the concept of purpose takes on different meanings for different theorists. However, the general consensus is that achievement goals are linked to how competence is defined and evaluated. Students with different types of achievement goals strive for different forms of competence. One type of achievement goal entails striving to prove yourself competent in relation to your peers, and another entails striving to perform better on a certain task than you did before. This focus on competence separates achievement goals from motivational goals that are not related to competence, such as social goals, like forming positive relationships with peers; work-avoidance goals, like doing as little school work as possible; and extrinsic goals, like earning money or prizes (Elliot & Thrash, 2001). Please note that my focus on achievement goals does not mean that other goals are unimportant. For example, Lee and Bong (2016) showed that higher social status, a form of social goal, was ranked as the most important reason for studying by Korean lower secondary students. Nevertheless, since such goals are not achievement goals they will not be discussed further in this thesis.

Achievement goal theory is considered one of the most influential theories of motivation in education (Pintrich, 2003; Wirthwein, Sparfeldt, Pinquart, Wegerer, & Steinmayr, 2013). However, despite being widely used in motivation

research, there are several areas concerning achievement goals where knowledge gaps still exist. I aim at contributing to filling three such gaps by my thesis: interactions between students' achievement goals and perceived *classroom goal structures* (i.e., what achievement goals that are emphasized in the classroom); the relationship between students' achievement goals and students' *epistemic beliefs* (i.e., students' beliefs about what knowledge is); and the development of these relationships over time. Research that fills these gaps has the potential to further achievement goal theory, but also to inform classroom practice by providing insight in the complex relationships that achievement goals form with both characteristics of the surrounding environment and with students' personal characteristics. For example, knowledge about the interactions between achievement goals and classroom goal structures may help to guide teachers towards positive classroom environments that strengthen students' motivation. The need for further knowledge about the role of students' achievement goals in relation to their epistemic beliefs and the classroom goal structures leads me to the aim of this thesis.

1.1 Aim and research questions

The overarching aim of this thesis is to deepen the knowledge about students' achievement goals in chemistry and how they relate to students' epistemic beliefs and to their perceptions of classroom goal structures. To reach this aim, I pursue the answer to four questions:

1. In what way do students' achievement goals correlate and interact with other achievement goals?
2. In what way do achievement goals interact with students' perceptions of the classroom goal structures?
3. In what way are achievement goals predicted by students' epistemic beliefs?
4. How do the relationships examined through questions 1, 2, and 3 change over the school years?

1.2 Study context

The context of this thesis provides a relevant complement to the context of previous research on achievement goals. To start with, the national culture in Sweden, where most of the data collection took place, differs from that of many other countries (see Article I for more details). The most important difference from, for example, the United States (where much achievement goal research has been conducted) or Germany (which I compared with Sweden in Article I) lies in how little Swedes value competition (Hofstede, Hofstede, & Minkov, 2010). This difference is related to the type of competence that is valued in the countries, and can therefore, at least theoretically, influence students' achievement goals. Also,

my studies have focused on students' achievement goals specifically concerning the school subject of chemistry. Although there exists previous research on achievement goals within chemistry (e.g., Church, Elliot, & Gable, 2001; Crippen, Biesinger, Muis, & Orgill, 2009; Kadioglu & Uzuntiryaki, 2008; Karabenick, 2004; Muis, Ranellucci, Franco, & Crippen, 2013; Tang & Neber, 2008; Zusho, Pintrich, & Coppola, 2003), most of this research targets university students, and none of the studies target students younger than upper secondary school (Grades 10-12). Actually, the broad range of grades included in my studies (Grades 5-11), is uncommon in achievement goal research overall, and my studies therefore have the potential to contribute with important information about the development of students' achievement goals. Neither culture, school subject, nor the broad range of grades are part of the aim of my thesis in themselves, but they are nevertheless part of a context in which my research can contribute with valuable knowledge.

1.3 Overview of this thesis

This thesis consists of one kappa[1] and four articles. The overarching aim of the thesis, described above, and the four research questions are related to the aims and research questions of the four articles of the thesis, although the respective articles are oriented towards different parts of the overarching research questions. Table 1 provides an overview of which articles that are connected to each overarching research question.

Table 1. Overview of which articles that address each overarching research question.

Research question	Article			
	I	II	III	IV
1	✓		✓	
2			✓	✓
3		✓		
4	✓	✓	✓	✓

The kappa is divided into five chapters after this introductory chapter. The second and third chapter describes theories, models, and previous research relevant to my studies. Because there are a number of unsolved issues in achievement goal research, extra emphasis is put on explaining my view of achievement goals and how achievement goals have been defined and used in my studies. The fourth chapter focuses on explaining the principles behind the methods and justify why they were chosen, all in a, hopefully, nontechnical language. In the fifth chapter, the results and answers to the overarching research questions are presented. The

[1]The word "kappa" is a Swedish word meaning "coat". A kappa comprises the introductory chapters of a compilation thesis and aims to connect the individual articles into a cohesive thesis.

sixth and last chapter contains a general discussion of themes relevant to the thesis, such as how the study context may have influenced my results, limitations of the studies, and implications for teachers as well as future research.

1.4 The DoLiS-project

All my studies have been conducted within a bi-national project, Development of Learning in Science (DoLiS), founded by the Swedish Research Council grant number 721-2013-2180. The project was a collaboration between Umeå University, Umeå, Sweden, and Leibniz-Institute for Science and Mathematics Education (IPN), Kiel, Germany. The aim of the project was to investigate whether differences between Sweden and Germany in terms of teaching or school organization could explain the significantly higher interest for higher studies in chemistry in Germany than in Sweden. Therefore, survey data on students' motivation, epistemic beliefs, interest in chemistry, self-concept, perception of classroom environment, and conceptual knowledge of chemistry, together with personal data such as age, sex, and socio-economic status (SES), were collected and analyzed. The main data collection was a cross-sectional survey study, covering Grades 5-11 in the two countries, but two follow-up collections were also conducted and two cohorts of students were followed longitudinally over three years.

With the start of my doctoral studies, I joined the DoLiS project in the early stages of its development, while measurement instruments where piloted, revised, and finalized. My part in the project was to focus on students' motivation. Within this theme, I could choose the direction of my studies relatively freely, with the constructs targeted in the questionnaires and the quantitative nature of the data collection as starting point.

2. Theories and models

In this chapter, I introduce the theories used in my thesis and the models that the theories result in. These theories have been important in guiding both the construction of instruments and the analyses conducted, so they play a central role in my attempt to reach the aim of the thesis.

To begin with, I will explain the main theory of this thesis, achievement goal theory, in detail. I will also present how achievement goal theory has been applied in my studies and the rationale behind my choices. Thereafter, I will present classroom goal structures, which refer to structures that emphasize certain achievement goals in the classroom, and how they are related to students' personal achievement goals. To conclude the chapter, I will give an overview of epistemic beliefs and self-determination theory, which are two other theories that have played a part in my research.

2.1 The deceptively simple achievement goal theory

In the following sections, I will present achievement goal theory in more detail than the quick overview in the introduction did. Achievement goal theory, with its neat separation into a manageable number of distinct goals, seems simple and straightforward at first glance. It is important to note, however, that this simplicity is deceptive as there are a number of unresolved issues surrounding the nature of achievement goals, achievement goal models, and achievement goal terminology. As Murphy and Alexander (2000) showed in their review, these issues are common in the motivation literature, but especially prominent in research on achievement goals and achievement goal orientations (the difference between these terms will be discussed later in this chapter). Murayama, Elliot, and Friedman (2012) even suggested that we should abandon the term "achievement goal theory" in favor of *theories of achievement goals* or *the achievement goal approach*. Because of these issues, it is difficult to give a both generally accepted and detailed description of achievement goal theory. Nevertheless, what I present here is an attempt to give an overview of achievement goal theory as I understand it.

2.1.1 What is an achievement goal?

First of all, achievement goals are considered internal, cognitive representations that individuals have access to (Pintrich, 2000a). As such, goal theorists assume that we can consciously access our achievement goals if we are asked about them, although the achievement goals usually guide our behavior subconsciously.

Theorists agree that achievement goals constitute the purpose behind engagement in achievement behavior (Elliot & Hulleman, 2017). However, already at this point, views start to diverge. What is a purpose? Is it the aim of the engaging (the "what"), the reason for engaging (the "why"), or both? Elliot and colleagues (Elliot & Hulleman, 2017; Korn & Elliot, 2016) broke this distinction down to a discussion concerning two different subcomponents of achievement goals: the *standard* and the *standpoint* subcomponent.

The standard subcomponent is equivalent to the *aim* of behavioral engagement and covers how competence is evaluated. Competence can be evaluated, and thus defined, in relation to different standards. The three recognized standards of achievement goals are:

1. Task-based (also known as absolute). Individuals evaluate competence against an absolute standard. Success is, for example, to be able to solve a difficult task.
2. Self-based (also known as intrapersonal). Individuals evaluate competence in relation to themselves. Success is, for example, to score better on a certain task than previously, or to feel that you have learned something new.
3. Other-based (also known as interpersonal). Individuals evaluate competence in relation to others. To be successful is to be better than others, for example, on a test.

The standpoint subcomponent constitutes the *reason* for striving towards a goal. Two different standpoints have been identified:

1. striving to develop competence, and
2. striving to demonstrate competence.

The standard and standpoint subcomponents are used to define different achievement goals. Traditionally, theorists have differentiated between two distinct achievement goals: *mastery goals* and *performance goals*. Alternative labels have been used, for example task and learning goals for mastery goals and ego and ability goals for performance goals, but mastery and performance goals are today considered standard labels (Pintrich, 2003). Mastery goals are traditionally associated with standard 1 and 2, task-based and self-based standard, and standpoint 1, developing competence. Performance goals are associated with standard 3, other-based standard, and standpoint 2, demonstrating competence. The emphasis on standpoints or standards varies between achievement goal theorists, as will be discussed in the presentation of different achievement goal models below.

Goal theorists have also separated achievement goals along an approach and avoidance dimension (also known as the *valence* of the goals; Elliot & Covington, 2001). Approach goals are pursued in order to reach a positive outcome, whereas avoidance goals are pursued to avoid a negative outcome. Crossed with the mastery/performance separation, this creates four possible goals: mastery-approach (MAp), mastery-avoidance (MAv), performance-approach (PAp), and performance-avoidance (PAv) goals (see Table 2, where these four goals are exemplified on both the basis of standards and standpoints). For example, students pursuing MAp goals may strive to learn as much as possible, whereas students pursuing MAv goals may strive to avoid forgetting what they have learnt. Correspondingly, students pursuing PAp goals may strive to perform better than their peers on a task, whereas students pursuing PAv goals may strive to avoid doing worse than their peers. How researchers have applied different combinations of goals will be described in section 2.1.3.

Table 2. Possible achievement goals in a 2x2 framework, with goals based on standards and goals based on standpoints presented separately.

Valence	**Mastery**		**Performance**	
	Standard: self-/task-based	Standpoint: developing competence	Standard: other-based	Standpoint: demonstrating competence
Approach	MAp: understand and master the content, learn as much as possible	MAp: increase competence	PAp: perform better than others	PAp: demonstrate competence
Avoidance	MAv: avoid learning less than possible or getting an incomplete understanding	MAv: not decrease competence	PAv: avoid performing worse than others	PAv: not demonstrate lack of competence

Note. MAp = mastery-approach goal, MAv = mastery-avoidance goal, PAp = performance-approach goals, PAv = performance-avoidance goals. Operationalization of each goal is inspired by Korn and Elliot (2016) and Elliot and Murayama (2008).

The distinctions made above can be condensed to a precise definition of achievement goals. Hulleman, Schrager, Bodmann, and Harackiewicz (2010) have formulated one such definition, describing an achievement goal as "a future-focused cognitive representation that guides behavior to a competence-related end state that the individual is committed to either approach or avoid" (p. 423).

2.1.2 Achievement goals and achievement goal orientations

Goal orientations, or achievement goal orientations, are also common terms in motivation literature. Although those two terms sometimes represent different things (Hulleman et al., 2010), they are treated as interchangeable here. Goal orientations have been given different meaning by different theorists. For example, Niemivirta and colleagues (Niemivirta, 2002; Pulkka & Niemivirta, 2013; Tapola & Niemivirta, 2008) defined goal orientations as tendencies to favor and select certain types of goals. Related to this definition, but with a slightly different emphasis, goal orientations have been described as broader than achievement goals and including several achievement-related beliefs and emotions that combine into general schemes that guide individuals in achievement situations (Ames & Archer, 1987; Schunk et al., 2013). Although goal orientations have much in common with the achievement goals I have studied, I want to separate the two concepts (in contrast to Schunk et al., 2013, where achievement goal is described as a shorthand term for achievement goal orientation). My studies have focused on achievement goals as defined by both standards and standpoints of competence, but I view the resulting achievement goals as entities on their own. I consider achievement goals related to achievement emotions, beliefs about self-efficacy, attributions of success and failure, fear of failure and need for achievement, et cetera, but these emotions and beliefs are not part of the goals per se. For a further discussion on the situational specificity of my concept of achievement goals, see section 2.2.3.

2.1.3 Goal models – past and present

Above, I have presented a number of different achievement goals and subcomponents of achievement goals. These different goals, and what subcomponents they consist of, have been organized in various models that will be described in this section. As these models differ in regard to which goals that are included and how those goals are defined, each model reflects a slightly different conceptualization of what achievement goals are and how they relate to each other. Consequently, which goal model is chosen and applied in a study can have an important influence on research design, data collection, and analysis.

The dichotomous goal model

Early achievement goal models only distinguished between mastery goals and performance goals (e.g., Ames & Archer, 1987). Because of the assumed dichotomy of these two goals, this type of model is often referred to as a dichotomous achievement goal model (Elliot & Hulleman, 2017). In the dichotomous achievement goal model, achievement goals were defined by the standard subcomponent (task/self-based or other-based), the standpoint subcomponent (developing or demonstrating competence), or a combination of the two.

The trichotomous goal model

Theorists applying the dichotomous achievement goal model generally assumed that mastery and performance goals were opposite ends of a continuum, and that mastery goals were adaptive but performance goals maladaptive. However, the continuum assumption was later challenged as research showed that the goals were relatively independent of each other and not negatively correlated as opposites would be (Harackiewicz, Barron, & Elliot, 1998). Also, positive effects of performance goals were shown in several studies, something that stood in contrast to the original conceptualization. This led to a revision of achievement goal theory. As a result, Elliot and colleagues (Elliot, 1999; Elliot & Church, 1997; Elliot & Harackiewicz, 1996) suggested that performance goals should be separated into performance-approach (PAp) and performance-avoidance (PAv) goals, but mastery goals were kept in their original form. This model is known as the trichotomous achievement goal model. Although not part of the terminology at the time, the mastery goals of the trichotomous model were mastery-approach (MAp) goals.

The separation in PAp and PAv partly explained the mixed results for performance goals. However, a new problem arose with mixed results for PAp goals. More recent research suggests that these mixed results are a function of yet another muddled definition, that of standpoint or standard (for meta-analyses, see Hulleman et al., 2010; Senko & Dawson, 2017). This research indicates that the negative effects of PAp goals are connected to goals defined by the standpoint subcomponent (i.e., PAp goals defined by standpoint 2, strivings to demonstrate competence). In contrast, PAp goals defined by the standard component (i.e., PAp goals defined by standard 3, striving to outperform others) show more positive effects. Although this research was not available at the time, the next development in achievement goal models remedied this duality of PAp goals.

The 2x2 goal model

The next development of achievement goal models resulted in a separation of mastery goals into approach- and avoidance goals. The resulting 2x2 goal framework (suggested in Elliot, 1999; and presented more thoroughly in Elliot & McGregor, 2001; and Pintrich, 2000a) includes four goals, organized on two different dimensions. First, mastery and performance goals are differentiated only on the standard of competence evaluation, not the standpoint. Second, both mastery and performance goals exist in an approach and an avoidance form. Thus, besides the addition of the new mastery-avoidance (MAv) goal, the 2x2 framework focuses exclusively on the standard subcompent and excludes the standpoint subcomponent.

Beyond the 2x2 goal model

The 2x2 achievement goal model is the latest, widely applied goal model, although several alternatives have been presented. One expansion of the 2x2 model is the 3x2 model, where mastery goals are further separated in task- and self-goals based on the standard of competence definition (Elliot, Murayama, & Pekrun, 2011). Another alternative is to separate standards and standpoints of both mastery and performance goals into individual goals, and then add an approach/avoidance dimension to create eight separable goals (Daumiller & Dresel, 2020).

In my eyes, the most interesting development is the recombination of standards and standpoints. Elliot and Thrash (2001) consider the standards to define the "real" achievement goals, but was still amongst the first to argue for an integration of standards and standpoints, or in Elliot and Thrash's terms the aim and reason. The aim, defined by the standard subcomponent, could be pursued for different reasons, defined by the standpoint subcomponent, resulting in a "goal complex". Such goal complexes have also been constructed with, for example, self-detemination theory defining reasons for goal pursuit (Vansteenkiste, Lens, Elliot, Soenens, & Mouratidis, 2014). According to Senko (2016), goal complexes can account for discrepancies in the goals' outcome patterns and have the potential to reconcile rivalling conceptualizations of achievement goals. Further research along this strand is needed, but I believe it is a promising development of achievement goals which could combine theoretical parsimony and clarity with practical applicability.

Based on this goal complex movement, Korn, Elliot, and Daumiller (2019) presented a 2x2 standpoints and standard (SaS) model, where the goals were defined by both standard and standpoint as in older achievement goal models. In this model, the goals represent both reason and aim, integrated with each other and of equal importance. In a way, achievement goal models are thus back where they started, with both standards and standpoints defining mastery and performance goals. However, the awareness of these previously implicit differences in definitions makes the integration of standards and standpoints more deliberate and systematic now.

2.2 The use of achievement goals in this thesis

Above, I have presented an overview of my understanding of achievement goal theory. In this section, the different issues discussed above are boiled down to how achievement goals have been defined and applied in this thesis.

2.2.1 Achievement goal definition applied

In this thesis, achievement goals have been defined according to the definition cited in section 2.1.1. Thus, I view an achievement goal as "a future-focused cognitive representation that guides behavior to a competence-related end state that the individual is committed to either approach or avoid" (Hulleman et al., 2010, p. 423). Hulleman et al. (2010) argue that this definition is close to the integrated standard and standpoint goal complex of Elliot and Thrash (2001). Moreover, I treat achievement goals as a combination, or even integration, of both the standard of reference for competence evaluation and the standpoint of competence, in the same way as in the 2x2 SaS model of Korn et al. (2019).

This does not mean that I claim to have measured goal complexes. To start with, in my instrument, the number of possible reasons for goal pursuit is limited to only include the development or demonstration of competence. This limitation makes my achievement goals too narrow to count as goal complexes. Furthermore, there is a built-in assumption that certain standards go with certain standpoints, for example, an other-based standard is paired with a standpoint of demonstrating competence. It is possible that students combine standards and standpoints in other ways. For example, someone may compare their performance to others (other-based standard), but have no need to demonstrate their superiority to anyone (Senko, 2016). Nevertheless, the achievement goals used here combine aim (standard) and reason (standpoint), and are thus one step towards the goal complexes envisioned by, for example, Elliot and Thrash (2001) and Senko (2016).

