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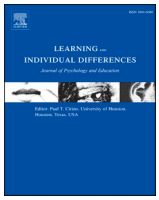

Social and dimensional comparisons of achievement in multifaceted task value formation among adolescents☆

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ABSTRACT

Students routinely compare their achievement across different subjects (dimensional comparison) and against that of their peers (social comparison). Yet, it is unclear how these comparison processes influence their task values (intrinsic, attainment, utility, cost) and the observed gender differences in these values. Utilizing structural equation models, we tested the associations between Grade 7 achievement (in Finnish and math) and Grade 8 task values among 1325 Finnish students (*M*age at Grade 7 = 12.8 years, 52 % girls). We observed positive social comparison (within-domain) effects on all value facets, and partial negative dimensional comparison (cross-domain) effects: higher Finnish achievement was associated with lower intrinsic value and higher cost in math. Despite outperforming boys in Finnish and math, girls reported lower intrinsic value and higher cost in math – effects not explained by achievement comparisons. These results imply that task values development may rely on comparisons of other factors beyond individual achievement.

Educational relevance statement

By assessing how common it is for students to compare their achievement across subjects and against their classmates, we aim to show how these comparisons shape their subsequent perceptions of task value (i.e., whether they like a specific subject, find it useful and important, or too costly or effortful). The findings indicate that students who were better performers in a subject (e.g., languages) ended up valuing this very subject, while also labeling the contrasting subject (e.g., math) as less interesting and more taxing. This pattern was similar among both male and female students, yet girls perceived math as less interesting and more taxing regardless of their achievement. Given the important role of task value in students' educational and career decision-making, we invite educators and researchers alike to consider carefully how these students compare their academic success across different subjects. We also invite further consideration of the social and contextual factors that could support students in developing adaptive task values.

1. Introduction

Throughout schooling, students commonly compare their achievements to those of their peers and against their own grades in different subjects – yet we know relatively little about how such comparisons influence their task values, or their perceptions of enjoyment, importance, and usefulness of a task. Although studies guided by Situated Expectancy Value Theory (SEVT, Eccles & Wigfield, 2020) have primarily demonstrated the importance of task values in shaping students' academic achievement (Gaspard et al., 2019; Trautwein et al., 2012), less is known about how these values develop in response to student achievement. Given the crucial role adolescents' task values play in influencing their educational and career choices (e.g., Bong, 2001; Durik et al., 2006; Musu-Gillette et al., 2015; see Wigfield & Eccles, 2020 for a summary), this study aims to investigate the development of students' value beliefs in relation to their academic achievement.

Academic achievement may influence task values through both social comparisons (comparing with others) and dimensional comparisons (comparing across different subjects), with the latter suggested as the more prominent process for adolescents (Wan et al., 2021). Social and

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dimensional comparisons of achievement are well-documented in the formation of student expectancy or ability self-concept (Wigfield et al., 2020; for meta-analyses, see Möller et al., 2020 and Wan et al., 2021), yet it is unclear to what extent these comparison processes also shape various facets of task value. Previous studies have mostly been conducted with samples of students within academic tracks and focused on intrinsic value formation, which limits our understanding of whether and how students utilize achievement comparisons in forming other task value facets. Moreover, the results have been mixed depending on how different task value facets are modeled (e.g., Arens & Niepel, 2023; Umarji et al., 2023; van der Westhuizen et al., 2023). The inconsistent modeling approaches and results raise questions about when we can expect achievement comparisons to influence distinct facets of task value, and whether this is a process that can be explored to improve students' learning. The current study addresses the inconsistencies by examining the influence of both social and dimensional comparisons of achievement on all task value facets simultaneously.

Previous research has also highlighted a potential link between achievement and gendered values development. These studies reveal that girls and boys have different achievement patterns, and hint that such differences may contribute to girls having higher language values and boys having higher math-related values (e.g., Chow & Salmela-Aro, 2011; Nagy et al., 2006; Wang et al., 2013). Identifying pathways connecting previous achievement to gendered values could inform intervention efforts supporting girls' and boys' values formation. The second aim of the current study, therefore, is to test two potential pathways based on theoretical assumptions and results of previous studies. We aim to find out whether (1) the impact of initial achievement on subsequent task values differs in magnitude between genders (i.e., moderation), or (2) previous achievement differs by genders and subsequently affects values through social and dimensional comparisons (i.e., mediation).

In sum, this study aims to shed light on how students use achievement comparisons across various domains to develop different facets of their task values, and the potential of this process in contributing to gender differences in task values. Specifically, we integrate Möller's (2016) generalized internal/external (GI/E) model into Eccles and Wigfield's (2020) SEVT framework, and analyze data from a large cohort of middle school students in Finland to address these questions.

1.1. Achievement comparisons in the generalized internal/external (GI/E) frame of reference model

According to the GI/E framework (Möller, 2016), students' academic achievement can influence their subsequent expectancy or self-concept of ability through two comparison processes: (1) social comparison, when they compare their achievement in a subject with that of other students; and (2) dimensional comparison, when they compare their own performance across different subject domains (see Möller et al., 2020 for a meta-analysis). In the former case, they externally compare their own achievement with the perceived achievement of their peers and rely on other students' achievement as a frame of reference. This usually leads to higher-achieving students having a more positive self-concept of their ability, reflected as a positive within-domain correlation between achievement and ability beliefs. Such within-domain associations have been used as an indicator of social comparisons in studies applying the GI/E approach, measured by regressing students' academic beliefs on their individual achievement in the corresponding domain. On top of the external comparison, students internally compare their achievement in one domain (e.g., math) with that in another, usually contrasting, domain (e.g., language). This internal frame of reference typically results in a negative cross-domain path between achievement in one domain to ability beliefs in a contrasting domain (e.g., "Since I have higher grades in math compared to language, I am more of a math person than a language person"; Möller & Marsh, 2013). This cross-domain association is how dimensional comparison is operationalized, linking students' achievement in a subject to their academic belief in a contrasting subject.

More recent studies have highlighted the impact of social and dimensional comparisons beyond self-concept of ability. Following the GI/E framework (Möller, 2016), multiple studies have reported that students rely on achievement comparisons to develop constructs that impact students' learning, such as test anxiety, coursework selection, interest, and academic emotions – both through within- and cross-domain comparisons (e.g., Arens et al., 2017; Dickhäuser et al., 2005; Goetz et al., 2008; Marsh et al., 2015; Schurtz et al., 2014). Similar findings were also reported for students' task values, aligned with situated expectancy-value theory (SEVT), which proposes a reciprocal relationship between students' academic achievement and subjective task values: "today's … performances become tomorrow's past experience" (Eccles & Wigfield, 2020, p.3). However, only a small number of studies have examined this relation (Wan et al., 2021; Wigfield et al., 2020), some of which yielded mixed findings.

Previous studies using GI/E and SEVT frameworks indicate that students engage in social and dimensional comparisons of achievement to form their task values, with the former more consistently observed than the latter. For instance, studies involving secondary school students, who are mostly enrolled in academic tracks (e.g., Arens & Niepel, 2023; Gaspard et al., 2018), consistently show that both within- and between-domain comparisons influenced students' task values. However, first-grade students seem to engage in social comparison but not dimensional comparison to form their values (e.g., van der Westhuizen et al., 2023). This difference seems to suggest that younger students may find dimensional comparisons less relevant for value formation because they have less exposure to achievement experiences and the environment also places less emphasis on achievement. Furthermore, when academic domains were considered, such as in math, language, physics, and chemistry (e.g., Gaspard et al., 2018; Guo et al., 2017) both social and dimensional comparisons were observed to influence task values across all the subject domains. This is not the case for studies that included non-academic subjects, such as music (e.g., Lohbeck, 2022) and physical education (Arens & Preckel, 2018): they only found partial dimensional comparison effects of achievements influencing task values. In sum, the mixed results from previous studies suggest that the influence of achievement comparisons on students' task values is nuanced. Although students readily engage with social comparisons to develop their values, they might rely more on dimensional comparisons if (1) they have been exposed extensively to academic achievements (i.e., older students), (2) they are primarily exposed to the subject within an academic context and much less outside school (e.g., in academic subjects, such as math), and (3) there is a strong emphasis of academic achievements in their context (i.e., for students enrolled in academic tracks).