In the regulation of achievement behavior, it is assumed that aim and reason of achievement goals become intertwined (Elliot & Thrash, 2001). Integrating standards and standpoints should therefore provide goal measures that are closer in resemblance to how goals exert their influence in real life, compared to the measures of "pure" goals (i.e., goals defined only by their standard) promoted in the 2x2 model (Elliot & Murayama, 2008). The downside is that part of the parsimony of the goal model is lost, and the results may be less straightforward because the effects of both the standard and the standpoint are combined. Nevertheless, I believe that research applying more realistic goal measures has higher potential to inform teaching practice than research based on simpler, but more theoretical, constructs.

2.2.2 Goal model applied

The goal model applied in this thesis contains MAp, PAp, and PAv, but not MAv. Although models including MAv have shown good fit to data (both the 2x2 and the 2x2 SaS model, see Elliot & McGregor, 2001; Elliot & Murayama, 2008; Korn et al., 2019), there have also been doubts concerning the role of MAv in achievement goal models. For instance, Elliot and Thrash (2001) note that the other goals have gained more attention, possibly because MAv goals are counter-intuitive, but also because the other three goals are assumed to be more prevalent than MAv (as shown by e.g., Lee & Bong, 2016). Moreover, Bong (2009) expressed several concerns regarding MAv, for example, their conceptual definition in relation to MAp goals, their relevance for school-age students, and their overlap with PAv goals. Maehr and Zusho (2009) were also concerned about the overlap between MAv and other goals, primarily PAv goals. Ciani and Sheldon (2010) showed that MAv goals were unusual and often confused with MAp goals among basketball players. As a conclusion, S. Lau and Nie (2008) argue that PAp, PAv, and MAp "have produced the most solid empirical base" (p. 15). Taken together, this led to the choice of a three-goal model including PAp, PAv, and MAp. Although this model is referred to as a trichotomous model in Article I and III, I prefer to see it as a reduced 2x2 SaS model as it explicitly integrates standards and standpoints. The article presenting the 2x2 SaS model (i.e., Korn et al., 2019) was not yet published at the time when we wrote Article I and III, which explains why the term trichotomous model was used instead. As MAv goals have not been investigated in my research, the term mastery goals henceforth refer to MAp goals in this text, unless explicitly stated otherwise.

2.2.3 Trait or state?

In addition to the issues discussed above, it is also worth considering how stable achievement goals are over time and different contexts. Adoption of different achievement goals is said to be generated by trait-like (i.e., stable) personal factors, such as need for achievement, fear of failure, perception of own competence, and implicit theories of ability, or mindsets (Elliot, 1999). Based on this, one could assume that achievement goals are also stable, trait-like characteristics, so that students either are oriented towards mastery goals or performance goals. However, achievement goals are also assumed to be contextual, and therefore influenced by the surrounding environment (Schunk et al., 2013). Research shows that students' achievement goals can change over time (e.g., Meece & Miller, 2001) and over different school subjects (Bong, 2001).

In my work, I have adopted the views of Pintrich (2000a) on this matter. Thus, students' achievement goals can vary in different situations, for example, at different time points, in different tasks, or in different school subjects. At the same time, there surely is intraindividual stability, so that some students are

more oriented towards mastery goals and other students are more oriented towards performance goals (cf. e.g., Pulkka & Niemivirta, 2013, where such general tendencies to favor certain goals are labeled goal orientations). In the instrument I have used, the measures of achievement goals have focused on school subject-specific achievement goals, more specifically the achievement goals pursued in chemistry. Thus, these goals lie somewhere between task-specific goals and general goals. As a consequence, I assume that the goals measured constitute an approximate average of the achievement goals that the participating students pursue within the school subject chemistry at the time of the data collection, but that these goals may differ in other subjects, and also fluctuate within the subject.

2.2.4 Achievement goals and culture

Culture is essential for understanding students' motivation (King & McInerney, 2016). Therefore, it is necessary to consider the effects of culture on the meaning and function of achievement goals before comparisons between different groups become meaningful (Pintrich, 2003). Consequently, the association between culture and achievement goals is highly relevant to Article I, where the achievement goal models of Swedish and German students are compared, but also to understand how the results of my studies in Sweden compare to studies in other countries.

This far, research on motivation, including achievement goal research, has often assumed that constructs are universal and free from culture (Zusho & Clayton, 2011). However, Zusho and Clayton (2011) argued that it is better to adopt a universalist approach if achievement goal theory is to be advanced. With a universalist approach, the impact of culture (and context) on motivation is recognized, but also the possibility that there may exist certain universal motivational processes. This is the approach that I have adopted in my work. I have assumed that achievement goals as phenomena are universal, but the exact understanding and structure of students' achievement goals may vary between, for example, different countries. This entails that instruments designed to measure achievement goals may not work in the same way in different cultural settings, but should be investigated for, for example, measurement invariance (see section 4.5.1).

I have defined culture according to Hofstede et al. (2010), as shared "patterns of thinking, feeling, and acting" that distinguish groups of individuals from other groups (p. 5). Furthermore, I have focused on national cultures. The focus on nationality may fail to capture the large variability that exists within the nations (Zusho & Clayton, 2011), but Hofstede et al. (2010) argued that nations are "…the

source of considerable amount of common mental programming of their citizens" (p. 21).

Most motivation research has treated culture as unidimensional, dividing students only based on, for example, nationality, ethnicity, or an individualistic-collectivistic continuum. Such a unidimensional approach highly reduces the complexity of cultural differences and may therefore overlook important aspects of culture. Although I focus on nationality, I adopt a multidimensional perspective where the national culture is based on the six dimensions of Hofstede et al. (2010). By acknowledging that two groups can differ in more than one dimension, a higher complexity is possible, and more nuanced differentiations can be made. The six dimensions of Hofstede's index of national culture, and what they refer to in an educational context, are presented below:

- Power distance – high values indicate a high distance between teachers and students in terms authority. Teachers are above critique and their role is to transfer their wisdom to students.
- Individualism versus collectivism – high individualism entails an emphasis on individual opinions, high collectivism entails an emphasis on the preferences of the group. There is also a difference in the purpose of learning: learning how to learn vs. learning how to do and learning as a lifelong process vs. a one time "rite of passage" [p. 119]).
- Competitiveness (called masculinity by Hofstede et al., 2010, see Article I for a discussion on labels) – high competitiveness entails an emphasis on competition, success defined in relation to others, and achievement in school as high stake, while low competitiveness entails an emphasis on self-fulfillment and achievement in school as low stake.
- Uncertainty avoidance – high values equal low tolerance of ambiguity and open-ended learning situations, avoidance of intellectual disagreement with authorities, beliefs in the existence of right and wrong answers, and attributions of results to external and uncontrollable factors, like luck, rather than own ability.
- Long-term versus short-term orientation – strong long-term orientation entails beliefs in the benefits of sustained effort, adaptiveness, and a preference for the concrete over the abstract. Strong short-term orientation entails beliefs in quick learning, stability, and a preference for the abstract over the concrete.
- Indulgence versus restraint – Indulgence is associated with optimism, the perception of personal life control, the importance of freedom of speech, and less moral discipline. Restraint is associated with pessimism, a perception of helplessness, freedom of speech as relatively unimportant, and moral discipline.

It should be noted that although all six dimensions of Hofstede are considered in this thesis, the main focus is on the competitiveness dimension. There are two reasons for this focus. First, there is a large difference in competitiveness between Sweden and Germany, the two countries that I have studied. Sweden is the country with the lowest competitiveness score of all 76 countries listed by Hofstede et al. (2010), while Germany is among the highest. Second, and more important, the competitiveness dimension is the dimension most relevant to achievement goals as it is strongly related to performance goals and their emphasis on competition with others.

Further details on cultural differences between Sweden and Germany are presented in Article I. The specific cultural context that Sweden constitute, and possible consequences for this particular study, is discussed in section 6.2.

2.3 Classroom goal structures

Achievement goals are assumed to be sensitive to both personal characteristics, such as fear of failure and theories of intelligence, and to contextual factors (Pintrich, 2000a; Senko, 2016). Such contextual factors include, for example, social climate, culture, and physical environment. Another contextual factor is *classroom goal structures*, that is, instructional practices that specifically emphasize certain achievement goals in the classrooms (Ames, 1992b).

Classroom goal structures can be divided into mastery and performance, much like achievement goals. Mastery goal structures are instructional practices that emphasize mastery goals in the classroom, and performance goal structures are instructional practices that emphasize performance goals in the classroom (Murayama & Elliot, 2009).

To detail what the classroom goal structures include, I will now introduce the TARGET framework. TARGET is an acronym for task, authority, recognition, grouping, evaluation, and time, describing six dimensions of classroom factors that are of importance to the classroom goal structures expressed. The TARGET acronym was originally presented by Epstein (1987), but Ames (1992b) developed it further by mapping mastery goals onto the framework. To create mastery goal structures in the classroom in accordance to the TARGET framework, teachers should strive for the following:

- Task – varied and diverse tasks with meaningful content and personal relevance. Tasks should be at a challenging level, but not too difficult.
- Authority – although the teacher is the leader in the classroom, students should be allowed to participate in decision-making and setting priorities.

- Recognition – recognition of student accomplishments should be given privately and to everyone. Focus should be on effort, personal improvement, and progress towards personal goals.
- Grouping – students should work both individually and in small groups, but never competitively. Groups should be varied and heterogeneous.
- Evaluation – assessment methods should be varied, but private. Errors should be seen as part of the learning process and feedback should have the same focus as the recognition above.
- Time – allowed time spent on tasks should be flexible, for example, if a student is having difficulties with a task. There should also be planning opportunities for the students (list compiled from Ames, 1992a, 1992b; Schunk et al., 2013).

As section 4.4.2 will show, not all these dimensions are included in the measure of classroom goal structures used in this thesis. However, they may serve as guidelines for teachers on how to create constructive learning environments from an achievement goal perspective (see section 6.3).

2.3.1 Models for the joint influence of achievement goals and classroom goal structures

Both achievement goals and classroom goal structures are correlated with outcomes such as intrinsic motivation, self-efficacy, learning strategies, classroom behavior, emotions, and academic achievement (see reviews in e.g., Kaplan & Maehr, 2007; Meece, Anderman, & Anderman, 2006; Mouratidis, Michou, Demircioğlu, & Sayil, 2018). At the same time, classroom goal structures are viewed both as antecedents of personal achievement goals and as possible moderators of the effect of achievement goals (Murayama & Elliot, 2009). Thus, the relationship between achievement goals, classroom goal structures, and outcomes takes several different forms. These forms were organized in an analytic framework by Murayama and Elliot (2009). Murayama and Elliot's framework, illustrated in Figure 1, separates three different models for the joint influence of achievement goals and classroom goal structures:

- *Direct effect model* – Both achievement goals and classroom goal structures have a direct, separate, effect on the outcome.
- *Indirect effect model* – Classroom goal structures have an indirect effect on the outcome through influencing which achievement goals students pursue, and achievement goals in turn have a direct effect on the outcome.
- *Interaction effect model* – The effect of achievement goals on the outcome is moderated by the classroom goal structures.

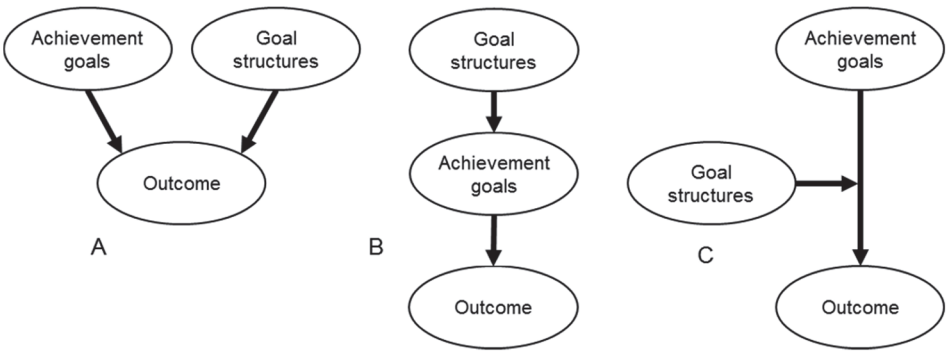

Figure 1. Murayama and Elliot's (2009) framework for studying the joint influence of achievement goals and goal structures on outcome variables. A is the direct effect model, B is the indirect effect model, and C is the interaction effect model.

I have chosen to focus on the interaction between achievement goals and classroom goal structures in both Article III and IV. However, I do not consider this model to be more important than the other two. The separation into three different models is not meant to imply that only one of the three models is correct. On the contrary, Murayama and Elliot argue that consideration of all three models is necessary to get a clear picture of the joint influence of achievement goals and classroom goals structures. Still, research on the interaction effect model is scarcer than for the other two models, and its mechanisms are still not well understood, and therefore research targeting it specifically is warranted.

2.3.2 Match and mismatch hypotheses

When achievement goals and classroom goal structures interact, several different hypothetical patterns of effects are possible. Both Linnenbrink (2005), S. Lau and Nie (2008), and Murayama and Elliot (2009) have proposed systems of organizing these patterns, but I have found the latter to be the most useful and will therefore base this description on Murayama and Elliot's terminology.

Murayama and Elliot (2009) divide the hypothetical patterns into *match* and *mismatch* hypotheses. A match represents a situation when the students' achievement goals are the same as those expressed by the environment (e.g., personal mastery goals in a mastery goal structure classroom) and a mismatch represents a situation where students' achievement goals differ from those of the environment (e.g., personal mastery goals in a classroom with strong performance goal structures). Traditionally, a match has been suggested to produce an optimal set of outcomes (Harackiewicz & Sansone, 1991; Linnenbrink & Pintrich, 2001). However, Murayama and Elliot (2009) suggested that a match hypothesis can be formulated either in terms of positivity (a match produce

optimal outcomes) or accentuation (a match accentuates the effects of the achievement goals, even if that is a negative effect).

A mismatch is usually expected to lead to a negative pattern of outcomes (Harackiewicz & Sansone, 1991; Linnenbrink & Pintrich, 2001), but according to Murayama and Elliot (2009), mismatches can be positive under certain circumstances. Next follows a presentation of three different hypothetical patterns that mismatch may result in. First, a mismatch may lead to a *vitiation effect*, where the beneficial influence of achievement goals is vitiated. For example, mastery goals may be less beneficial for intrinsic motivation if the classroom heavily emphasizes performance goal structures. Second, a mismatch may lead to a *mitigation effect*, where detrimental effects of achievement goals are mitigated by the classroom goal structures. For example, PAv goals' tendency to promote test-anxiety in students may be weakened by a classroom with strong mastery structures. Third, a mismatch may lead to an *exacerbation effect*. According to this hypothesis, a detrimental effect of an achievement goal may be strengthened when the classroom goal structures do not match the goals. One example would be if the mismatch between PAv goals and mastery goal structures led to more test anxiety rather than less, as a mitigation effect suggests.

2.4 Epistemic beliefs

The nature of students' beliefs about knowledge and knowing is what constitute their epistemic beliefs (Conley, Pintrich, Vekiri, & Harrison, 2004). Like for achievement goals, there are several different conceptualizations and operationalizations of epistemic beliefs, but epistemic beliefs are often described as a system of several independent dimensions (Pintrich, 2002). Within each dimension, epistemic beliefs can be organized on a continuum from naïve to sophisticated beliefs (DeBacker & Crowson, 2006). Individuals with naïve beliefs typically believe that all problems are solvable, that there is only one correct answer, and that authorities provide knowledge. Individuals with sophisticated beliefs believe, for example, that there may be several different solutions to a problem, that knowledge claims need to be justified by evidence, and that everyone is active in the construction of knowledge. Although the terms naïve and sophisticated are associated with negative and positive connotations, respectively, the naïve-sophisticated continuum is not necessarily connected to the productivity of beliefs in a certain context. My use of the labels naïve and sophisticated beliefs should therefore not be seen as a valuation of beliefs. Instead, they should be considered neutral labels, based in traditional research on epistemic beliefs, distinguishing between different stances on the nature of knowledge and knowing (see Lindfors, 2018, for a more detailed discussion).

Moreover, students' epistemic beliefs can vary between different domains. Therefore, Muis, Bendixen, and Haerle (2006) recommended the use of domain-specific epistemic beliefs. Hence, the epistemic beliefs treated in this thesis are related to the science domain and the dimensions used are those previously used in this domain by Conley et al. (2004) and J. A. Chen (2012). These dimensions are:

- *certainty of knowledge* – beliefs concerning whether there is only one correct answer to any given question (naïve), or if more than one answer may be correct (sophisticated);
- *development of knowledge* – beliefs concerning the stability of knowledge over time, ranging from knowledge as fixed (naïve) to knowledge as variable over time (sophisticated);
- *source of knowing* – beliefs concern the origin of knowledge, ranging from beliefs that knowledge comes from authorities (naïve) to beliefs that the individual herself constructs knowledge (sophisticated);
- *justification for knowing* – beliefs concerning the need for evidence to justify knowledge, ranging from knowledge equal to opinions and therefore not needing justification (naïve) to the need for all claims of knowledge to be justified by evidence (sophisticated).

Two of these dimensions pertain to beliefs about knowledge (certainty and development of knowledge) and two pertain to beliefs about knowing (source and justification for knowing).

2.4.1 Epistemic beliefs and achievement goals

Epistemic beliefs are construed as antecedents of achievement goals, by affecting students' preferences for certain types of goals (Hofer & Pintrich, 1997). DeBacker and Crowson (2006) proposed that sophisticated epistemic beliefs lead to the adoption of mastery goals, while naïve epistemic beliefs lead to the adoption of performance goals. This proposal seems reasonable as naïve beliefs entail strong reliance on authorities and therefore a focus on external validation, similar to the other-based standard of competence evaluation associated with performance goals. Conversely, sophisticated epistemic beliefs that the source of knowledge is internal ought to be connected with mastery goals' self-based standard of competence evaluation.

2.5 Self-determination theory

Achievement goal theory is the main focus in this thesis, but Deci and Ryan's self-determination theory (SDT; Deci & Ryan, 1985) also plays a part as outcome in Article III and IV. According to SDT, three basic psychological needs underlie our motivation: the need for *competence*, *autonomy*, and *relatedness* (Ryan & Deci, 2000). The need for competence is the need to feel mastery over the situation, the need for autonomy is the need to feel a sense of control and agency, and the need for relatedness is the need to feel belonging to a group. The level of fulfilment of these basic needs lays the foundation for which type of motivation a person experiences. The classic separation in different motivation types is that between *intrinsic* motivation and *extrinsic* motivation (Ryan & Deci, 2000). Being intrinsically motivated means doing an activity for its inherent value and the enjoyment it brings, not for any external reward or consequence. The opposite is extrinsic motivation, when a person engages in an activity for the separable consequences it entails.