The current study seeks to further explore these dynamics by examining adolescent students in Grades 7 to 8 from Finland, where students only started receiving formal numeric grades from schools from the end of Grade 6 and have limited exposure to achievement evaluations. Therefore, our study provides a unique opportunity to test whether achievement comparisons in math and language as theoretically described are prominent in such a sample. Moreover, to extend the results from past studies, this study also investigates the effect of both social and dimensional comparisons of achievement for adolescents' task values across different facets, as we describe next.

1.2. Achievement comparisons in task values

The four facets of *subjective task value* according to SEVT are *intrinsic*, *attainment*, *utility*, and *cost* (Eccles et al., 1983; Eccles & Wigfield, 2020). They reflect the quality or characteristics individuals assign to tasks, and are thought to be developed to some extent through comparison processes (Wigfield et al., 2020). *Intrinsic value* is the personal enjoyment derived from engaging in a specific task, representing individuals' positive affective perception of a task. This value can be identified in

students as early as first grade (Wigfield, 1994), and is assumed to develop from individuals' comparisons of enjoyment across different activities (Hidi & Renninger, 2006). *Attainment value* refers to the importance of an activity concerning one's identity, and *utility value* is the perceived usefulness of a task. Attainment and utility values are posited to be shaped mainly by comparing and adopting the beliefs of important socializers, such as parents, teachers, peers, and the media (Eccles, 2009): which activities, behaviors, and/or goals are perceived to be appreciated or rewarded. *Cost* represents the perceived negative consequences of engaging in a task and is posited to develop by comparing the costs associated with different activities — including how much negative emotions are experienced and the effort that one needs to exert for different tasks. Given that each value facet is assumed to develop to a certain extent through comparisons of different experiences, we proceed to describe empirical evidence related to the influence of achievement experiences on multifaceted subjective task values.

In terms of social comparisons of achievement, studies have consistently reported that it influences intrinsic values across various school subjects but have not thoroughly explored other value facets. When students' achievements in single subject domains were explored, most studies reported consistent within-domain effects of achievement on values. For example, adolescent students with higher math performance report higher intrinsic, attainment, utility value, and lower cost for math in secondary or high schools (e.g., Simpkins et al., 2006; Wang, 2012; Weidinger et al., 2020). Similar patterns have been also reported for language-related (e.g., Durik et al., 2006; Viljaranta et al., 2014) and science subjects (e.g., Simpkins et al., 2006). On the other hand, when students' achievements in multiple subject domains were simultaneously explored, the within-domain relationship was mostly identified for intrinsic value (e.g., Arens & Niepel, 2023; Arens & Preckel, 2018; von Keyserlingk et al., 2021), and only few studies have tested the effect beyond intrinsic value (e.g., Gaspard et al., 2018; Guo et al., 2017; Lazarides & Lauermann, 2019; Umarji et al., 2023). These studies indicated that there is a general effect of social comparison on all task values regardless of the subject domain, although only a handful of these studies examined this by including all task value facets. Therefore, we aim to provide more evidence that students' social comparison of achievement is also relevant to the perception of the subject's importance, usefulness, and cost.

In contrast, cross-domain or dimensional comparisons of achievements seem to inconsistently affect different task value facets depending on the value facet in question. A consistent effect of cross-domain comparisons was observed for adolescents' intrinsic value (e.g., Arens & Niepel, 2023; van der Westhuizen et al., 2022; von Keyserlingk et al., 2021), but was not consistently found for utility value. Only some studies reported small effects of dimensional comparisons on adolescent students' utility value (e.g., Guo et al., 2017; Lazarides & Lauermann, 2019), while others did not find it (e.g., Gaspard et al., 2018). This inconsistency may be due to similar levels of utility value reported across different domains by adolescent students, and indication that they have yet to develop the relation between specific tasks and their personal goals. These patterns suggest that dimensional comparisons may more consistently affect adolescents' domain-specific constructs (Möller, 2016) such as intrinsic value and cost (Trautwein et al., 2012), and less for domain-general constructs such as attainment and utility values.

Furthermore, the influence of dimensional comparisons on task values has varied depending on the different approaches used to model task value facets. Studies that modeled task values as different facets consistently found cross-domain effects, especially for intrinsic value (e.g., Gaspard et al., 2018; Guo et al., 2017; Lazarides & Lauermann, 2019). On the contrary, in a study that utilized a single composite construct of values, no evidence of dimensional comparison effects was found (Umarji et al., 2023). The different approaches and mixed results highlight gaps in our understanding regarding the potential effects of dimensional comparisons on all task value facets. To address these gaps, our study will examine achievements in math and language alongside the distinct facets of task values in both domains simultaneously in a single model, without reducing them to a single composite variable. This approach will provide deeper insights into whether achievement comparisons as posited by GI/E, especially dimensional comparisons, indeed influence each task value facet or only specific facets.

1.3. Achievement comparisons and gender differences in task values

The open questions related to how achievement comparisons influence task value formation also invite questions about whether social and dimensional comparisons of prior achievement may contribute to the development of gendered values. Indeed, earlier studies have compared boys' and girls' task values and found gender differences (e.g., Chow & Salmela-Aro, 2011; Gaspard et al., 2020; Nagy et al., 2006; Olive et al., 2022; Wang et al., 2013), such that girls report valuing languages more highly and have better achievements, whereas boys value math-related subjects and achieving higher in these subjects. However, these studies have not explicitly tested the specific pathways that link achievement to such gendered outcomes. In line with theoretical assumptions in SEVT and results reported in previous empirical studies, we identify two potential pathways: gender could either (1) affect the strength and direction of the effect of previous achievement on values (i.e., moderation), or (2) influence initial achievement and subsequently affect values (i.e., mediation).

In support of the former, SEVT posits that values are shaped by individuals' personal interpretations of achievement experiences – which may vary by gender (Eccles et al., 1983; Wigfield et al., 2020). Based on this assumption, we could test whether gender influences the direction and/or strength of how achievement relates to task values. Evidence of difference in magnitude and direction would most likely indicate that, even if male and female students have the same level of achievement, they would still form different levels of task values. For example, a boy may look at an excellent math performance and say, "I like math even more!" while a girl may look at the same performance and say, "It is such a burden to keep up with such achievement, I like math even less."

Such gender moderation of the relation between achievement and task value seems to be visible during specific schooling stages. Studies done with younger samples, such as primary school and early secondary school students, reported that both girls and boys engaged in within- and cross-domain achievement comparisons to form their intrinsic values (e.g., Arens & Niepel, 2023; van der Westhuizen et al., 2023). On the contrary, samples of older students enrolled in academic tracks tend to show differences between girls and boys on the within- and cross-domain relations of achievement and intrinsic value (Nagy et al., 2006). For these students, cross-domain effects from math and Biology domains were invariant for both gender groups, but the within-domain effect for Biology was only significant for girls. As these students were required to specialize in one of the sciences early in their schooling, gender moderation was attributed to potential reliance on gender stereotypes, leading boys and girls to engage in achievement comparisons differently in developing their value.

Beyond intrinsic value, gender moderation of achievement in other task value facets, such as cost, attainment, and utility value, has only been hinted at by results of studies that investigated conceptually similar beliefs. For instance, when reporting math-related anxiety, a similar construct with cost, adolescent girls were more sensitive to their performance in math compared to boys although they have comparable achievement (e.g., Goetz et al., 2013; Yu et al., 2023). Similarly, boys are more strongly influenced by their achievement in math when forming their aspirations compared to girls with similar achievements (e.g., Korhonen et al., 2016; Widlund et al., 2020). Given that aspirations are closely related to what students believe is useful for their future and what they find important, similar findings may be observed for utility and attainment value. The results of these studies highlight the potential moderating effect of gender in all value facets, which implies that

additional research is needed to clarify whether adolescent boys and girls utilize different mechanisms in interpreting their achievement to task value. Therefore, the current study investigates the moderating effect of gender to find out how it may affect the relationship between math/verbal achievements and different value facets.