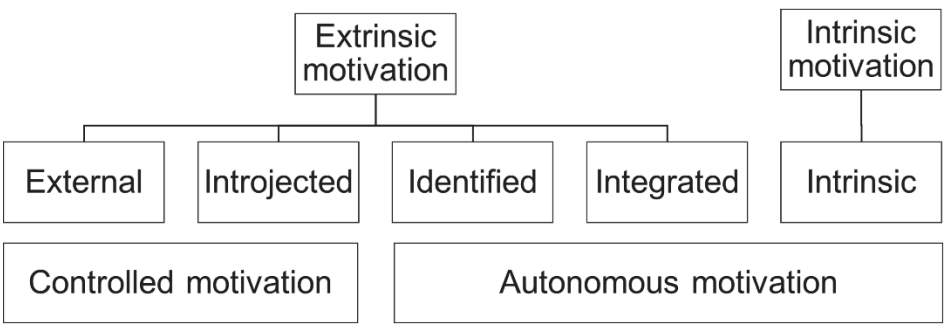

Figure 2. Types of motivation and regulatory styles in self-determination theory. Extrinsic motivation is divided into 5 regulatory styles, of which the two most external (external and introjected regulation) make up controlled motivation, while identified and integrated regulation, together with intrinsic motivation, make up autonomous motivation. Amotivation is omitted.

Intrinsic motivation is the most self-determined form of motivation and it would be fantastic if all students engaged in schoolwork for the pure fun of it. However, most people are not intrinsically motivated, and school activities are not often designed to support intrinsic motivation (Ryan & Deci, 2000). Acknowledging different levels of internalization and integration of the surroundings' values, picturing them on a continuum, Deci and Ryan (1985; Ryan & Deci, 2000) also developed a subtheory of SDT. In this subtheory, several types of extrinsic motivation, also called regulatory styles, were defined (see Figure 2). In one end of this taxonomy of motivation, we find *amotivation*, the absence of will to act. At the other end, we find intrinsic motivation. Between these two, there are four types of extrinsic regulatory styles: *external*, *introjected*, *identified*, and *integrated* regulation. These four regulatory styles represent an increasingly

internal loci of causality, that is, to what extent the individual perceives that the decision to act comes from him/herself.

Lately, research based on SDT has turned its focus from intrinsic motivation, extrinsic motivation, and separate regulatory styles to a differentiation between *controlled* and *autonomous* motivation (Deci & Ryan, 2008, see also Figure 2). Controlled motivation comprises the two most external regulatory styles, external regulation and introjection, while autonomous motivation comprises identification, integration, and intrinsic motivation. It is in this form self-determination has been used in my research, primarily in Article III and IV.

3. Empirical background

Besides the theories and models presented in the last chapter, my research is based on the empirical results of previous research. In this chapter, I present empirical results that have laid the groundwork for my studies and that can be used to reflect on my results.

3.1 Effects of achievement goals

There is extensive research on the relationship between achievement goals and a multitude of outcomes. As it would be outside the scope of this thesis, the intention here is not to give an exhaustive review of effects, but a few examples that are relevant to my studies. The relationships between achievement goals and classroom goal structures and between achievement goals and epistemic beliefs will be treated in their own sections (section 3.3 and 3.4). Therefore, this section will primarily present results concerning the outcomes used in Article III and IV: academic achievement and autonomous motivation (I have deemed intrinsic motivation and autonomous motivation to be similar enough to review results of both these constructs together in this review).

Although the research on the relation between achievement goals and outcomes is extensive, it is important to note that it is mostly correlational (Linnenbrink-Garcia, Patall, & Pekrun, 2016). It is therefore not possible to discern which variable is the cause and which is the effect, other than in the statistical meaning of the terms. For example, classroom goal structures are often assumed to be the predictor of achievement goals instead of the other way around, although there are studies showing a reciprocal relationship between the two (e.g., Tapola & Niemivirta, 2008). However, even when the direction of a relationship is not established, I will use the term "effect" in this thesis to indicate a relationship between constructs where a direction can be assumed from theory or have been defined as part of a statistical analysis. Still, no claim of causality is intended by the use of the term effect.

Originally, theorists tended to present a picture of positive mastery goals and negative performance goals (see e.g., Ames, 1992b). However, with increasing support showing that performance goals also can lead to positive outcomes, the nature of this dichotomy received increased attention (see discussions in e.g., Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002; Midgley, Kaplan, & Middleton, 2001). The separation of achievement goals into approach and avoidance helped to explain part of the mixed results for performance goals. However, the discussion of, for example, when mastery and performance goals are beneficial for academic achievement continues (Senko, 2019).

Mastery goals, both when measured as general mastery goals and when explicitly measured as mastery-approach (MAp) goals, are usually correlated with a set of positive outcomes. This includes both behavior, like exerting higher effort in school tasks and using more productive learning strategies (Wolters, 2004), and affective outcomes, like higher interest (Church et al., 2001) and positive emotions in relation to school work (Winberg, Hellgren, & Palm, 2014). Performance-avoidance (PAv) goals on the other hand are often related to a negative pattern of outcomes. For example, PAv goals have been shown to correlate negatively with engagement and adaptive learning strategies (Wolters, 2004), but positively with test anxiety (Elliot & McGregor, 1999) and self-handicapping (Urdan, 2004a). Performance-approach (PAp) goals have been connected to both positive and negative outcomes. For example, a meta-analysis by Senko and Dawson (2017) showed that PAp goals correlated positively with positive competence perceptions, deep learning strategies, and enjoyment, but also with help-avoidance, negative affect, and anxiety. These mixed results, and the fact that different studies show different results for the same outcomes, can in part be explained by differing definitions of the goals. Both the meta-analysis by Senko and Dawson (2017) and by Hulleman et al. (2010) show that the emphasis on standpoint or standard (see section 2.1.1) in the definition and operationalization of PAp goals influences the outcome patterns. PAp goals emphasizing the standpoint of demonstrating competence are more negative than PAp goals that emphasize the standard of normative comparison.

3.1.1 Achievement goals and academic achievement

Now we turn to academic achievement specifically. I am basing this overview more on meta-analytic results than individual studies. In a large meta-analysis by Hulleman et al. (2010), academic achievement was negatively correlated with PAv goals and positively correlated with MAp goals. Moreover, Hulleman et al. identified several moderators. For example, MAp goals were more strongly correlated with academic achievement in Europe than in the United States or Canada and more strongly in published studies than in unpublished studies. Additionally, the correlation was weaker for MAp measures that were categorized as goal-relevant according to the definition used by Hulleman et al. Items that were categorized as not MAp goal-relevant focused on, for example, interest, challenge-seeking, or curiosity instead. My studies have been conducted in Europe, but with MAp goal measures that are goal-relevant. Therefore, it is difficult to predict how these moderators may have affected the results.

Contrary to early conceptualization of achievement goals, PAp goals were stronger predictors of academic achievement than mastery goals were, as long as both types were measured with relevant measures (Hulleman et al., 2010). However, when PAp goals were separated according to emphasis on standpoint

and standard, PAp goals that emphasized demonstration of competence (standpoint) are negatively correlated with achievement, but PAp goals that emphasized normative comparison (standard) were positively correlated with achievement. My PAp goals were defined by both standard and standpoint, so again it is difficult to predict how these differences may have affected the results.

Apparently, both MAp goals and PAp goals may facilitate academic achievement, but it is possible that they do so under different conditions. However, the results regarding possible explanations for when which goal is most beneficial for academic achievement are often largely inconclusive (e.g., Linnenbrink-Garcia, Tyson, & Patall, 2008; Senko, 2019). Nevertheless, there are indications that MAp goals may be more beneficial, and PAp goals more detrimental, for young students, for students with low ability or low perceived competence, when students' interests align with the topic, and when long-term retention of information is sought (Elliot & McGregor, 1999; Linnenbrink-Garcia et al., 2008; Senko, 2019).

3.1.2 Achievement goals and autonomous motivation

Turning to autonomous and intrinsic motivation (as stated in 3.1, the results of these two are treated together), several studies have shown a positive correlation between MAp goals and intrinsic motivation (Church et al., 2001; Elliot & Harackiewicz, 1996; Elliot & Murayama, 2008; Murayama & Elliot, 2009). Similarly, several studies report a detrimental effect of PAv goals on intrinsic motivation (Elliot & Church, 1997; Elliot & Harackiewicz, 1996; Elliot & Murayama, 2008; Murayama & Elliot, 2009). The results for PAp are more ambiguous. Some studies show positive correlations between PAp and intrinsic motivation (Elliot & Harackiewicz, 1996; Murayama & Elliot, 2009) while others do not (Elliot & Church, 1997; Elliot & Murayama, 2008). In this case, the emphasis on standard or standpoint does not seem to be a deciding factor.

In this thesis, autonomous motivation is regarded as an outcome of achievement goals (see e.g., the process model of intrinsic motivation in Harackiewicz & Sansone, 1991). However, it is not always treated as such. Several studies treat intrinsic motivation as an antecedent of achievement goals (e.g., Ciani, Sheldon, Hilpert, & Easter, 2011; Vansteenkiste et al., 2014). Others have shown a reciprocal relationship between the two (Cho & Kim, 2019). However, in the analyses applied in Article III and IV, either the goals must be defined as the predictors of motivation types or the other way around. I have chosen to define achievement goals as the predictors and autonomous motivation as the outcome. A possible mechanism for how the match between achievement goals and classroom goal structures influence students' autonomous motivation is discussed in section 6.4.

3.2 Development of achievement goals over school grades

A developmental perspective of achievement goals, that is, changes in achievement goals and their effects over the school years, is a theme found (more or less explicitly) in all four articles in this thesis. In this section, I will give an overview of previous research concerning three possible aspects of change over time: changes in which achievement goals the students pursue, in the relationship between different achievement goals, and in the effects that achievement goals have on outcomes.

First, do students of different age pursue different achievement goals? Motivation in general tend to decline as students grow older (Schunk et al., 2013). This does not necessarily mean that the decline is directly dependent on the physical and/or psychological development of the students (and, therefore, is inevitable). Instead, arguments have been raised that the decline relates to changes in the school environment during advancement through the grades (Eccles & Midgley, 1989). Both the decline over time, and the relation to the school environment, is mirrored in research concentrating on achievement goals. On a general level, the review of students' assessment of intellectual competence presented by Stipek and Iver (1989) showed that students tend to shift from mastery-like assessment of competence to normative, performance-like assessment as they grow older. Therefore, a shift towards less reliance on mastery goals and more on performance goals can be expected. Midgley, Anderman, and colleagues have examined the changes in students' achievement goals over grades in several studies (Anderman, Maehr, & Midgley, 1999; Anderman & Midgley, 1997; Midgley, Anderman, & Hicks, 1995; Urdan & Midgley, 2003), with a focus on the transition between elementary school and middle school (i.e., the transition between Grades 5 and 6). The overall result is in line with Stipek and Iver (1989). Students in elementary school have stronger mastery goals and weaker performance goals than the middle school students. However, the change in achievement goal adoption can be tied to similar changes in the perceived emphasis on mastery and performance goals in the classroom (Urdan & Midgley, 2003). Also, though the transition between school stages is a possible source of changes in the school environment, Urdan and Midgley (2003) showed that the changes between Grades 5 and 6 were comparable to those between Grades 6 and 7, when there is no transition between stages. Meece and Miller (1999, 2001) also showed that mastery goals decreased within the school year, although the goals were relatively stable between the grades.

The decrease in mastery goals, and the importance of the environment, is also supported by other researchers, for example, Lüftenegger et al. (2012) and Vedder-Weiss and Fortus (2011, 2012). Vedder-Weiss and Fortus' studies are especially interesting as they compared two different types of school with

different approaches to learning. The results show that in the traditional school, both mastery goals and perceived mastery structures decreased between Grades 5 and 8. However, in the "democratic schools", offering a more autonomous learning environment, no such decrease was observed. On the contrary, students in democratic schools reported lower PAv goals and perceived performance structures in Grades 8 than in Grade 5. This again shows that the decline in mastery goals is not inevitable, and that the school and classroom environment have the potential to break the negative trend.

The general pattern in most of the studies above is in line with Stipek and Iver's (1989) conclusions, that the level of mastery goals decreases and the level of performance goals increases or does not change significantly. However, there are also studies where performance goals decrease together with the mastery goals (e.g., Bong, 2009; Meece & Miller, 2001). Therefore, the trajectory of performance goals is less clear than that of mastery goals.

The second possible change, besides which achievement goals that the students pursue, is if the goals themselves and the relation between them may change with school years. For example, Bong (2009) showed that young students (Grades 1-2) had high correlations between PAp and PAv goals and between PAv and MAv goals in the 2x2 achievement goal model. In general, Bong's results show that the younger the students are, the more difficulties do they have to discriminate between all four goals. There are indications that the school year affects the goal-goal correlation in Hulleman et al.'s (2010) large meta-analysis too, although the goal measurement used is a possible confounder as the measurement instruments used correlated with students' age. In conclusion, I agree with Linnenbrink-Garcia et al. (2012) that the evidence of an effect of students' age on the correlations between goals is weak. Therefore, achievement goal models should be invariant over grades. Furthermore, any observed differences can potentially be attributed to differences in school environment, unless additional research shows something else.

Third, do the outcomes of achievement goals vary with students' age? As far as I have found, not many longitudinal studies have investigated this issue. However, meta-analytic results cover a lot of different studies with different age groups, so they should give a hint of the age-dependence of the effects of achievement goals. Judging from existing meta-analyses, it appears as if the age of the student sample may influence the relationship between PAp goals and several outcomes: interest (Hulleman et al., 2010), competence perceptions, deep study strategies, help seeking, and positive affect (Senko & Dawson, 2017). For all these outcomes, PAp goals become less adaptive as students become older. One exception is that PAp was significantly positively correlated with academic achievement among university students and high school students, but not among elementary or

middle school students, in Wirthwein, Sparfeldt, Pinquart, Wegerer, and Steinmayr's (2013) meta-analysis. Still, Wirthwein et al. did not find similar differences in the effects of MAp, MAv, or PAv goals over educational levels. Furthermore, several other meta-analyses have found no moderating effect of sample age on the relationship between achievement goals and academic achievement (Huang, 2012; Hulleman et al., 2010; Van Yperen, Blaga, & Postmes, 2014). Overall, the effect of achievement goals on academic achievement does not seem to depend on students' age, though there is some evidence that the relation between PAp goals and other outcomes may be affected. Again, differences in the school environment cannot be ruled out as a confounding variable behind this age effect.

As shown in this review, there is research covering age-related changes in which achievement goals the students pursue, in the relationship between different achievement goals, and in the effects that achievement goals have on outcomes. However, few studies have included a span of grades as wide as my studies have (Grades 5-11). Besides, my main focus does not fall into any of the three aspects described above. When it comes to age-related changes in the relationship between achievement goals and epistemic beliefs, and in the interaction between achievement goals and classroom goal structures, the research is much scarcer. Even studies that include more than one grade tend to ignore age-related differences in the relations between the constructs (two exceptions for the relationship between achievement goals and epistemic beliefs are Mason, Boscolo, Tornatora, & Ronconi, 2013; Murphy et al., 2010). To avoid over-generalizing results and drawing erroneous conclusions about students' motivation, it is therefore important to investigate if these relationships are stable over the grades, or if there are variations that need to be considered.

3.3 Relationship between achievement goals and classroom goal structures

As presented in section 2.3.1, the joint influence of achievement goals and classroom goal structures on educational outcomes can be described by Murayama and Elliot's (2009) three models. In this section, I will focus on the indirect effect model and the interaction effect model, which are the models that incorporate a relation between achievement goals and classroom goal structures. For direct effects of achievement goals on outcomes, see section 3.1, and for examples of direct effects of classroom goals structures on outcomes, see overviews in Articles III and IV.

The indirect effect model suggests that classroom goal structures predict achievement goals, which in turn predict educational outcomes. The correlation between classroom goal structures and achievement goals have been thoroughly

studied and the general conclusion from individual studies (e.g., Kaplan & Maehr, 1999; Lüftenegger, van de Schoot, Schober, Finsterwald, & Spiel, 2014; Roeser, Midgley, & Urdan, 1996; Urdan & Midgley, 2003) as well as from meta-analyses (Bardach, Oczlon, Pietschnig, & Lüftenegger, 2019; Givens Rolland, 2012) is that mastery goal structures predict mastery goals, while performance goal structures predict performance goals. Accordingly, both the link from classroom goal structures to achievement goals and the link from achievement goals to outcomes (section 3.1) are well established. There are also several studies that have combined these links to a complete chain, from classroom goal structures, via achievement goals, to outcomes. For example, an effect of classroom goal structures, mediated by students' achievement goals, has been shown on outcomes such as social relationships (Polychroni, Hatzichristou, & Sideridis, 2012), learning strategies (Michou, Mouratidis, Lens, & Vansteenkiste, 2013), self-efficacy (Midgley et al., 1995), and academic achievement (Mouratidis et al., 2018). In conclusion, the indirect effects of classroom goals structures on outcomes, via achievement goals, are relatively well documented in previous research.

The effect model that has gained the least attention is the interaction effect model. Theoretically, a match between students' personal achievement goals and the goals emphasized in the classroom, that is, the classroom goal structures, should lead to optimal outcomes, while a mismatch should lead to a negative pattern of outcomes (Harackiewicz & Sansone, 1991; Linnenbrink & Pintrich, 2001). More detailed and nuanced hypotheses have also been presented (see section 2.3.2), but the empirical support for these hypotheses is still weak.

I have found only six studies investigating the interaction between achievement goals and classroom goal structures (S. Lau & Nie, 2008; Linnenbrink, 2005; Muis et al., 2013; Murayama & Elliot, 2009; Newman, 1998; Wolters, 2004). Based on the results of these studies, matching effects seem to accentuate the basic pattern of the achievement goals. The beneficial effects of mastery goals are strengthened in mastery structures (Muis et al., 2013; Wolters, 2004), but the negative effect of PAv goals are also strengthened in a performance structure (S. Lau & Nie, 2008; Murayama & Elliot, 2009; Wolters, 2004). Furthermore, a mismatch between achievement goals and goal structures has been found to vitiate the positive effect of achievement goals. For example, the positive correlation between performance goals and intrinsic motivation was weakened in mastery goal structures in Murayama and Elliot (2009), and the positive correlation between mastery goals and effort was weakened in performance goal structures in Wolters (2004). Hence, there are studies that indicate the existence of both matching effects and mismatch effects, primarily vitiation, but it is also important to point out that the interactions do not appear in all studies. Linnenbrink (2005) found no significant interactions at all, and Wolters (2004)

only found 4 out of 42 possible interactions significant. Thus, whether interactions between achievement goals and classroom goal structures are of importance, and if so, when and how the interactions influence outcomes are issues that require further attention. A part of the purpose of this thesis is to address this issue.

3.4 Relationship between achievement goals and epistemic beliefs

As described in section 2.4.1, epistemic beliefs are hypothesized to be the antecedents of achievement goals rather than the other way around. Although this directionality is assumed in much of the research on epistemic beliefs and achievement goals, I have only found one study that can add insight on whether this assumption holds empirically. This study, a longitudinal study by Bråten and Strømsø (2004), indicates that students' epistemic beliefs at one time point can predict their achievement goals at a later time point, thus supporting the role of epistemic beliefs as antecedents of achievement goals. Even though the empirical evidence is weak, I follow theoretical assumptions by, for example, Hofer and Pintrich (1997) and treat epistemic beliefs as an antecedent of achievement goals in this thesis.