Alternatively, the second pathway describes a mediation mechanism where differences in achievement between boys and girls lead to the development of gendered values. Girls have indeed been observed to have higher achievement in languages compared to math-related subjects (e.g., Wang et al., 2013; Watt, 2004). Therefore, in line with dimensional comparison theory (Möller & Marsh, 2013), girls may subsequently devalue math in favor of languages, and the reverse may be true for boys. These assumptions are supported by findings in studies that observed different initial achievements for male and female students, which are correlated with their values within a specific domain (e.g., Chow & Salmela-Aro, 2011; Wang et al., 2013). For instance, it seems that boys' higher performance in math is strongly correlated with their higher values and aspirations related to math and Science. Similarly, other studies explicitly tested the relation between previous achievement and intrinsic value or a composite task values variable (Jansen et al., 2021; Nagy et al., 2008). In this case, girls had higher achievement in language compared to math, and through within- and cross-domain comparisons of achievement, also valued language more highly. These studies indicate that the mediation pathway, intensified by social and dimensional comparisons, contributes at least partially to gendered values formation. It remains an open question, however, whether such mediation influences all facets of task value similarly. The current study aims to test the extent to which gender shapes task values through achievement comparisons.

1.4. The present study

The current study aims to address the gaps that have yet to be addressed about the role of achievement comparisons in task value development, which includes the potential differential processes contributing to gender differences. We first tested both the social and the dimensional comparison effects of math and verbal achievement on the formation of multifaceted task values, as described in the GI/E model (see Fig. 1). Following the first aim, we identified the pathways through which gendered task values emerged.

Our research questions and hypotheses were as follows:

RQ1: How does student achievement in the verbal and math domains influence subsequent facets of subjective task values?

- H1: We expect to find social-comparison effects in all facets, and dimensional-comparison effects in some facets of subjective task values.
  - o H1a: In the case of social-comparison effects, we expect positive within-domain relationships between math/verbal achievement and the respective math/verbal values. Higher achievement will be followed by higher intrinsic, attainment, and utility values as well as lower costs in the same domain.
  - o H1b: Regarding dimensional-comparison effects, we expect negative cross-domain relationships between math-verbal achievement and the subsequent values in the contrasting domain. Higher achievement in math will predict lower intrinsic value and higher cost in the verbal domain. We formed no prior hypotheses for attainment and utility values. We also expect the same relation in the case of verbal achievement and math values.

RQ2: How does gender influence the relation between past achievement and subjective task values?

Previous studies have not confirmed which pathway connecting previous achievement to gendered values is more likely (i.e., moderation or mediation), therefore we formed no prior hypotheses related to this process. We tested both pathways and explored the processes contributing to gender differences in task values.

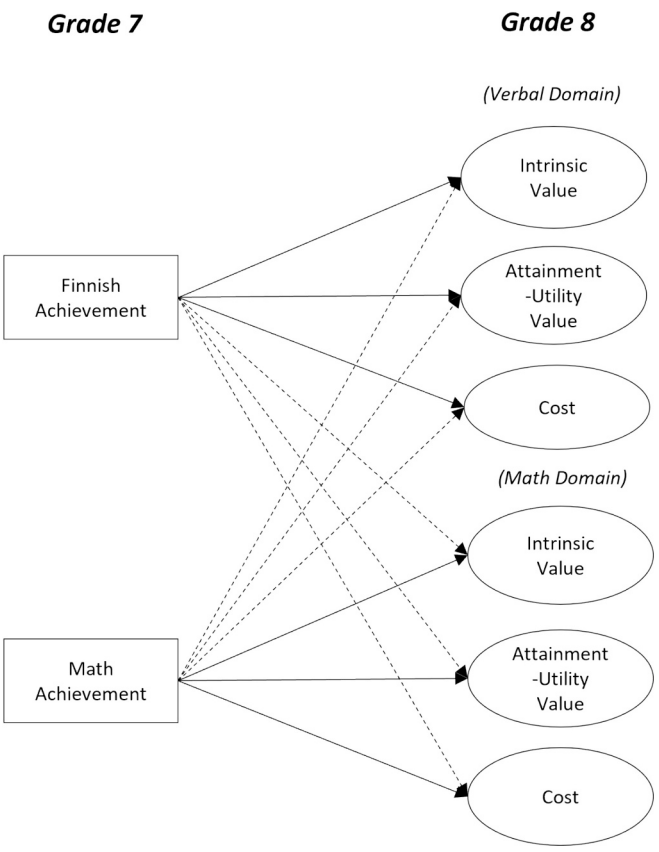

Fig. 1. A conceptual model of the dimensional and social-comparison process.

2. Material and methods

2.1. Sample

Participants in this study were a cohort of students from 31 middle schools in Helsinki, Finland, who were involved in an ongoing longitudinal study. We obtained achievement data in 2019 when the students were in the seventh grade ($M_{age} = 12.8$ years), and questionnaire data in the subsequent year when they were in the eighth grade. The questionnaire data were collected in the fall semester through online questionnaires.

Participation was voluntary, with active consent obtained from students and their parents. The study protocol was reviewed and approved by the ethical review board of the authors' institution. This study is the first to be published from the longitudinal dataset using the variables described below.

As our inclusion criterion, the students had to be present during the Grade 7 data collection and showed no evidence of straight-lining in their responses during Grade 8. Of the 1357 students who had achievement data and parental consent, 32 were excluded on such grounds, leaving a final analytic sample of 1325 students. Approximately 52 % self-identified as girls, 45 % as boys, and 3 % as other.

2.2. Measures

2.2.1. T1 achievement (Grade 7)

In Grade 7, students' grades in Finnish and math were obtained from the school registry as an indicator of their academic achievement. We operationalized achievement using actual school grades, which as shown in a previous study appear to have a stronger subject-specific

relationship with personal expectancy compared to standardized test scores (Jansen et al., 2014; Möller et al., 2020). Higher grades in the Finnish system indicate better achievement, ranging from 4 = *fail* to 10 = *excellent*.

2.2.2. T2 subjective task values (Grade 8)

During Grade 8, subjective task values were measured using a short version of the expectancy-value scale (Eccles & Wigfield, 1995). This eight-item scale measures intrinsic value (i.e., "(*this subject*) *interests me*", "*I like* (*the subject*)"), attainment (i.e., "(*this subject*) *is important to me*", "*It is important for me to be good at* (*this subject*)"), utility value (i.e., "(*this subject*) *is useful for me*", "(*this subject*) *is useful for my future profession*"), and relative cost (i.e., "(*this subject*) *is exhausting me*", "*studying* (*the subject*) *stresses me*"). The scale measures values separately for math and Finnish. The responses were rated on a seven-point scale (*1 = not true at all*; *7 = very true*).

2.3. Statistical analysis

First, we analyzed the missing data patterns to identify potential systematic bias from attrition and missing responses. This was followed by confirmatory factor analyses (CFAs), which we conducted in both subject domains to evaluate the factor structure of the task value constructs. We modeled task values as latent factors, indicated by multiple items, and treated as continuous variables. To account for parallel items across domains, we included correlated uniqueness between matching indicators (Marsh & Hau, 1996).

Following the CFAs, we tested the items for reliability, their bivariate correlations, and measurement invariance across genders. The degree of invariance for the latent factor structure was determined by $\Delta CFI < 0.01$, as recommended by Chen (2007). All the main analyses were performed in Mplus 8.6 (Muthén & Muthén, 1998–2017), which by default deletes cases without responses to all the focal variables, and handles other missing values with the robust maximum likelihood estimator (MLR). We used an alpha level of 0.05 in all the significance testing.