Overall, the relationship between achievement goals and epistemic beliefs has received surprisingly little attention in previous research (Murphy et al., 2010). However, DeBacker and Crowson's (2006) hypothesis, that mastery goals are related to sophisticated epistemic beliefs and performance goals are related to naïve beliefs, has been tested in a couple of studies. Examples of studies that support this hypothesis are, besides DeBacker and Crowson's study, Abedalaziz, Nor, Chin, and Orleans (2015), Bråten and Strømsø (2004), and Muis and Foy (2010). There are also several studies (Kizilgunes, Tekkaya, & Sungur, 2009; Mason et al., 2013; Ricco, Schuyten Pierce, & Medinilla, 2010) where the results instead imply that performance and mastery goals correlate in the same way with naïve and sophisticated beliefs, and thereby challenge this hypothesis.

To summarize, previous research on the relationship between achievement goals and epistemic beliefs shows some support for the hypothesis that epistemic beliefs precede achievement goals. There is also some support for the hypothesis that mastery goals are associated with sophisticated beliefs and performance goals with naïve beliefs. Still, the studies are few and the results are not unanimous so more research on the subject is needed before we can draw safe conclusions. Within this thesis, I address the latter of these issues, the correlational pattern between achievement goals and epistemic beliefs.

4. Research design and methods

Here I will present information about my studies' context, the participants, how the data was collected, the measures used, the analyses used, and ethical consideration. I also discuss my choice of methods and, first of all, my theoretical points of departure.

4.1 Theoretical points of departure

In this section, I will discuss my theoretical points of departure, as these lay the foundation for the choices I have made throughout my studies.

In this thesis, motivational variables are measured by self-report questionnaires that are analyzed using statistical analyses. However, I would like to point out that I do not subscribe to the idea that I thereby have measured an objective "truth", or even reality. For example, I doubt that the different types of achievement goals are observable entities that exist inside us humans. Instead, I view achievement goal theory, and other motivation theories, as an explanation model that attempts to organize the complexities of human behavior in a comprehensible and manageable form. The definition and evaluation of competence may differ between individuals, and these differences may affect the individuals' behavior. But these differences may not fall into the neat categories that theory describes at all times, or for everyone. Still, I believe the simplification is justified when it helps us understand more about the underlying complexity, just like the Bohr model helps students understand basic chemistry even though it is a primitive approximation of how atoms function.

Kaplan, Katz, and Flum (2012) describe how psychological and educational phenomena can be described as simple, complicated, or complex systems. A simple system consists of a small number of pieces that are related to each other in a few cause-effect relations. Complicated systems are similar to simple systems, but consists of more parts and more relations, though cause-effect relations are still assumed. Finally, complex systems consist of many pieces in intricate webs of interrelations that cannot be influenced in deterministic ways. A complex system is more than the sum of its parts, and it is constantly changing. According to Kaplan et al., current motivational theories often assume complicated systems, but motivation research tends to fall back on simple systems when the theories are operationalized.

My theoretical point of departure is that motivation is a complex phenomenon. However, while acknowledging that motivation is complex, this thesis is more concerned with motivation as a complicated system than a complex one. This choice limits the authenticity of results, but it increases the feasibility of research to focus on a limited part of the system and ignore parts of the complexity. Still, as far as possible, the studies within this thesis have avoided to over-simplify systems. For example, instead of assuming a simple cause and effect relation between achievement goals and outcomes, I have studied the possibility that the same cause can have different effects depending on the context (i.e., the interaction between achievement goals and classroom goal structures). In these analyses, both mastery and performance goals, and mastery and performance goal structures, are included, as well as interactions between them. This increases the complexity of analyses, and thus makes the interpretation of results more difficult. But it is also a way to approach the complexity of reality and make the results more authentic. Thus, authenticity was prioritized over simplicity in the analyses.

Despite my view of motivation as complex, I have chosen to focus on only achievement goals here. This is not because I consider achievement goals more important or informative than other motivation theories. Neither should achievement goals be regarded as a complete explanation of all motivated behavior. On the contrary, I believe different motivation theories complement each other and should be considered jointly to get a fuller picture of students' motivation. Still, we need to know the particulars of each piece to be able to complete the jigsaw puzzle. To understand the particulars of each piece, they need to be studied separately for pragmatic reasons. Therefore, I focus on achievement goals in this thesis and leave the joining of puzzle pieces to future research.

4.2 Context and participants

This thesis focuses on Swedish students, but the studies were conducted within the DoLiS-project in which both Swedish and German students participated. Both countries were included in Article I (see Table 3 on the next page). Therefore, I will present the study context for both Swedish and German students in the following section, including a short overview of the school systems that the participants are part of.

4.2.1 The Swedish school context

The Swedish school system consists of nine compulsory years (Grades 1-9, of which six years belong to primary school and 3 years belong to lower secondary school) and three more noncompulsory years at upper secondary school. Upper secondary school is not compulsory, but most students still go there directly after finishing Grade 9 (98% year 2015; Skolverket, 2016). As students move through

the school system, they may change classes, teachers, and schools several times, but it is most common for such transitions to occur between Grade 3 and 4, Grade 6 and 7, and Grade 9 and 10 (first year of upper secondary school).

In Grades 1-9, there is no separation of students based on academic achievement or interest. However, at the start of Grade 10, students choose 1 of 18 three-year long national programs. Six of these programs are higher education preparatory programs, and 12 are vocational programs.

Chemistry is studied by all students in Grades 5-9, either together with biology and physics in a combined natural science subject (which is more common in the earlier grades) or as a subject on its own (which is more common in the later grades). In upper secondary school, only students in the Natural Science Program (14.4% of the students studying a national program school year 2014/2015; Skolverket, 2016) and the Technology Program (8.9% of the students studying a national program school year 2014/2015; Skolverket, 2016) take separate chemistry courses. All other students take a general natural science course that includes chemistry.

Table 3. Overview of what type of data that is included in the articles

Article	Focus	Countries	Type of data
I	AG factor structure	Sweden & Germany	Cross-sectional MP1, Grades 5–11
II	EB-AG	Sweden	Cross-sectional MP1, Grades 5-11 Longitudinal MP1-3, Grades 5-7 and 9-11
III	Interaction AG-CGS	Sweden	Cross-sectional MP1, Grades 6–10
IV	Interaction AG-CGS across grades	Sweden	Cross-sectional MP1, Grades 6–10

Note. EB = epistemic beliefs, AG = achievement goals, CGS = classroom goal structures, MP = measuring point in the longitudinal study.

4.2.2 The German school context

In Germany, the school system varies between different federal states so what follows here is a description of the school system of the federal state that the data was collected in.

Like in Sweden, Grades 1-9 are compulsory in this state. Primary school constitutes Grades 1-4, lower secondary school Grades 5-9, and upper secondary school Grades 10-12. There is no differentiation between students in primary school, but at the start of secondary school, students go to one of several different types of school. In school year 2014/2015, when the data collection for my studies began, Gymnasium (43.5% of the students; Statistisches Amt für Hamburg und Schleswig-Holstein, 2018) and Gemeinschaftschule (44.0% of the students; Statistisches Amt für Hamburg und Schleswig-Holstein, 2018) were the two most common. Of these two, the Gymnasium represents the higher academic track with the purpose of preparing students for higher education. The choice of academic track lies with the parents of the individual student, but the primary school teachers make a recommendation based on students' academic performance.

4.2.3 Participants

Two municipalities in northern Sweden took part in the studies. In these municipalities, we invited all public schools (i.e., schools governed by the municipality) with students in any of the grades between 5 and 11 to participate. We only excluded students in upper secondary programs for students with learning disabilities or for students recently immigrated to Sweden. In total, 2109 Swedish students (48% female, 42% male, 10% undefined) responded to the questionnaires distributed at the first measuring point (MP1). Of the upper secondary students, 20% attended the Natural Science program, 9% attended the Technology program, and 70% attended other programs. Similarly, all public schools in a single federal state in Germany were invited to participate. 2845 German students (52% female, 44% male, 4% undefined) in Grades 5-11 responded at MP1, of which a majority (91%) attended the higher academic track, Gymnasium. Table 4 displays the sample sizes in each grade for both countries.

Table 4. Sample sizes for each grade and in each country.

Grade	Country	
	Sweden	Germany
5	216	510
6	244	381
7	401	299
8	326	310
9	360	469
10	318	357
11	244	519
Total	2109	2845

From this sample, subsamples were extracted for different studies (see Table 3). Longitudinal data was also collected by following two cohorts for three school years. Students in Grade 5 continued to respond to questionnaires through Grade 6 and 7, and student in Grade 9 continued to respond to questionnaires in Grade 10 and 11.

On the one hand, the sample is a result of a convenience sampling and is therefore not as generalizable as a random sample (Cohen, Manion, & Morrison, 2011). On the other hand, complete municipalities/federal states were invited to participate, which should ease some of the limitations of a convenience sample. Then again, there was no control over which schools, classes, or individual students that chose not to participate so the sample may be biased. From preliminary analyses of dropout, it seem common that whole classes, or even schools, chose not to participate, but that the dropout on individual level was less prominent. To conclude, the sample cannot be regarded as a perfectly random sample, but bias due to individual student characteristics should be limited.

4.3 Data collection

The data from German students was collected through paper-and-pen questionnaires distributed by project assistants. The first data collection, designated MP1, was conducted in early spring 2015. The following collections, MP2 and MP3, were conducted in the spring 2016 and 2017, respectively.

Instead of paper-and-pen questionnaires, the Swedish students responded through digital questionnaires created and distributed through Textalk WebSurvey®. Students responded to these questionnaires in their own classrooms, supervised by their own teachers who had received instructions from us researchers. The schools were offered support in the form of equipment (tablets) and visits from the researchers during data collection, though few schools requested such assistance. As the questionnaires were extensive, the recommendation was that teachers should split the response sessions over two or three occasion, but the final decision was up to the individual teachers.

Using paper-and-pen questionnaires in Germany but digital questionnaires in Sweden could lead to measurement errors, but Hox, De Leeuw, and Zijlmans' (2015) overview of measurement invariance between different modes of data collection showed that paper-and-pen surveys tend to behave similar to web surveys. Therefore, I have treated the data from these two methods as equivalent in all subsequent analyses. However, research also shows that online questionnaires tend to increase careless responses (i.e., responses unconnected to the item content; Meade & Craig, 2012). One indicator of careless responding is long strings of identical answers (e.g., student responding with a 3 to all

achievement goal items), something that was clearly evident in my data during preliminary analyses. Also, the problem with long strings of identical answers was more pronounced among the Swedish students than the German students. Thus, the mode of data collection may have led to a lower data quality in Sweden. As we later cleaned the data for extreme long strings of identical answers (see e.g., Article I for more details), this led to the discarding of more data from Swedish students than from German. The use of digital questionnaires had several reasons, but the main reason was that it saved resources. With digital questionnaires, the researchers did not need to visit each classroom for data collection, and the compilation of the responses was made easier. The backside is that not visiting the classrooms may have negatively affected students' motivation to fill in the questionnaires carefully and thus contributed to careless responses.

4.4 Measures

In the following sections, I will describe the measures used in my research: measures of achievement goals, classroom goal structures, autonomous motivation, epistemic beliefs, and a chemistry test. As the data used in my research was collected within the DoLiS-project, the distributed questionnaires contained additional measures. These measures included attributions (based on Weiner, 1985, 2000), perceptions of autonomy support (adapted from Williams & Deci, 1996), perceptions of general classroom environment (adapted from Aldridge & Fraser, 2000), interest (adapted from Dierks, Höffler, & Parchmann, 2014), and self-concept (adapted from Marsh et al., 2008; Spinath, Stiensmeier-Pelster, Schöne, & Dickhäuser, 2000). However, the results of these measures have not played any part in this thesis and will therefore not be discussed further.

Students answered all items on a 5-point Likert scale, except for the chemistry test where the students were tasked with identifying the most correct answer out of four alternatives. The Likert scale allowed answers from 1 (*strongly disagree*) to 5 (*strongly agree*). All items of the measures described below can be found in the Appendix.

4.4.1 Achievement goals

The instrument used to assess achievement goals was based on the idea of combining the standard and standpoint of achievement goals. Therefore, items from the revised Achievement Goal Questionnaire (AGQ-R; Elliot & Murayama, 2008), which focus exclusively on the standard of achievement goals, and items from Patterns of Adaptive Learning Scales (PALS; Midgley et al., 2000), focusing on the standpoint of achievement goals, were combined in a single scale. Hence, this scale bears resemblance to the 2x2 SaS measure developed by Korn et al. (2019) in its combination of standard and standpoint. Differences in the operationalization of achievement goals are often ignored in comparisons of

results. However, different operationalizations lead to different results (Hulleman et al., 2010; Senko & Dawson, 2017), so differences in operationalization make direct comparisons complicated. This is something to keep in mind when comparing the results of this thesis with studies using only the standard or only the standpoint as definition of achievement goals. I will return to this issue Chapter 5.

As mentioned in section 2.2.2, mastery-approach (MAp), performance approach (PAp), and performance-avoidance (PAv) goals were measured, but not mastery-avoidance (MAv) goals. For more information about the development of the achievement goal measure, see Article I.

In Article I, confirmatory factor analysis (CFA, see section 4.5.1) was used to determine which achievement goal model that fitted the data best. As the results show, PAp and PAv goals were not separable in the Swedish sample (see section 5.1.1). As a result of the difficulties in separating PAp from PAv goals in Article I, we combined the two goals into a single general performance goal in all subsequent studies. As PAp and PAv goals are known to have different outcome patterns, with PAp being considered more beneficial than PAv, the combination of the two have an uncertain pattern of outcomes. An alternative to combining PAp and PAv would have been to focus on only one of them and remove the other. However, the two goals were indistinguishable in the CFA analysis and showed very similar predictive patterns. Therefore, the choice was made to discard as little information as possible and instead combine the two goals into one.

4.4.2 Classroom goal structures

The students' perceptions of classroom goal structures were assessed through an instrument adapted from PALS (Midgley et al., 2000). PALS contains several scales targeting the classroom environment, with some focusing on students' perceptions of the teacher and some focusing on the classroom environment in general. Koskey, Karabenick, Woolley, Bonney, and Dever (2010) showed that instruments directed at the teacher have higher validity than instruments directed at the general classroom environment, so I chose to use items from PALS' *Approaches to instruction* and *Perception of Teacher's goals* scales. Items in the Approaches to instruction scale is directed to the teacher, formulated as, for example, "I consider how much students have improved…". For these items, the focus was changed by replacing "I" with "my teacher". Other small adjustments were also made to better fit the context, like removing mentions of "report card grades" that do not exist in neither Germany nor Sweden.

What constitutes the classroom goal structure is often described by the TARGET framework (see section 2.3). The PALS items that were used in my studies

primarily cover two of TARGET's six dimensions, *task* and *recognition*. Thus, there are dimensions of the classroom goal structures that are not included in our measure, such as the distribution of authority in the classroom and the flexibility in time. Arguably, task and recognition are two of the most central dimensions of classroom goal structures, but they still do not represent all possible goal structure indicators. Thus, conclusion from my analyses including classroom goal structures should be considered with this in mind. This is further discussed in section 6.3 and 6.4.

Another thing to note is that my studies targeted classroom goal structures, but not structures on, for example, school level (cf. Eccles, 2004). It is possible that the characteristics of the school climate also affect students' motivation. However, the classroom-level structures should have a more direct effect on students and are thus preferable for studying the interaction with students' achievement goals, as in my studies. Furthermore, I have used the individual students' perceptions of the classroom goal structures in my studies instead of aggregated scores of whole classes. This is further discussed in section 4.5.3.

4.4.3 Epistemic beliefs

To assess students' epistemic beliefs regarding chemistry, the instrument by Conley et al. (2004) was modified to specify the chemistry context. The four dimensions of epistemic beliefs that were measured were source, certainty, justification, and development (see section 2.4 for more information about the content of these dimensions).

4.4.4 Autonomous motivation

Students' autonomous motivation was assessed using an adapted version of the Academic Self-Regulation Questionnaire (SRQ-A; Ryan & Connell, 1989). SRQ-A is built around statements, with multiple possible reasons connected to each statement. The two statements used ("When I work with the tasks I get during chemistry class, I do it because…" and "When I try to do well during the lessons in chemistry, I do it because…") are not directly from SRQ-A but formulated to fit this particular study. The reasons connected to these two questions taps into external, introjected, identified, and intrinsic regulation (see section 2.5). These reasons are similar to those used in the original SRQ-A, with small rephrasing and a few larger adaptions to suit the study context. One example of such an adaption is the original item "So that the teacher won't yell at me". As it is highly unlikely that a teacher would yell at a student in Swedish schools, this was rephrased to "I don't want the teacher to become angry with me". The analyses presented in this thesis only use autonomous motivation, which was assessed by collapsing the identified and intrinsic scales into a single scale.

4.4.5 Chemistry test

The chemistry test was designed to assess students' conceptual knowledge of three central themes in chemistry: energy, chemical reactions, and the structure and composition of matter. Reach students answered 10 questions from each theme. Of these 10 questions, four were specific for that student's grade and six were anchor items answered by students in all grades. Some of the questions were simple multiple-choice questions, with one correct answer and three distractors, while others had an ordered multiple-choice format (Alonzo & Steedle, 2009). For the ordered multiple-choice questions, one answer was the scientifically most acceptable response, while the other three represented different lower levels of understanding or alternative conceptions. For more information about the development of this chemistry test, see Hadenfeldt, Bernholt, Liu, Neumann, and Parchmann (2013) and Podschuweit and Bernholt (2018).

4.4.6 Translation and piloting

Originally, some of the instruments were formulated in English, some in German, and some in Swedish. During the development of the instruments, researchers from Sweden and Germany worked together on formulating English items and then translate these into Swedish and German. Additionally, external researchers, proficient in both languages, reviewed both language versions to make sure they were equivalent. All instruments were piloted on students in both countries and revised accordingly.

4.5 Overview of analyses

In this section, I will present an overview of the analyses that I used to reach the results. As the technical details surrounding the analyses are thoroughly described in the individual articles, I will not repeat all the details here. I will instead focus on explaining the ideas behind the analyses, and to some degree justify my choices of analyses.

Two forms of data were collected for my studies, data from a self-report questionnaire and data from a chemistry test. After the data was collected, it underwent several steps of processing and analysis. Some of these steps were used for all the articles, but some were unique for specific articles. Figure 3 (see next page) provides an overview of these steps for all questionnaire data, from raw data to the final analyses. The data from the chemistry test did not go through the same steps as the data from the questionnaire. Instead, the raw scores from the chemistry test were used to produce an estimate of students' conceptual understanding of chemistry. However, the chemistry test is not in focus in this thesis, so I will not describe the process here. For information on how the results from the chemistry test were treated and how scores were calculated, see Article

III and IV, as well as Hadenfeldt et al. (2013) and Podschuweit and Bernholt (2018).