The main model (see Fig. 1) was fitted using structural equation modeling to address our first research question, which concerned the process of social and dimensional comparisons in the development of task values across the domains. Task value constructs in math and Finnish were included as separate latent factors and regressed on students' grades in both domains (see Online Supplement for Mplus syntax). We also adjusted the standard error for the clustering effect of students in classes using the TYPE = COMPLEX command.

Next, we tested two different models to enhance understanding of the processes contributing to gender differences in task values: (1) a model testing the moderating role of gender in the effects of achievement on task values, and (2) another model testing the mediating role of achievement between gender and task values. Only a subset of the data ($n = 1115$) was included in this part of the analysis, as we removed students identifying as non-binary ($n = 37$) and those who provided no responses for gender ($n = 173$). To test the gender-moderating effect, we first estimated a multigroup model in which all paths between achievement and task values were constrained as equal across boys and girls. Next, we compared the fit of the constrained multigroup model to an alternative model in which all paths were freely estimated. A significant difference in model fit indicates differences in the strength of the relationship between achievement and subsequent task values for boys and girls. For the mediation model, we regressed values and achievement on gender. Significant indirect pathway(s) illustrate the effects of gender on values through achievement, indicating that gender differences in achievement partly explain differences in task values. The model fit was considered satisfactory in all the analyses following the cutoff values suggested by Hu and Bentler (1999), with CFI and TLI values close to 0.95, SRMR values close to 0.08, and RMSEA values close to 0.06.

3. Results

3.1. Preliminary analysis

Of the 1325 students who had achievement data in Grade 7, 719 students completed the questionnaire in Grade 8, and missing-data rates were low on the item and domain levels (all < 10 %), but higher for math-related variables (3–5 %) compared to the Finnish-related variables (1–3 %). We tested whether the drop-out and missingness were related to gender and grades, and found that students who had missing data in Grade 8 were more likely to be boys and to have had lower achievement in Grade 7. These patterns indicate a missing-at-random (MAR) process, therefore we opted to utilize full information maximum likelihood estimation rather than listwise deletion to handle the missingness. This estimation strategy can provide unbiased parameter estimates even in such high missingness conditions (e.g., Enders, 2010).

Factor analysis supported the distinctiveness of the intrinsic value and cost items. However, the attainment and utility value items were highly correlated and loaded together in this sample. They were therefore treated as a single latent variable (attainment-utility) in subsequent analyses. Moreover, we followed the suggestion from the modification indices to correlate the residuals from the first items measuring attainment and utility (i.e., "(*this subject*) *is important to me*" and "(*this subject*) *is useful for me*"), as they showed a strong residual association. The model fit from the confirmatory factor analysis for this model was excellent ($CFI \geq 0.95$, $TLI \geq 0.95$, $RMSEA < 0.06$, $SRMR < 0.08$, see Supplementary Table 1 for the exact fit indices).

All the scales used in this study showed good reliability according to Cronbach's alpha (for the four-item scales, i.e., attainment-utility value), and the Spearman-Brown formula (for the two-item scales, i.e., intrinsic value and cost). The observed reliability for items assessing task value in Finnish was $\rho = 0.89$ for intrinsic value, $\alpha = 0.81$ for attainment-utility value, and $\rho = 0.67$ for cost, compared with $\rho = 0.89$, $\alpha = 0.82$, and $\rho = 0.76$, respectively in math.

The bivariate correlation (Table 1) revealed an association between achievement in Grade 7 and values in Grade 8: higher achievement in Grade 7 correlated significantly with higher task values for matching subjects in Grade 8 ($r \leq 0.30$, $p < .001$), and less strongly with non-matching subjects ($r \leq 0.16$, $p < .001$).

Table 2 shows the means and standard deviations for achievement and task values in the overall sample. Small gender differences were observed: female students tended to have higher grades in both subjects, but the difference was more pronounced in Finnish than in math. Additionally, male students reported higher intrinsic values and lower cost in math, and higher cost in Finnish.