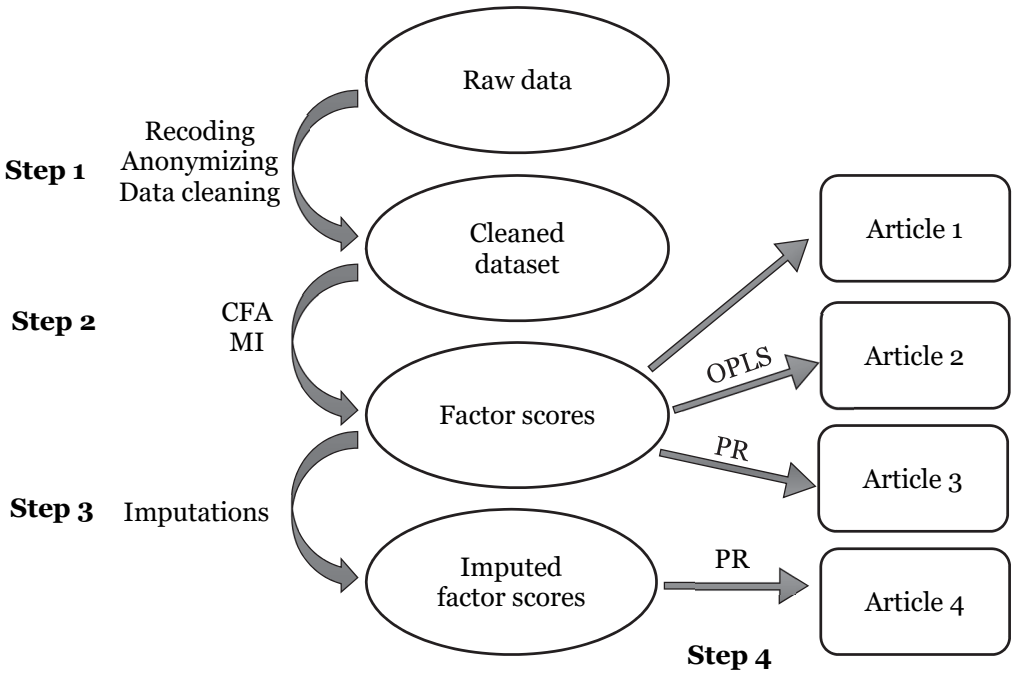

Figure 3. Schematic overview of the process from raw data to final analyses. CFA = confirmatory factor analysis, MI = measurement invariance, OPLS = orthogonal projection to latent structure, PR = polynomial regressions.

In all the studies presented in Articles I-IV, the first step was to recode and anonymize the raw questionnaire data, and then clean the data to remove student responses with long strings of identical answers. In a second step, the data was subjected to confirmatory factor analysis (CFA) to confirm that the data showed acceptable fit to the hypothesized structures. I also conducted measurement invariance (MI) testing to confirm that the measured constructs were invariant across different groups (e.g., different grades). The results of the CFA and MI analyses were directly reported as the main results in Article I. For the other three articles, factor scores from the CFA and MI models were used in further analyses. For Article IV, a third step was introduced in the form of imputations of missing data conducted before the final analyses. The final analyses in Article II-IV were conducted through orthogonal projection to latent structure (OPLS) or polynomial regressions and constitute the fourth and final step of analysis. The following sections will expand on three of these analyses: the confirmation of construct models through CFA and MI (section 4.4.1), the analysis of the

relationship between achievement goals and classroom goal structures through polynomial regressions and response surface methodology (section 4.4.2 and 4.4.3), and the analysis of the relationship between achievement goal and epistemic beliefs though OPLS (section 4.4.4).

4.5.1 Confirming the structures of constructs—confirmatory factor analysis and measurement invariance

Confirmatory factor analysis (CFA) is a method for validating the measurement instrument for its use in the particular context of a study. My studies were grounded in the theories and models presented in Chapter 2. Thus, my aim was to measure variables that are not directly observable. To accomplish this, the theoretical constructs that the theories describe are operationalized as sets of questions or statements (collectively known as *items*) in a questionnaire. In this way, unobservable variables, like students' achievement goals, can be studied indirectly through observable variables, that is, students' responses to questionnaire items (Knekta, Runyon, & Eddy, 2019). For example, to capture students' mastery-approach (MAp) goals, the instrument contained items such as "It is important for me to understand chemistry as well as possible" and "I strive to develop a broad and deep knowledge in chemistry" (see the Appendix for a list of all questionnaire items). These items are meant to capture different aspects of MAp goals and together represent the underlying, unobservable, variable MAp goals. Variables formed by combining information from two or more items are known as *latent variables* in statistical analyses, or more specifically, *latent factors* in factor analysis. CFA is used to validate that each item is related to the intended latent factor (in other words, that the items load on the intended factor), and that the latent factors are related to each other according to the hypothesized structure. CFA can therefore be used to confirm that the collected data can be organized in line with the chosen theory.

In Article I, I used CFA to examine how well the achievement goal data fitted to different possible models. The best fitting model from Article I was also used in the three following studies. Thus, CFA was used as the main method of analysis in Article I, but also to validate that the achievement goal instrument measured what it was supposed to measure, and that the data fitted the theoretical models. CFA was also used to validate the classroom goal structures, epistemic beliefs, and autonomous motivation instruments.

After confirming that the data fitted a theoretical model, I continued with measurement invariance (MI) testing to examine whether the instruments were invariant between different groups. I was primarily interested in invariance between different age groups (grades). An invariant instrument can be said to measure the same underlying unobservable variables in the same way in all

groups. Thus, MI is a prerequisite for both comparing the different groups and for combining groups into a single, larger sample. For example, if the achievement goal instrument proves to be invariant over Grades 5-11, we know that students conceptualized MAp goals similarly in all grades. Hence, it is possible to, for example, compare to what extent students in Grade 5 have MAp goals with the extent to which students in Grade 10 have MAp goals. Without confirming MI, we could be comparing apples and oranges.

MI testing is conducted through multi-group CFA. First, one creates a CFA model for each individual group (e.g., for each grade). Second, one adds restrictions on how similar these individual CFA models must be. If the CFA models of each group are too different from each other, they will not fit together within these restrictions and one can conclude that the instrument do not measure the same thing in the same way in all groups.

The restrictions imposed on the CFA models can be on several different levels, where higher levels demand higher similarity between the groups. The following three levels are usually recommended to establish before the instrument can be used to compare the different groups (Vandenberg & Lance, 2000; Wang & Wang, 2012):

1. Configural invariance: all groups are restricted to have the same number of latent factors and same factor loading patterns (i.e., items load on the same latent factors in all groups).
2. Metric invariance: equal factor loadings across groups.
3. Scalar invariance: equal factor loadings and item intercepts across groups.

These three levels are consecutively more restrictive, so that scalar invariance demands more similarity between the groups than metric invariance do, and metric invariance demands more similarity than configural invariance do. A popular illustration of metric and scalar invariance is to compare it with temperature measures in two hypothetical experiments (e.g., Zusho & Clayton, 2011). If the data supports metric invariance between groups, the unit of measurement is the same in all groups, but the baseline of the scale is not necessarily the same. This is analogous to measuring temperature in Celsius in one experiment and in Kelvin in another experiment. One degree Celsius equals one degree Kelvin, even though the exact numbers differs by 372.25° (the intercept differs by 372.25° in statistical terms). If scalar invariance is supported too, the scale also has the same starting point in all groups, analogous to measuring temperature in Celsius in both experiments. Unfortunately, configural invariance does not fit this temperature example, but the example should still serve to illustrate why the more restrictive levels (metric and scalar invariance)

are important to compare temperature measures in different experiment. Similarly, to compare the responses of different groups, all three levels of measurement invariance should be established for the comparisons to be meaningful (Wang & Wang, 2012).

Instead of using the raw responses to the questionnaire items or their means in subsequent analyses, each student's *factor score* on the latent variables from a CFA model was used. The factor score is computed by assigning different items different importance depending on how well they describe the latent variable, and then give each individual a score based on how they responded to each item. Hence, it is a form of weighted measure of how strongly the individual agree with the latent factor. For example, suppose that the first of the two MAp goal items mentioned in the beginning of 4.5.1 (p. 41) fits into the hypothesized model better than the second, and that it is more strongly correlated with the other MAp items than the second. In that case, the first item is considered as a better indicator of a student's MAp goals than the second item. Accordingly, agreement with the first item is worth more than agreement with the second for the students' factor score on the MAp goal factor.

In Article II, the factor scores from a combined CFA model including all grades were used. However, for Articles III and IV, factor scores from the scalar invariance model were used instead. A model that combines all groups into a single group represents the best model to describe the average of all group, but it may also be slightly wrong for all individual groups. The scalar invariance model represents a compilation of CFA-models, one for each group. Furthermore, the CFA-models for each group are restricted by the configural, metric, and scalar invariance restrictions, but each group may vary slightly. As the scalar invariance model allows for small individual differences between groups, it is a better source of factor scores, with less error, than a model that forces all groups into a single model (Muthén, 1989; also see forum comments August 3 and August 4 by Muthén, 2016).

4.5.2 Studying how achievement goals and classroom goal structures interact—polynomial regressions and response surface methodology

Article III and IV focus on the interaction between students' achievement goals and the classroom goal structures that the students perceive in the classroom. To study this interaction, I used polynomial regression (PR) analyses and the results were visualized and interpreted through response surface methodology (RSM). PR is a regression type that is used here to analyze complex relations between variables, and RSM is used to visualize the results of PR. Visualization helps the

researcher draw conclusions from the complex regression results. This section describes these methods, and why I chose them.

PR is a form of regression that models nonlinear relations between one outcome variable and one or more predictor variables. Generally speaking, a regression is a form of statistical analysis that aims at describing the relationship between variables through a regression equation. When we calculate a regression equation, each predictor variable is assigned a specific *regression coefficient*, a value that shows how much the outcome variable is affected when the predictor increases in value. The estimated regression coefficients can therefore be studied to determine each predictor's effect on the outcome variable.

The difference between a PR and ordinary linear regressions is that PR includes polynomial predictors, for example, the squared terms (e.g., the square of predictor x, i.e., x^2) of at least some of the predictor variables. The inclusion of nonlinear predictors allows for detection of certain types of interactions that may otherwise go unnoticed (Chatzisarantis et al., 2016), so it is an important extension of ordinary linear regressions for the study of interactions. When PR is used to study the effect of a match between variables, as in my studies, interaction terms (e.g., the product of predictor x and y, i.e., xy) are also included.

Because these regressions are so complex, including both linear terms (e.g., x), nonlinear terms (e.g., x^2), and interaction terms (e.g., xy) as predictors, interpreting the results through regression coefficients alone becomes difficult. The regressions presented in Article III and IV do not only include one achievement goal and one goal structure as polynomial regressions in their simplest form would do. The results were also controlled for student characteristics (e.g., grade and sex) and additional achievement goals and goal structures. Therefore, visualization of the results through RSM was deemed necessary to enable any conclusions to be drawn. RSM produces a three-dimensional surface with two predictors and one outcome on the three axes (see Figure 4 on p. 59 for an example). This allows for a qualitative interpretation of the regression equation. RSM also allows a quantitative interpretation of the joint effect of linear, nonlinear, and interaction terms through calculations of surface values. Surface values are mathematical representations of, for example, the slopes and curvatures along the diagonals or the sides of the response surface (see e.g., Shanock, Baran, Gentry, Pattison, & Heggestad, 2010).

Another advantage of response surfaces is that they allow the researcher to see a fine-grained picture of the relationship between the two predictor variables and the outcome variable. Direct interpretation of regression coefficients or simple two-dimensional graphs (e.g., Murayama & Elliot, 2009) offer a much cruder picture of the studied relationship. Although the response surface is limited by

the nature of the regression equation it depicts, and thus do not necessarily fully illustrate the "true" relationship, I believe this more fine-grained picture can be important to capture deviations from the general trends.

Why is the inclusion of nonlinear terms important? If we assume that a match between students' personal achievement goals and the classroom goal structures, no matter the absolute level of the two, leads to the most beneficial pattern of outcomes (Harackiewicz & Sansone, 1991; Linnenbrink & Pintrich, 2001), we need a method of analysis that allows for such interactions. In a three-dimensional surface, such as those in Figure 4 (p. 59), that kind of interaction would lead to a ridge along the diagonal from the near right corner to the far left corner. This hypothetical ridge corresponds to a higher outcome, for example autonomous motivation, when the two predictors have similar values than when one of them is higher than the other. As this ridge is an example of a nonlinearity in the surface, a purely linear model would not allow for such general match effects. Furthermore, an analysis with only linear terms assumes that the effect of a predictor on the outcome is at its maximum at either the highest or lowest value of the predictor. However, an analysis that includes nonlinearity allows for the optimal level of the predictor to be anywhere on the scale. For example, students' academic performance could be the highest when they have medium-high level of performance goals (Chatzisarantis et al., 2016). Thus, nonlinear models allow the study of more complex relationships and not using them may preclude the detection of certain types of interaction.

The use of RSM to visually present the results of PR has been presented as an effective way to analyze effects of a match between variables. For more details on this, see the work of Edwards (1994, 2002; Edwards & Parry, 1993). For a helpful step-by-step guide to conducting PR and RSM, see Shanock et al. (2010). Although these methods are uncommon in motivation research, a few examples can be found in Chatzisarantis et al. (2016); Cron, Slocum, VandeWalle, and Fu (2005); and Brunet, Gunnell, Gaudreau, and Sabiston (2015).

4.5.3 Classroom environment as individual-level phenomenon

In all my studies that involved classroom goal structures, the individual students' perception of the goal structures was used in the analyses. In this section, I will explain why this individual-level measure of classroom goal structures was chosen instead of a classroom-level measure.

An alternative to individual-level measures is to aggregate individual students' perceptions to create classroom-level measures (cf. Lüdtke, Robitzsch, Trautwein, & Kunter, 2009). Although the aggregation to classroom-level is a relatively common practice, I see several advantages with individual-level

measures. To start with, even if classroom goal structures describe classroom-level features, the same classroom environment may be perceived differently by different students (Kaplan & Midgley, 1999; Roeser et al., 1996; Tapola & Niemivirta, 2008). Additionally, students may be treated differently within the same environment (Patrick, Kaplan, & Ryan, 2011; Turner & Patrick, 2004). Therefore, one advantage of using individual-level measures of classroom goal structures in analyses is that the results should reflect how classroom goal structures influence students in practice. This conclusion is based on the assumption that it is the classroom goal structures that the individual student experiences that is of importance, not what an outside observer or the class in average experiences. This assumption is supported by studies showing that individual perceptions of goal structures are more strongly related to motivational variables than classroom-level measures (Urdan, 2004b; Wolters, 2004). Empirical findings have also demonstrated that there is much higher variation in perceived classroom goal structure within classes than between classes (Patrick et al., 2011), and that classroom-level aggregate scores of student's perceptions of goal structures fit poorly in confirmatory factor analyses (Lam, Ruzek, Schenke, Conley, & Karabenick, 2015). Taken together, there are plenty of arguments for the use of individual-level measures of classroom goal structures. Therefore, theorists have argued for the use of individual students' perceptions of classroom goal structures over perceptions aggregated to classroom-level (Ames, 1992b).

The disadvantage of using individual-level measures of classroom goal structures in analyses is the increased distance between empirical results and implications for teachers and school organizations (cf. S. Lau & Nie, 2008). If we assume that the classroom goal structures only exist as subjective experiences on the individual level, how can teachers possibly expect that changing their teaching practices can have any effect at all? The answer is that students' experiences still can be affected by the teacher (see e.g., Kaplan, Gheen, & Midgley, 2002). Even if it is students' subjective perceptions that are important, students are likely to pick up on a clear and consistent goal message from the teachers (Turner et al., 2002; Urdan, 2004b). However, it is probably rare that teachers provide clear mastery or performance goal structures in the classroom. Questions about what to do and how to do it trump why to do it in teachers' planning and execution of school activities (Urdan, 2004b). Still, there is hope that systematic changes in teacher practices can influence students' perceived goal structures.

The discussion above focuses on conceptual issues regarding the level of analysis. However, there are also methodological issues. If the data has a nested structure (i.e., there are groups of individuals that are expected to be more similar to each other than to individuals from other groups), relying on only individual-level measures in statistical analyses can lead to biased results (S. Lau & Nie, 2008).

One could argue that students from the same class should rate the classroom goal structure more similarly than students from different classes do. Therefore, the data used in this thesis was examined to determine whether aggregation to classroom-level was relevant. Investigation of intraclass correlations (ICCs, see Lam et al., 2015; Lüdtke et al., 2009) showed that only a few percent of the student-level variance could be explained by which class the students belonged to. Likewise, the reliability of aggregated classroom-level means was low (see Article III and IV for details). As a consequence of these results, and the arguments above, I have treated classroom goal structures as individual-level phenomena throughout this thesis.

4.5.4 Studying the relationship between achievement goals and epistemic beliefs—orthogonal projection to latent structure

To study the relationship between achievement goals and epistemic beliefs, orthogonal projection to latent structure (OPLS), a development of projection to latent structure (PLS; Abdi, 2010) was used. Below, I will describe the basics of OPLS and why OPLS was a better choice than, for example, regression analysis for this particular purpose. From a theoretical perspective, epistemic beliefs are assumed to be antecedents of achievement goals and were therefore treated as predictors in these analyses.

In an OPLS analysis, a set of predictor variables, in this case the epistemic belief dimensions, and the relations between them are used to predict an outcome variable, in this case mastery or performance goals. Hence, the analysis serves a similar purpose as regression analyses, although the procedure is a bit different. OPLS treats the predictor variables together as a system, and the predictors are allowed to correlate with each other, which is especially useful for data that contains multicollinearity (i.e., where the predictors are correlated with each other). In OPLS, the relationship between the predictors is part of the model. In contrast, a linear regression analysis assumes that the predictors are independent of each other and multicollinearity pose a problem to analyses (Tabachnick & Fidell, 2013). Treating the epistemic beliefs dimensions as a system rather than independent variables was also preferable from a theoretical point of view, as this was how me and my colleagues assumed that the dimensions act in the mind of the students. Another important difference is that regression models use all the variance in the predictors, but OPLS separates the variance that is systematic and predictive of the outcome from the variance that is unrelated to the outcome variable. I will elaborate on how OPLS works below, and use epistemic beliefs and MAp goals as an example in this description.

To start with, in OPLS the variation in the epistemic beliefs dimensions is divided into systematic variation and random variation, or "noise". The random variation is treated as residuals in the analysis, and hence does not contribute to the prediction of the MAp goals. The systematic variation is further divided into variation that is predictive of the MAp goals and variation that is not predictive of the MAp goals (i.e., orthogonal variation). Consequently, a single *component* describing how the system of epistemic beliefs dimensions predict the MAp goals, uncontaminated by irrelevant variation, is created. The component is a linear combination of the data points, in this case the epistemic beliefs dimensions. The individual epis dimensions are of different importance for the orientation of this component, and therefore their loadings on to it represent their relative importance for the prediction of the outcome. This is similar to how individual items are of different importance for the latent factor, described in section 4.5.1. As only the variation that is relevant for the prediction of the MAp goals is used in the predictive component, interpretation of the results is improved over models where all variation is used. For more technical details, see Eriksson et al. (2006).

4.6 Ethical considerations and processing of personal data

My research process has been guided by the principles for research ethics stipulated by the Swedish research council (Vetenskapsrådet, 2017) and the principles for processing of personal data stipulated in the Swedish Privacy Act (PuL; http://rkrattsbaser.gov.se/sfst?bet=1998:204) and the General Data Protection Regulation (GDPR; https://gdpr-info.eu). When the research project started, PuL applied to all research, but this law was replaced by GDPR in 2018.

According to the principles and regulations mentioned above, the participants (who were all students) were informed that all participation was voluntary, that they could abort their participation at any time, that the data was going to be used in research purpose only, and that they would not be identifiable in the publications. They were also informed that their teachers, or other unauthorized persons, would not have access to the collected data. The information was given through both written and oral communication. To protect the participants' anonymity, all personal data was pseudonymized. A code key to the pseudonymized data was kept until the final data collection (measuring point 3), as the project needed to de-pseudonymize the participants during the process of matching data from different time points. However, this code key was kept secure and was deleted after the final measuring point. In accordance with GDPR, the research project was registered at the university because it handled personal data.

5. Results and discussion

In the following sections, I will answer the thesis' research questions based on the results of the individual articles and complementary results new for the kappa. The new results primarily concern the interaction between different achievement goals, something that has not been covered in detail in any of the four articles. Because the focus is on the general research questions of the thesis, the results from the individual articles will not be repeated in detail. For more detailed results, see the articles relating to each research question (see Table 1 for an overview of which articles are related to which research question).

My presentation of the results will be structured according to the research questions of the thesis, found in section 1.1.

5.1 The relationship between achievement goals

Here, I present results concerning the correlation between achievement goals and how the goals interact with each other in the prediction of autonomous motivation and chemistry test performance. Both the correlation and the interaction between achievement goals are seen as aspects of their relationship with each other. To start with, I will present the results concerning the correlations between the achievement goals in the CFA models of Article I.

5.1.1 Correlations between achievement goals

The most important finding was that performance-approach (PAp) and performance-avoidance (PAv) goals were so strongly correlated in the Swedish sample that they could not be significantly separated from each other. More generally, all achievement goals were positively correlated with all other achievement goals.

The positive correlations, ranging from moderate to strong, between all measured achievement goals are not so surprising. For example, the meta-analysis by Hulleman et al. (2010) also shows that achievement goals tend to correlate positively with each other. However, the magnitudes of the correlations are consistently higher in my study than in Hulleman et al. Part of the explanation is found in the moderator analysis included in Hulleman et al.'s meta-analysis. The present study has many of the properties that were found to inflate correlations. For example, the correlations tended to be higher among Europeans (like in our study) than among Americans and Canadians. Furthermore, correlations were higher when the questionnaire items measured achievement goal content than when the items were not goal relevant. For example, some instruments included items that measured affective components such as fear or satisfaction, and these

are normally not seen as components of achievement goals. Thus, there are several plausible reasons for the correlations observed. However, there was one exceptionally high correlation, namely that between PAp and PAv goals in the Swedish sample. This correlation was high enough to deserve a closer look.

The correlation between PAp and PAv was high in both countries (above .7 in all individual grades), but substantially higher in the Swedish sample than in the German. In the Swedish sample, the correlation between PAp and PAv was not significantly different from 1, representing a perfect correlation, and thus, they cannot be considered separate constructs. Again, the moderator analysis in Hulleman et al. (2010) helps explaining the high correlation between the two performance goals. As described in section 2.2.1, both the standard and standpoint were included in the achievement goals of this thesis, and such measures show higher correlations than measures excluding the standpoint (in the case of performance goals, the importance of appearing competent to others). However, the same instrument was used in both Sweden and Germany, so this moderator does not explain why the correlation was stronger in the Swedish sample than in the German. Several other Swedish studies, conducted by different researchers using different instruments and different approaches to statistical analysis, have found that PAp and PAv goals are difficult to separate (Blomgren, 2016; Palm, Sullivan Hellgren, & Winberg, 2010; Winberg et al., 2014). This consistency strengthens the conclusion that achievement goal models are not universal across countries. Sweden, and possibly other countries (cf. Bong, Woo, & Shin, 2013), may differ from, for example, the United States where much of the groundwork for the current achievement goal models has been laid. In Article I, five plausible explanations to differences in PAp-PAv correlation (based on explanations suggested by Linnenbrink-Garcia et al., 2012) were considered. These were differences in age, differences in students' perceived competence, differences in the definition of PAp and PAv goals, differences in the specificity of achievement goal items, and differences in students' fear of failure. Three of these five are identical in the Swedish and German sample (age, definition of PAp and PAv, and specificity of items) and can therefore not explain differences. Students' perceived competence was significantly higher in Sweden than in Germany, but this difference should lead to lower PAp-PAv correlation in Sweden than in Germany, not the other way around (Linnenbrink-Garcia et al., 2012). Finally, our data did not allow comparison of fear of failure. Consequently, none of the explanations that we could explore can explain the higher correlation in Sweden. Instead, as argued in Article I, a plausible explanation lies in cultural differences. Particularly the competitiveness dimension, where Sweden score extremely low (see section 2.2.4), is a likely explanation. In cultures with low competitiveness, there are only weak consequences of failure (Hofstede et al., 2010). I propose that these weak consequences of failure may in turn render the difference between avoiding failure and approaching success unimportant to

students. Consequently, instead of striving to avoid failure or approach success, Swedish students' performance goals are only defined by the overarching performance goal definition (competence is evaluated in comparison with others and it is important to appear competent to others). In other words, PAp and PAv are inseparable and together make up a general performance goal.

Regardless of the reason for the difference in correlations between Sweden and Germany, the results still stand. Because of the high correlation between PAp and PAv, Swedish students' achievement goals were best described by only two separate goals: mastery-approach (MAp) and performance.

5.1.2 Interaction between achievement goals as predictors

When investigating the interaction between achievement goals and goal structures (Article III and IV), the interaction between the two goals (MAp and performance goals) was also included to control for this relationship. The results show that there was a significant negative interaction between MAp and performance goals. The beneficial effect that MAp goals had on both test score and autonomous motivation was mitigated by the presence of performance goals. Hence, students with both strong MAp goals and performance goals performed worse and had less autonomous motivation than did students with strong MAp goals and weak performance goals. However, in the absence of MAp goals, it proved more beneficial for students to have strong performance goals than no strong goals at all.

My results indicate that the combination of strong MAp and performance goals is negative for students. This contradicts studies by, for example, K.-L. Lau and Lee (2008) and Pintrich (2000b). Both these studies showed that the combination of high MAp and high PAp goals may be adaptive. However, none of these two studies considered interaction between MAp and PAp, they only considered the difference in outcomes between student groups created by median-split methods. Studies including statistical interactions between achievement goals are rare, in the same way that studies including interactions between achievement goals and goal structures are surprisingly few (see Article III). For example, Chatzisarantis et al. (2016) found only six studies concerning the influence of interactions between different achievement goals on students' academic achievement. Of these six, one found a negative interaction like we did, but the other five did not find significant interactions. Chatzisarantis et al.'s own results imply that students' course grades are best when strong MAp goals are paired with moderate PAp goals. Moreover, a recent meta-analysis of person-centered research on achievement goals found no evidence that students pursuing both MAp and PAp goals had any advantage over those pursuing only MAp goals (Wormington & Linnenbrink-Garcia, 2017). Hence, there is little support that strong

endorsement of both mastery and performance goals would be favorable over only mastery goal endorsement. On the contrary, the results of Article III points to a maladaptive effect of performance goal pursuit. In the context of my studies, mastery goals seem preferable over performance goals.

It is possible that the performance goals could have shown a more beneficial, or a more detrimental, pattern of outcomes if they would have been operationalized differently. PAp goals that are defined by the standard of performing better than others are usually more adaptive than PAp goals defined by the standpoint of demonstrating knowledge (Hulleman et al., 2010; Senko & Dawson, 2017). The performance goals in my study do not exhibit neither strong positive nor negative direct effects, which may be partly attributed to the mix of standard and standpoint. Additionally, PAp and PAv goals were combined into a general performance goal (see section 4.4.1). PAp goals generally show a beneficial outcome profile, but PAv goals show a detrimental outcome profile (see section 3.1 and its subsections). A combination of the two could lead to adaptive and maladaptive effects cancelling each other, resulting in a neutral outcome profile similar to what I see in my studies. Nevertheless, the results in Article I demonstrated that PAp and PAv goals could not be separated in this sample. Consequently, the neutral outcome profile should represent how performance goals influence students' outcomes in Sweden instead of representing a limitation in my operationalization of achievement goals. Still, both the combination of standard and standpoint in the definition of achievement goals and the combination of PAp and PAv goals into general performance goal hamper comparisons between my results and the results of other studies using different operationalizations. This limitation in comparability is not unique to my studies. The results of achievement goal studies are often compared without controlling for differences in operationalization. I believe that the achievement goal field of research would benefit from increased transparency regarding this issue. As I see it, two alternatives are possible. The first alternative is to continue defining and operationalizing achievement goals in different ways but be more explicit about the differences. The other alternative is to agree on a single definition for what constitutes achievement goals and what does not, as well as how achievement goals should be operationalized. Although the second alternative seem utopic for the time being, it is the best alternative in the long run and would benefit the whole field.

5.2 The relationship between achievement goals and classroom goal structures

Through my studies, I have investigated how achievement goals and perceived classroom goal structures, separately and jointly, predict students' results on a chemistry test and their autonomous motivation. The analyses showed that achievement goals, particularly MAp goals, were more important predictors of both outcome variables than the goal structures, but also that the effect of the goals was moderated by the classroom structures. More specifically, the positive effect of MAp goals was more pronounced when the classroom was perceived as mastery-supportive, that is, when students' personal achievement goals and the classroom goal structures matched each other.

This match effect is in line with the positive effects of matching proposed by, for example, Harackiewicz and Sansone (1991), and Linnenbrink and Pintrich (2001). It further fits the match hypothesis in Murayama and Elliot's (2009) interaction effect model as the match accentuated the basic pattern of the MAp goals. Murayama and Elliot suggested that a match hypothesis can either be stated as accentuation of a goal's basic pattern, or promotion of an optimal pattern (beneficial effects are strengthened while detrimental effects are weakened). These two possibilities are only distinguishable from each other when studying relationships where achievement goals have a detrimental basic pattern. As a result, I cannot conclude from our results which formulation is the more correct.

Although there was a matching effect, the effect was not evident at all levels of achievement goals and goal structures. Strong mastery structures strengthened the effect of mastery goals, but at medium strong mastery structures, strong mastery goals were still more beneficial than medium mastery goals. Thus, the direct positive effect of mastery goals was more important than the effect of a matching level of mastery goals and mastery structures. This speaks against a *general match effect*, that is, that the positive effect of mastery goals would be at its maximum when it matches the mastery goal structures of the classroom, no matter the level of mastery goal structures. Furthermore, the results did not show any similar matching effects between performance goals and performance goal structures. This implies that even if there is a match effect, it is not universal. Even if a teacher creates classroom structures that match each student's personal achievement goals, it will not guarantee better results or more autonomously motivated students. However, as presented in the background (see section 3.3), previous research has shown that mastery goal structures can predict students' mastery goals, and mastery goals were beneficial for both students' test score and autonomous motivation in Article III and IV. The results from these two studies showed that mastery goals were especially beneficial when paired with a

classroom that was perceived as mastery supportive. Consequently, mastery goal structures should still have an overall positive influence on students.

Besides presenting a match hypothesis, Murayama and Elliot (2009) proposed three possible mismatch hypotheses (see section 2.3.2). Of these proposed mismatch hypotheses, my results only support a possible vitiation effect (a beneficial effect of an achievement goal is weakened in case of a mismatched classroom goal structure). A vitiation effect is evident for the effect of performance goals on test score, particularly for students in Grade 10 (see Article IV). At low mastery structures, performance goals were significantly positive for test score, but at high mastery structures, performance goals were significantly negative for test score. It is therefore possible that a teachers' attempt to support mastery goals in their classroom can be detrimental for the academic achievements of students with strong performance goals. However, as this mismatch effect is found only for one of the outcomes, and is only pronounced in one of the grades, the evidence for this negative mismatch effect is much weaker than the evidence of the positive match effect of mastery structures. Accordingly, I do not think this possible mismatch effect warrants caution with the construction of mastery structures in the classroom.

Something that was investigated in Article III and IV, but have not been included in previous research on the interaction between achievement goals and classroom goal structures, was the role of nonlinear relations. We included quadratic predictors, for example, the square of the MAp score, in our regressions and investigated both the significance of the corresponding regression coefficients and the significance of curvatures in the response surfaces. Overall, quadratic regression coefficients were of little importance for the prediction of test score and autonomous motivation, and few curvatures in the response surfaces were significant. This lack of significant results indicates that achievement goals and goal structures interact with each other and relate to test score and autonomous motivation mainly in linear ways. Consequently, the best and worst outcomes are expected at the high or low level of the predictors so that, for example, high mastery goal structures should lead to more autonomous motivation than medium high mastery goal structures. Nevertheless, several response surfaces in both Article III and IV were slightly curved. Moreover, there is a growing body of research that finds nonlinear relations relating to achievement goals and goal structures (Chatzisarantis et al., 2016; Sideridis & Stamovlasis, 2016; Sideridis, Stamovlasis, & Antoniou, 2016). My conclusion is that nonlinear effects still deserve further attention.

For all regressions presented in Article III and IV, the achievement goals and classroom goal structures predicted autonomous motivation to a higher extent than they predicted test score. One explanation may be that autonomous motivation and achievement goals are constructs describing human motivation, and they thus have a theoretical overlap. Test scores on the other hand can be regarded as a secondary outcome of motivation. From previous research, we know that mastery goals can have a beneficial effect on, for example, effort put into schoolwork, productive study strategies, and adaptive help-seeking (e.g., Karabenick, 2004; Wolters, 2004). Although the nature of the link from achievement goals to test scores is not within the scope of this thesis, it is likely that achievement goals act as an indirect predictor of test score, via more direct predictors such as effort, study strategies, and adaptive help-seeking. The relationship between achievement goals and outcomes is highly complex and there are many possible pathways that is not explored here. More research targeting details in specific relations is needed to further understand the nature of these relations.

The issues surrounding the operationalization of the performance goals, discussed in the last paragraph of section 5.1.2, applies here too. To summarize, performance goals showed neither substantial positive nor substantial negative effects on the outcomes. This neutrality in terms of outcome patterns might be related to both the combination of standard and standpoint and to the combination of PAp and PAv goals.

Another issue that is worth mentioning is the direction of the relationship between classroom goal structures and achievement goals. In both the effect models of Murayama and Elliot (2009; see section 2.3.1) and in my discussion above, classroom goal structures are treated as antecedents of achievement goals or moderators of the effect of achievement goals. Despite this, the reverse relationship is also possible and students' achievement goals may influence the classroom goal structures they perceive. For example, Kaplan and Midgley (1999) showed that students' personal dispositions (e.g., positive and negative affect) influence their perceptions of the classroom environment, although the characteristics of the classroom environment seem to be more important than individual dispositions. I have previously argued that this subjectivity in classroom goal structures is a reason to treat the structures as individual-level phenomena rather than using classroom-level aggregates (section 4.5.3). It may as well be used as an argument for a reciprocal relationship between achievement goals and goal structures. For instance, students with strong mastery goals can be expected to perceive the classroom environment as more mastery oriented than students with strong performance goals do. A possible consequence of this is an inflated correlation between matching achievement goals and goal structures (i.e., between mastery goals and mastery structures, and between performance

goals and performance structures). An inflated correlation between predictors can in turn lead to problems with multicollinearity in regression analyses, and reduced statistical power (Agresti & Finlay, 2009). However, no strong correlations between achievement goals and classroom goal structures were observed. Moreover, analyses of the variance inflation factor (VIF; see Agresti & Finlay, 2009) did not indicate problems with multicollinearity. Consequently, I conclude that the reciprocity between achievement goals and classroom goal structures did not pose a problem in my statistical analyses.

5.3 The relationship between achievement goals and epistemic beliefs

A general pattern emerging in the relationship between achievement goals and epistemic beliefs was that MAp goals were positively related to sophisticated beliefs about the *justification* and *development* of knowledge and knowing. Another pattern was that performance goals were positively correlated with naïve beliefs about the *source* and *certainty* of knowledge and knowing.

The positive correlation between MAp goals and justification and development indicates that students who believe that knowledge claims need to be justified by evidence, and that knowledge is changeable over time, often pursue mastery goals. This is an expected correlation, considering that mastery goals are assumed to be related to an incremental theory of intelligence (Dweck, 2000), which is very similar to sophisticated beliefs about the development of knowledge. It is also in line with the hypothesis by DeBacker and Crowson (2006), that sophisticated epistemic beliefs should lead to an internal focus and therefore goals involving task mastery and personal development.

Turning to the prediction of performance goals, the general pattern was the opposite of that of mastery goals. For performance goals, beliefs about the source and certainty of knowledge were more important than those of justification and development. Students with naïve beliefs about the source and certainty of knowledge had stronger performance goals. These naïve beliefs include believing that knowledge comes from authorities rather than being constructed by the individual and that there is only one correct answer for each question. The relationship between performance goals and naïve epistemic beliefs also fits well with DeBacker and Crowson (2006) and the assumption that high reliance on authorities is associated with an outward focus and thus other-based standards of competence and success.

To summarize, the general pattern follows DeBacker and Crowson's (2006) hypothesis that sophisticated beliefs are related to mastery goals and naïve beliefs are related to performance goals. The epistemic belief dimensions appeared to be grouped in two pairs: justification with development and source with certainty. Sophisticated beliefs about justification and development of knowledge were important for students' mastery goals, but naïve beliefs about the source and certainty of knowledge were important for students' performance goals. Sophisticated beliefs about source and certainty were not generally predictive of mastery goals, and naïve beliefs about justification and development were not generally predictive of performance goals. Why did not all dimensions follow the general pattern of sophisticated and naïve beliefs? The explanation may lie in the operationalization of the different epistemic beliefs dimensions. Justification and development consist of items formulated as measures of sophistication, so students that agree with these items have sophisticated beliefs. In contrast, source and certainty items were formulated as measures of naiveté. But a low endorsement of naïve beliefs does not equal high endorsement of sophisticated beliefs, or the other way around, so justification and development measure a different end of the naïve-sophisticated continuum. Hence, the general results are in line with DeBacker and Crowson's proposal, sophisticated beliefs, in this case justification and development, predict mastery goals and naïve beliefs, in this case source and certainty, predict performance goals. The results are also in line with studies by Abedalaziz et al. (2015), Bråten and Strømsø (2004), and Muis and Foy (2010), as well as DeBacker and Crowson's (2006) own results.

My results indicate that students that believe that knowledge claims must be supported by evidence and that knowledge is variable over time also pursue mastery goals. However, the results can also have implications for the theorization of epistemic beliefs. If the only difference in the predictive ability of epistemic beliefs is if they measure the naïve or sophisticated end of the continuum, there is no inherent difference between different dimensions and the multidimensionality of epistemic beliefs should be questioned. Consequently, the implications for achievement goals may be stated more generally: supporting sophisticated beliefs about knowledge and knowing also supports mastery goals among students.

5.4 Changes across school years

Above, I have discussed the general findings concerning the relationships targeted in research questions 1, 2 and 3. I now turn to research question 4, how these relationships are affected by the school year of the students. Here, I will discuss age-related issues, tapping into all three sections above.

In summary, the school year of the students seems to be important for some of the studied relationships, but not for all. To start with, the interaction between mastery and performance goals was hypothesized to change over the school years in Article I, but analyses presented in section 5.4.1 do not support this hypothesis. In contrast, the results presented in section 5.4.2 imply that the relationship between students personal achievement goals and the classroom goal structures they perceive do change over the school years. However, the changes were not consistent over different outcomes and deserve further attention. Finally, as described in section 5.4.3, the relationship between achievement goals and epistemic beliefs changed over the school years. Particularly, dramatic changes occurred in the transition from lower secondary school to upper secondary school (the transition from Grade 9 to 10). In the following sections, more detailed descriptions of these results are presented.

5.4.1 The change in the interaction between mastery goals and performance goals over school years

As reported in Article I, the correlation between Swedish students' MAp and performance goals increased with students' age. This result is unexpected as the support for age-related changes in correlations between achievement goals is weak (see section 3.2). Also, when differences are found, the correlation between MAp goals and both PAp and PAv goals have been shown to decrease with age (Hulleman et al., 2010). We hypothesized that it could be an effect of increasing adaptiveness of the combination of the two goals when the school environment becomes more demanding. If the combination of the two goals is more adaptive in higher grades, students may adapt and to a higher extent pursue the two goals together, leading to higher correlations. This issue was not central in Article I and was therefore not further explored. The results of Article III showed that the combination of MAp and performance goals was detrimental for both students' test score and autonomous motivation. Still, the sample studied in Article III was an aggregated sample of students from Grades 6-10 so the question whether the adaptiveness of the combination increases with age remained unanswered. The results in Article IV did not answer this question either. However, the grade-specific regressions from Article IV can be used to plot response surfaces for the joint prediction of test score and autonomous motivation, respectively, by MAp goals and performance goals (controlling for mastery and performance structures, students' socioeconomic standard, and students' sex, see Article IV for more details). The resulting series of surface plots are presented in Figure 4.

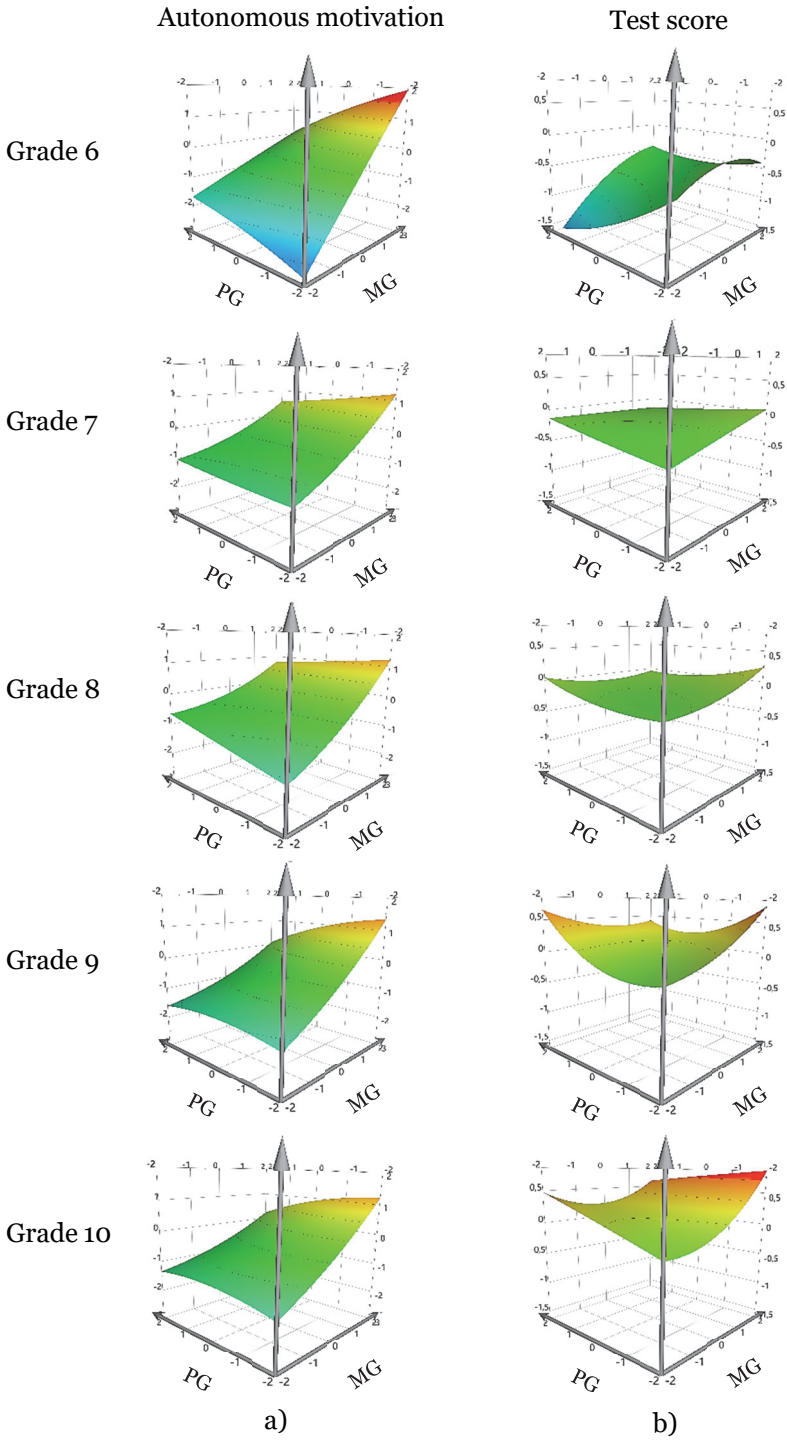

Figure 4. Response surfaces illustrating the relationship between mastery goals and performance goals in the prediction of autonomous motivation and test score in Grades 6-10. Panel a) contains the prediction of autonomous motivation, panel b) contains the prediction of test score. PG = performance goals, MG = mastery goals.

Starting with panel a) of Figure 4, the relationship between MAp goals, performance goals, and autonomous motivation seems stable over Grades 7-10. MAp was beneficial for autonomous motivation, although slightly less so when performance goal pursuit was strong (illustrated by the steeper slope along the mastery axis at low performance goals than at high performance goals). Performance goals had less impact on the outcome, although they were always detrimental in combination with high mastery goals, supporting the idea that the two goals are incompatible. The response surface for Grade 6 is a bit different than the others. The pattern is the same, but more extreme, possibly implying that mastery and performance goals are less compatible at this young age than at the older ages. Even so, with the stability over the next four grades, the evidence must be considered weak.

In panel b) in Figure 4, where test score is the outcome, Grade 6 is again different from the other grades, but the patterns over Grades 7-10 also look less consistent (even when ignoring the absolute level of the surfaces, which is expected to increase as students in higher grades are expected to perform better on the test). Again, mastery goals were generally positive for test score, but the effect was weaker than for autonomous motivation. In Grade 7 and 8, the surfaces are almost flat, so neither mastery nor performance goals influenced the test score substantially. In Grade 9, mastery goals had a positive relation with test score, but performance goals were almost as beneficial. As the test score peaked at high mastery goals and low performance goals in Grade 9, as well as at low mastery goals and high performance goals, the two goals seem incompatible in Grade 9. A similar pattern was evident in Grade 10, although mastery goals were more beneficial than performance goals. Grade 6 exhibited a slightly different pattern. The best test score was not achieved by students with the highest mastery goals, but by students with slightly higher than medium mastery goals. Also, the slope along the performance goal axis is clearly negative at low mastery goals but not at high mastery goals, while the slope along the mastery goal axis is steeper at high performance goals than at low performance goals. However, the steeper slope along the mastery axis at high performance goals is the result of the lowest test scores being lower there than at low performance goals, not of a positive effect of combining strong mastery and performance goals. Still, taken together, these results indicate that the two goals hampered the effect of each other less in Grade 6 than they did for older students.

The general pattern in Figure 4 strengthens the conclusions in section 5.1.2. Mastery and performance goals are incompatible, and a combination of the two were often worse for students' autonomous motivation and test score than each goal on its own. Concerning the development over age, there was no evidence that the combination of mastery and performance goals become more adaptive for older students. Therefore, the mystery with the increasing mastery-performance

correlation in Article I remains unsolved. However, the response surfaces for Grade 6 stand out in comparison with the older students so it is too early to discard a developmental effect completely. At the same time, it is important to remember that the presented data comes from a cross-sectional study. In a cross-sectional study, each grade represents a different group of students with potential differences that are not controlled for. To further study the development of the mastery and performance goal interaction, longitudinal studies are needed.

What we do know is that even if the correlation between mastery and performance goals changed over grades, the data supported scalar invariance for the two-goal model in Article I. This means that our instrument worked in the same way in all grades. For example, when a student in Grade 5 rates an item with a 3, it corresponds to a student in Grade 11 rating the same item with a 3. In each grade, each individual item relates to the latent factor (i.e., the intended achievement goal) in the same way, the distance between two steps in the rating scale signifies the same difference in agreement in all grades, and the baseline of responses (i.e., what a response of 1 indicates) is the same in all grades. Thus, the achievement goal model was stable enough over the grades for reliable comparisons between the grades and differences in, for example, correlations are minor issues.

5.4.2 The change in the relationship between achievement goals and goal structures over school years

In Article IV, we presented a hypothesis that classroom structures affect older students less than younger. This hypothesis was based on research showing that students become less oriented towards adults, such as teachers, and more oriented towards peers as they grow older (Lynch & Cicchetti, 1997). One consequence of this should be that the interaction between achievement goals and perceived goal structures should be stronger for younger students than for older ones. The hypothesis was partly supported by the results, but the pattern was not consistent. The strongest support was found in the prediction of students' autonomous motivation by their mastery goals and the perceived mastery goal structures. For students in Grades 9-10, the relationship between mastery goals and autonomous motivation was independent of the perceived mastery structure. For these students, mastery goals predicted autonomous motivation positively even at the lowest level of perceived mastery structure. In contrast, the effect of mastery goals varied with the perceived master structures for the students in the three lowest grades (6-8). Mastery goals were only significantly predictive of the students' autonomous motivation when the students perceived a strong mastery structure. Hence, in line with the hypothesis, the classroom goal structures seem to be less important for older students than for younger. However, the pattern was the opposite for the prediction of test score by performance goals and mastery

structures. In this case, the performance goals of the Grade 10 students were beneficial for test score at weak perceived mastery structures, but detrimental at strong mastery structures. Performance goals had no significant effect at any level of mastery structures for student in Grades 6-9. Thus, the oldest students were the ones most susceptible for a mismatch between personal goals and perceived goal structures. For the prediction of autonomous motivation by performance goals and mastery structures, and the prediction of test score by mastery goals and mastery structures, no such age-related patterns could be discerned.

In conclusion, the age of the students seems to matter for the interaction between achievement goals and perceived goal structures, but it is too early to conclude in what way. It is possible that effect of age varies for different outcomes, or that there are other confounding variables that were not included in this study. Therefore, further study of the subject is warranted. Also, the results indicate that mastery structure may not be equally beneficial for everyone. From a practitioner's point of view, further studies of these relations is important to help create a classroom environment that is as supportive as possible for as many students as possible.

5.4.3 The change in the relationship between achievement goals and epistemic beliefs over school years

The relationship between the achievement goals and epistemic beliefs changed over the school years, especially at the point of transition between lower secondary and upper secondary school. As the development of the relationship between achievement goals and epistemic beliefs was treated thoroughly in Article II, this will be a condensed summary of the findings.

As already mentioned, the relationship between achievement goals and epistemic beliefs changed noticeably between Grades 9 and 10, when students enter upper secondary school. The changes were mostly consistent in the cross-sectional and the longitudinal part of the study, which decreases the likelihood that the change occurs as a result of random variation between groups. In the prediction of mastery goals, beliefs about the *certainty* and *source* of knowledge went from fluctuating around zero in Grades 5-9 to a clear positive loading weight in Grade 10. Because of reverse coded scales, this should be interpreted as if the absence of beliefs in a single correct answer, and absence of beliefs that authorities are the only source knowledge, became important for students pursuing mastery goals. At the same time, these beliefs about certainty and source became less important for predicting performance goals. Moreover, beliefs about the need for *justification* of knowledge by evidence and beliefs that knowledge can develop over time became strongly positively related to performance goal pursuit. These changes challenge the universality of DeBacker and Crowson's (2006) hypothesis

regarding the relationship between epistemic beliefs and achievement goals. This hypothesis fits well with the general pattern of Article II (see section 5.3), where sophisticated epistemic beliefs predict mastery goals and naïve beliefs predict performance goals, but cannot explain why sophisticated beliefs of justification and development of knowledge suddenly are important to predict performance goals in Grade 10. As was concluded in Article II, it is difficult to specify a mechanism for the changes that occur at the transition to Grade 10, other than that they are probably driven by the large changes that the school environment undergoes in the transition to upper secondary school. Even without a clear mechanism, the results point out the transition to upper secondary school as a particularly interesting time to study the relationship between epistemic beliefs and achievement goals, something future studies should take into consideration.

6. General discussion

Chapter 5 includes the results and a discussion of the results. In the present chapter, I will discuss themes that are not directly linked to specific results, but still may have an impact on the conclusions of my studies. Before turning to discussions on the implication of my studies, I will discuss the possibility of a response bias among the participants and how the Swedish national culture may have influenced my results.

6.1 Response bias

I have already discussed certain issues pertaining to my methods in Chapter 4 and 5. However, one issue that I have not touched on this far is response bias. A response bias is "a systematic tendency to respond to a range of questionnaire items on some basis other than the specific item content" (Paulhus, 1991, p. 17). Response bias can always be an issue in survey-based research, but particularly so when comparing different groups. Response bias may both disguise differences between groups and lead to differences that are not inherent to group characteristics other than how they respond to questionnaire items (Kemmelmeier, 2016). Therefore, this is a relevant issue for my comparisons between groups of students from different countries and groups of students from different grades, primarily in Article I. As I did not consider this issue when writing that article, I will expand on it here.

Van Vaerenbergh and Thomas (2013) summarized several different response styles that are directly related to how a Likert scale is used, but present four as most common:

- Acquiescence response style (ARS) – a tendency to agree with items
- Disacquiescence response style (DARS) – a tendency to disagree with items
- Mid-point response style (MRS) – a tendency to use the middle point of the scale
- Extreme response style (ERS) – a tendency to use the highest or lowest response on the scale

Response styles affect both univariate distributions (and therefore e.g., means and variances of variables) and multivariate distributions (and therefore e.g., the correlations between variables). Thus, in all research using rating scales, response styles may be an alternative explanation for results (Van Vaerenbergh & Thomas, 2013).

Even if differences in response styles can be problematic when comparing groups, studies have also shown that response styles are linked to differences in culture and may therefore be an indication of cultural differences rather than a confounding variable. For example, high levels of ARS seem to be related to a national culture with high individualism, low uncertainty avoidance, and low competitiveness (Johnson, Kulesa, Cho, & Shavitt, 2005). High levels of ERS seem to be related to national cultures with high competitiveness, power distance, and individualism (De Jong, Steenkamp, Fox, & Baumgartner, 2008; Johnson et al., 2005). MRS have been shown to be related to a national culture with low individualism (C. Chen, Lee, & Stevenson, 1995).

Comparing Sweden and Germany in terms of individualism, uncertainty avoidance, competitiveness, and power distance reveals both similarities and differences (see Article I for a comparison of the national cultures of Sweden and Germany, and Hofstede et al., 2010 for the original source of the cultural index). Compared to an average of all other countries included in Hofstede's index of national culture (Hofstede et al., 2010), both Sweden and Germany have relatively high individualism and low power distance. However, Germany have a much more competitive national culture and a higher uncertainty avoidance than Sweden. With Sweden's lower competitiveness, Swedish students are expected to have lower levels of ERS than German students. Also, because high levels of ARS have been connected to low uncertainty avoidance and low competitiveness, Swedish students are expected to have higher levels of ARS than German students. Finally, the similarity in individualism may imply that differences in MRS should not be prominent.

Besides culture, there are several other factors that can promote certain response styles (for an overview, see Van Vaerenbergh & Thomas, 2013). For example, paper-and-pen surveys tend to lead to less ERS and DARS than online surveys, even when measurement invariance has been established (Weijters, Schillewaert, & Geuens, 2008). This implies that the Swedish students, responding to an online survey, would have more ERS than German students, contrary to what the national culture implies. Also, because of the difference in data collection, Swedish students should use the lowest parts of the scale (DARS) more than German students. However, according to the difference in national culture, Swedish students should use the highest parts of the scale (ARS) more than German students. In conclusion, it is difficult to predict differences in response styles for the Swedish and German subsamples in my studies. But if there are differences, what are the consequences? According to Van Vaerenbergh and Thomas (2013), ARS, DARS, and MRS increase and ERS decreases the magnitude of multivariate relationship, for example correlations. Thus, if either ARS, DARS, or MRS is more common among Swedish students than German, or ERS is more common among German students than Swedish, that may contribute to the

difference in PAp-PAv correlation observed (see section 5.1.1). Also, biased correlations will affect methods that are based on the correlation between individual items, like factor analyses, and can therefore jeopardize the validity of the analyses of Article III and IV.

A comprehensive investigation of response styles (see e.g., Moors, 2003) is outside the scope of this thesis, but a simple count of the use of each response on the 5-point Likert scale should give an indication of the response styles of Swedish and German students. Thus, I used Microsoft Excel to summarize the frequencies of responses on each of the 12 achievement goal items used in my studies, and how high proportion of all answers that was. Defining ERS as the use of 1 or 5 on the Likert scale, ARS as using 4 or 5, DARS as using 1 or 2, and MRS as using 3, I could compare the proportion of answers within each response style between Swedish and German students. In accordance with Agresti and Finlay's (2009, pp. 187-190) instructions, I calculated whether the differences in proportions were significantly different in the two countries (two-tailed probabilities calculated). The data used in all other analyses in my studies was cleaned for long strings of identical answers. For reasons of consistency, the following results are also from the cleaned data.

The results indicate that ARS was more common among German students (40%) than Swedish students (32%), MRS more common among Swedish students (28%) than German students (18%), and DARS slightly more common among Swedish students (40%) than German students (36%). All these differences were significant ($p < .001$). The difference in ERS was not significant ($p = .53$).

To summarize: there were differences in how Swedish and German students responded to the achievement goal items in the questionnaire. This could potentially be an alternative explanation to the high correlation between PAp and PAv observed in Article I. However, the analyses presented above indicate that differences in response patterns should not contribute notably to the higher PAp-PAv correlation observed in Sweden compared to Germany. Even if MRS was more common in the Swedish sample than in the German, the difference in ARS should negate it, assuming each response style affect correlations in the same magnitude. Thus, the conclusion from Article I still holds: national culture is a plausible explanation to the difference in PAp-PAv correlation observed. Also, based on the conclusion that the correlations were not substantially affected by response bias, the validity of the regression analyses of Article III and IV should not be threatened either. However, to avoid the risk of biased results, future research should strive to both minimize difference in response styles (e.g., by including both positively and negatively worded items; Kemmelmeier, 2016) and control for differences in the analyses (e.g., Baumgartner & Steenkamp, 2001).

6.2 The results through a lens of national culture

First of all, the use of national culture in general, and Hofstede's index of national culture (Hofstede et al., 2010) in particular, is not unproblematic. For example, Moulettes (2007) was critical of the predominance of white, well-educated men in the sample on which Hofstede based his index; McSweeney (2002) directed critique at the methodology used; and both Schmitz and Weber (2014) and Blodgett, Bakir, and Rose (2008) found that the validity of Hofstede's dimensions of national culture is lacking. Signorini, Wiesemes, and Murphy (2009) specifically warned against an overreliance on Hofstede's index in educational research, partly because of the lack of empirical evidence from educational settings.

Without diving too deep into details, I believe that culture is more complex than what Hofstede's cultural dimensions give impression of. For example, there are several different subcultures within a national culture, and these subcultures are not restricted by the limits of nations but stretch across borders. Still, I believe that an empirically based multidimensional measure of culture, such as Hofstede's index, is preferable over the use of a single dimension (e.g., collectivism/individualism, see e.g., Zusho & Njoku, 2007) or less informative labels based on ethnicity or nationality only (see e.g., Murayama, Zhou, & Nesbit, 2009). Using an index such as Hofstede's as a tool to identify cultural differences between groups offers the possibility to theorize about the mechanism behind observed differences between the groups, something nationality or ethnicity do not. Moreover, although the relevance of the national culture is questionable on individual level, nation-level differences may very well exist and affect the organization of education and the goal-relevant messages of the classrooms.

So, assuming national cultures do differ from each other, and that Hofstede's index describes national cultures relatively accurately, how can the particular national culture of Sweden have affected my results? The most obvious thing is the high correlation between PAp and PAv goals, discussed in section 5.1.1. As the problem of separating PAp and PAv is consistent in Swedish samples, it seems plausible that something in the national culture of Sweden affects this correlation. The hypothesis presented in Article I and in section 5.1.1 is that competitiveness is the cultural dimension behind this.

It is also possible that the noncompetitive national culture in Sweden affects the consequences that different achievement goals have. There is an assumption, partly supported by my own results, that achievement goals are most beneficial when the classroom goal structures match the goals (see section 3.3 and 5.2). Following the same logic, performance goals, that are inherently competitive-focused, should be less beneficial in an environment that does not support

competitive behavior than in a highly competitive environment. Hence, performance goals could be less beneficial in Sweden (and other countries with low competitiveness) than in most other countries. Previous research shows that PAp goals can be positively correlated with academic achievement and intrinsic motivation (see section 3.1), while the performance goals of my studies mostly showed insignificant effects on these outcomes. However, this result may also be a consequence of the combined approach and avoidance focus in the performance goal items used in my studies (see section 4.4.1 and the discussion in the last paragraph of section 5.1.2).

Besides a very low competitiveness, Sweden also scores high on indulgence and individualism, and low on power distance and uncertainty avoidance compared to an average of all other countries in Hofstede's rankings (see Figure 1 in Article I). These cultural dimensions are not as closely tied to achievement goals as the competitiveness dimensions. Still, there are a few possible connections that I will discuss below.

According to Zusho and Njoku (2007), high individualism should be related to adoption of performance goals, but mostly because individualism is connected to a preference for competition. With such a low competitiveness as Sweden's, this relation between individualism and performance goals seems unlikely. Moreover, Zusho and Njoku argue that the correlation between mastery and performance goals may be higher in collectivistic cultures than in individualistic. The reason would be that the boundary between the self and others is less clear in collectivistic cultures. Consequently, the difference between a self-based standard (mastery goals) and an other-based standard (performance goals) for competence is diminished in collectivistic cultures, and correlations between the two are inflated. If this hypothesis holds, the correlation should be low in Sweden. My results in Article I show that MAp had a low to moderate correlation with performance goals, and it is possible that this correlation would have been higher if the same study would have been conducted in a more collectivistic culture.

Hofstede et al.'s (2010) description of the indulgence vs restraint dimension does not offer any clues about possible relations to achievement goals. However, strong uncertainty avoidance is related to high trust in authorities. Similarly, a high power distance entails a high reliance on the teachers' authority. High trust and reliance in authorities, such as teachers, could potentially be linked to a preference for external validation of knowledge, and thus to performance goals. For Sweden, with a low uncertainty avoidance and power distance, such a link would lead to a lower reliance on performance goals than in cultures with high uncertainty avoidance and power distance. In line with this hypothesis, the results in Article I showed that Swedish students had a lower mean score on performance goals than the German students did. However, measurement

invariance between the two countries was never established so it is risky to compare the two scores. Besides, the mean scores were never in focus in my studies, so I did not explore these differences further. Even if Swedish students adopt performance goals to a lower degree than students from many other countries, it is unclear how this affects the outcome of the goals, or their relationship to epistemic beliefs and classroom goal structures. The influence on my result is therefore difficult to discern.

6.3 Implications for teachers

The articles in this thesis can be viewed as a progression from abstraction towards classroom practice. The first article is concerned with fitting students' answers to a set of questionnaire items into theoretical models and thereby structure something as abstract as human motivation. The second article concerns how the resulting constructs, the achievement goals, from Article I are related to other constructs, students' epistemic beliefs. As this study does not concern the constructs themselves but how different constructs relate to each other, I consider it one step forward in the progression from abstraction. Then Article III and IV take one more step by including students' perceptions concerning what is happening in their classrooms. Although this thesis stops at this point in the progression, there are several steps left before we reach the classroom practice. I have not taken these steps in this thesis, but I can describe my conclusions regarding the classroom practice.

To start with, the fact that PAp and PAv goals could not be separated in the Swedish students' answers can have consequences for any goal-related recommendations to teachers. When the two goals can be separated, PAp goals typically show a positive outcome profile when it comes to, for example, academic achievement and intrinsic motivation, while PAv is generally negative (see section 3.1). Thus, one could argue for the support of students' PAp goals, but not PAv. However, with inseparable PAp and PAv goals, supporting one of them but not the other is impossible. Hence, the first implication for teachers that come of my results is that there is no use in trying to promote "positive" competition in student groups that behave like the students in my sample. Additionally, it is known from previous research that performance goal structures tend to promote both PAp and PAv goals, and be more strongly related to PAv than PAp goals (Urdan, 2004a). Thus, even if PAp and PAv goals were separable, it would be difficult to guide students toward only the positive aspects of performance goals.

Next, the results concerning the interactions between different achievement goals, and between achievement goals and goals structures, also have implications for teachers' classroom practices. Before I present these, a word of caution is in order. As discussed in 4.5.3, I have used students' perceptions of

classroom goal structures throughout my studies. These perceptions do not necessary correspond fully to the classroom goal structures that the teachers themselves, or outside observers, would experience. However, there are indications that students' perceived goal structure compare well with objective measure (Hastie, Sinelnikov, Wallhead, & Layne, 2014; Patrick, Anderman, Ryan, Edelin, & Midgley, 2001). The following text is based on the assumption that my results regarding students' perceived classroom goal structures can be transferred to classroom-level structures.

The combination of strong personal mastery goals and perceived strong mastery structures proved to be the most beneficial combination for both students' test score and their autonomous motivation. Moreover, both performance structures and performance goals seem to affect students with mastery goals negatively. Also, performance structures have been shown to interfere with the positive effect of mastery structures (Skaalvik & Federici, 2016), although no such interaction was evident in my studies. To conclude, I join many theorists before me (e.g., Karabenick, 2004; Skaalvik & Federici, 2016; Turner et al., 2002) and recommend that teachers strive to create a mastery-supportive environment in their classroom, while avoiding promoting performance goals. In my studies, there was one interaction in one grade where an increase in mastery structures was detrimental for students with strong performance goals, but the general positive effect of mastery structures far outweighs the negative. Strong mastery structures have the potential to directly affect student outcomes positively, but also have a positive indirect effect through increased mastery goal adoption and through interactions where mastery goals become more beneficial in a matching goal structure.

But how can teachers create such a mastery-supportive environment? One helpful framework that was mentioned in section 2.3 is the TARGET framework. TARGET describes six dimensions of classroom goal structures and how to support mastery goals through manipulation of these dimensions (see Ames, 1992a, 1992b; Schunk et al., 2013). However, the measures used in my studies mainly tap into the task and recognition dimensions, and recommendations only based on the results of my studies should therefore focus on these two. I argue that task and recognition together capture large parts of what the mastery goal structures represent, but further research is needed to verify that my results hold for more complete goal structure constructs (see section 6.4 for further discussion).

To create a mastery structure according to the task and recognition dimensions of TARGET, teachers should strive to present diverse tasks with a sense of novelty. Moreover, the tasks should feel meaningful and personally relevant to the students, as well as challenging but not too difficult to solve. The tasks should

not present opportunity for public or social comparisons. Students should be recognized for their effort and progress toward individual goals and personal improvement. It is important to provide everyone with such recognition, but to do it privately to avoid competitive elements. For further recommendations on how to promote mastery goals according to all six dimensions in TARGET, see Deemer (2004).

Though I believe these recommendations to be valid and useful, I also believe that recommendations to teachers can bear even more fruit if they are based on a broader theoretical foundation. If we widen our perspectives from the area of achievement goals, we can see that several different theories of student motivation share important principles for how a positive classroom environment should be structured. For example, Linnenbrink-Garcia et al. (2016) formulated five design principles for how classrooms should be organized to support beneficial motivation and emotions. I will not describe these principles here, but they combine elements related to achievement goals, self-determination theory, competence beliefs and expectations, effort attributions, values and interest, and positive emotions. I believe that both research interventions and school development based on such broad and comprehensive frameworks have a much higher chance of success in promoting positive motivation profiles than actions based on individual theories, or details in individual theories. Intervention studies and school development projects should also be long-term efforts. Systematic changes of structures take time, but we should strive to make systematic, consistent, and stable changes to the core of the classroom practices instead of polishing the surface.

6.4 Implications and ideas for future research

The results presented here have several implications for future research, but I have also identified interesting areas of research that are not directly linked to my results. Both these categories of future research will be discussed below.

To start with, I would like to pick up a thread from the above discussion regarding implication for teachers (section 6.3). I mentioned there that our measure of classroom goal structures did not cover all the dimensions described by TARGET. I also argued that further research is needed to confirm that my results can be generalized to a broader definition of classroom goal structures. Lüftenegger, Tran, Bardach, Schober, and Spiel (2017) presented an instrument that explicitly includes all TARGET dimensions. This type of instrument may be a better representation of classroom goal structures, assuming TARGET is used to define what constitutes classroom goal structures. Therefore, the interaction between achievement goals and classroom goal structures could be investigated with Lüftenegger et al.'s instrument to verify whether our results, based on the task

and recognition dimensions, hold for more general measures of classroom goal structures.

Next is another issue related to the interaction between achievement goals and classroom goals structures. Match and mismatch effects have been described both theoretically and empirically. Match is often described as beneficial and a mismatch as detrimental (mitigation effects are exceptions, see 2.3.2). Still, as far as I know, no one has proposed a mechanism that can explain why a match is beneficial and a mismatch is detrimental for outcomes. I suggest that a possible mechanism involves satisfaction of the three basic needs of SDT, that is, need for autonomy, competence, and relatedness (see section 2.5). To start with, if students feel that their teacher values the same type of competence that the students value themselves, it is possible that they feel less controlled by the teacher and more autonomous in their classroom environment. For example, a student that defines success as developing their own knowledge and being able to solve more difficult tasks should feel freer to pursue their goals if the teacher also emphasizes these types of success. Thus, they experience a sense of autonomy in the situation. It is also possible that the student feels more competent when the teacher defines competence in line with the student's own definition. Lastly, the students could feel a stronger sense of relatedness with a teacher that shares the same values. In other words, students in a classroom where the goal structure matches their personal goals experience that their needs for autonomy, competence, and relatedness are satisfied. Autonomous motivation, in turn, is related to enhanced academic performance (see overview in Deci & Ryan, 2008). As the studies conducted within this thesis have not tested this hypothesized mechanism, further studies are needed to investigate if this mechanism is relevant. To investigate the mechanism behind match effects, causality among variables must be determined. To determine causality, such studies should include longitudinal relationships between the match and/or mismatch between achievement goals and goals structures, autonomous motivation, and academic achievement. Although I, as part of the DoLiS project, had access to collected longitudinal data (see Article II), the attrition between measuring points was high and the sample sizes therefore too small to reliably investigate causal relationships over time.

I would also like to see further investigation of nonlinearity in achievement goal research. As already described in section 5.2, there were few significant nonlinear relations in my studies. However, there are several studies that have shown the importance of nonlinear terms (Chatzisarantis et al., 2016; Sideridis & Stamovlasis, 2016; Sideridis et al., 2016). Nonlinear terms also allow more complex relations and models including nonlinearity should therefore represent the complexity of reality better than simple models. The downside of including nonlinear terms is also the increased complexity of regressions, and that the

resulting regression coefficients therefore become difficult to interpret. However, with data presentation methods such as response surface plots, where the results of regressions can be viewed without examining the regression coefficients directly, the added complexity is less of a problem. As the exclusion of nonlinearity can force the data into patterns that hide certain forms of interactions (Chatzisarantis et al., 2016), I recommend future research on interaction between achievement goals and goal structures to consider including nonlinear terms, and to investigate their significance as predictors.

Finally, I return to what I ended the section on implications for teachers with. My results show that mastery structures should be emphasized in the classrooms, but I believe that a narrow focus on only mastery structures can be a mistake if we want to promote a positive pattern of motivation and emotions in students. Instead, I call for long-term interventions that study the effects of a motivational teaching based on principles that go above and beyond single theories. Such interventions should also be conducted together with teachers with the additional aim to provide professional development for the teachers. Otherwise, even successful intervention programs can prove difficult to translate to the everyday classroom reality (Lazowski & Hulleman, 2016). As it is now, motivation theory has been described as in a "dismal state" (Kaplan et al., 2012, p. 168) when it comes to application to educational practice. For motivation research to become more relevant for teachers, I believe we must bridge the gap between research and school development, and between researchers and teachers.

6.5 Limitations

As with all research studies, the studies presented here come with a number of limitations. One such limitation is the generalizability of the results. Due to differences between the student sample of my studies and students in large, the results may not apply to all students. For example, I have argued that cultural differences may affect what achievement goal model that the students' achievement goals fit into. As a consequence, students from other cultures may see achievement goals slightly differently than the students in my studies. This, in turn, can affect, for example, how the goals interact with the classroom goal structures that the students perceive. Furthermore, it is possible that the sample of this study deviates from Swedish students in general, despite the shared national culture. The fact that all students in two municipalities in Sweden were invited to respond to the questionnaires should make the sample more representative of the general population than if only a few schools were selected. On the other hand, there were whole classes and schools that chose not to participate for unknown reasons, so I cannot reject that my sample is biased.

One important limitation of my studies is that they are mostly correlational. Therefore, despite using terminology such as *effect on* and *predict*, I cannot draw any conclusions concerning causality in observed relationships. To determine the direction of causality between, for example, epistemic beliefs and achievement goals or classroom goal structures and achievement goals, it is necessary to conduct longitudinal studies with, for example, a cross-lagged panel analysis. Another alternative is experimental studies.

The operationalization of achievement goals also limits the results as it limits students' achievement goals to our preconceived categories. Our combinations of standards and standpoints assume that, for example, an other-based standard always combines with a standpoint of demonstrating competence. Thus, it disables the possibility that students strive to outperform others because they, for example, like the challenge. Such cross-overs would be possible in goal complex approaches where standards are separated from the reasons behind competence strivings (cf. Senko, 2016; Vansteenkiste et al., 2014). Goal complexes of this sort were discussed already close to 20 years ago (by Elliot & Thrash, 2001), but research using goal complexes is still surprisingly scarce. Personally, I find goal complexes highly interesting and promising as a way to reconcile previous achievement goal conceptualizations (see Senko, 2016 for a thorough discussion). Thus, I hope that goal complexes will be further explored in future research.

6.6 Concluding remarks

I started this thesis by comparing my research to pieces in the jigsaw puzzle of students' motivation. I argue that we now know more about the form and coloring of these particular achievement goal pieces than we did before my research, and that this thesis thereby has contributed to the complete picture. Although the complete picture probably is outside the grasp of motivation research, each added piece is a step towards a school environment characterized by positive motivation and emotions. Especially if research and educational practice can bridge the gap between them and work together.

7. Acknowledgement

I must start this section by apologizing to all English speaking readers. Although this thesis is written in English, I will now switch to my native language. A personal “thank you” is much easier to write in one’s own language.

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"I may not have gone where I intended to go,
but I think I have ended up where I needed to be"

8. References

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Appendix

Questionnaire items

Table A1. Achievement goal items.

Subscale	Item
Mastery-approach	It is important for me to understand chemistry as well as possible.
	I strive to develop a broad and deep knowledge in chemistry.
	My goal is to learn as much as possible in chemistry.
	In chemistry, I want to learn things, even if they are not assessed on tests or affect my grades.
Performance-approach	In chemistry it is important for me to perform better on tests than the other students.
	In chemistry my goal is to perform better than other students.
	One of my goals is to show others that I am good at chemistry.
	It is important to me that I look smart compared to others in my class.
Performance-avoidance	My goal is to avoid doing worse in chemistry than other students.
	In chemistry, it is important for me to not perform worse than other students on tests.
	In chemistry, it is important to me that I don't look stupid.
	One of my goals in class is to avoid to show that I have trouble understanding

Table A2. Classroom goal structure items

Subscale	Item
Mastery structure	My teacher makes a special effort to recognize my individual progress.
	My teacher considers how much I have improved when we talk about how I am doing in chemistry.
	My teacher gives a wide range of assignments, matched to my needs and skill level.
	My teacher wants me to understand my work, not just memorize it.
Performance structure	My chemistry teacher gives advantages to students who do the best work.
	My teacher displays the work of the highest achieving students as a good example
	My teacher encourages students to compete with each other.
	My teacher points out those students who do well as a model for other students

Table A3. Autonomous motivation items.

Subscale	Item
Stem: When I work with the tasks I get during chemistry class, I do it because…	
Intrinsic motivation	It is fun
	I enjoy it
Identified motivation	I want to learn new things
	It is important for me
Stem: When I try to do well during the lessons in chemistry, I do it because…	
Intrinsic motivation	I enjoy doing my school work in chemistry in a good way.
Identified motivation	It is important to me to try to do well in chemistry.

Table A4. Epistemic belief items

Subscale	Item
Source	Only scientists know for sure what is true in chemistry.
	Everybody has to believe what scientists say.
	You have to believe what the chemistry textbook say about stuff.
Certainty	Scientists pretty much know everything; there is not much more to know.
	Chemistry knowledge is always true.
	Scientists always agree about what is true in chemistry.
Justification	In chemistry there can be many ways to test your ideas.
	For good opinions in chemistry you need evidence from many different sources.
	To become certain about something in chemistry, you need to compare information from different sources.
	The more evidence there is for an opinion in chemistry the more you can trust it.
Development	New discoveries in chemistry can change what scientists think is true.
	Some ideas in chemistry today are different than what scientists used to think.
	Sometimes chemists change their minds about what is true in chemistry.
	Ideas in chemistry sometimes change.