We tested the invariance assumption up to metric invariance (see Supplementary Table 1). Metric invariance supports the notion that relationships between latent factors are comparable across groups, and that group differences for the factor loadings of each task value are unbiased. Given that we aimed to compare group-based relations among the constructs and not the mean differences between the groups, evidence of metric invariance was sufficient (Gregorich, 2006).

3.2. Social and dimensional comparisons

Our first research question concerned social and dimensional comparison processes. In terms of social comparison, we expected that higher achievement would be positively associated with task values in matching domains, and that regarding dimensional comparisons higher achievement would be negatively associated with task values from contrasting domains. Our results (illustrated in Fig. 2) indicate that students engaged in both within- and cross-domain comparisons of achievements to develop their task values, although only partially for cross-domain comparison (see Supplementary Table 2 for the detailed regression coefficients of the main model).

Table 1
Bivariate correlations of value facets, achievement, and grades.

	Variable	1	2	3	4	5	6	7	8
1	Gender (*0 = boys, 1 = girls*)								
Finnish									
2	Prior Achievement (Grade 7)	0.32***							
3	Intrinsic Value	0.00	0.15***						
4	Attainment-Utility Value	0.02	0.16***	0.58***					
5	Cost	−0.09*	−0.25***	−0.38***	−0.25***				
Math									
6	Prior Achievement (Grade 7)	0.14*	0.67***	0.07	0.12*	−0.14***			
7	Intrinsic Value	−0.12***	0.13*	0.35***	0.27***	−0.16***	0.30***		
8	Attainment-Utility Value	−0.04	0.16***	0.25***	0.40***	−0.14***	0.27***	0.54***	
9	Cost	0.10*	−0.09	−0.18***	−0.11	0.50***	−0.21***	−0.40***	−0.24***

Note: Bivariate correlations of value facets were calculated from prior achievement (collected in Grade 7) and the summed items of each variable (collected in Grade 8).
* $p < .05$.
*** $p < .001$.

Table 2
Mean and standard deviations of value facets and achievement in each domain.

Variable	Total Sample		Girls		Boys		*Cohen's d*
	M	*SD*	*M*	*SD*	*M*	*SD*	
Finnish							
Prior Achievement (Grade 7)	8.4	1.1	8.7	1.0	8.0	1.1	0.67
Intrinsic Value	4.1	1.7	4.1	1.7	4.1	1.7	0.01
Attainment-Utility Value	5.6	1.3	5.6	1.3	5.6	1.4	0.05
Cost	3.9	1.8	3.8	1.8	4.1	1.8	0.18
Math							
Prior Achievement (Grade 7)	8.5	1.2	8.7	1.2	8.3	1.2	0.28
Intrinsic Value	4.7	1.8	4.5	1.8	4.9	1.7	0.24
Attainment-Utility Value	6.0	1.3	5.9	1.3	6.0	1.2	0.08
Cost	4.1	1.8	4.2	1.8	3.9	1.8	0.20

Note: This table presents the mean and standard deviations of prior achievement in Grade 7 (ranging from 4 to 10) and averaged value items in Grade 8 (each item based on a 7-point scale) from the total sample, girls and boys. The effect sizes of the differences between the gender groups are also presented as Cohen's *d* (interpretation of effect size as 0.2 = small; 0.5 = medium; 0.8 = large).

As expected, we observed within-domain associations in both math and Finnish, indicating social comparison processes, as all matching paths between grades and value facets were significant ($p < .05$). In other words, compared to students with lower achievement, those with higher achievement in Grade 7 subsequently reported higher intrinsic value ($\beta = 0.20$, $p < .001$ for Finnish, $\beta = 0.45$, $p < .001$ for math), higher attainment-utility value ($\beta = 0.20$, $p < .001$ for Finnish, $\beta = 0.34$, $p < .001$ for math), and lower cost ($\beta = -0.32$, $p < .001$ for Finnish, $\beta = -0.34$, $p < .001$ for math) for the matching subject.

Moreover, we observed partial cross-domain comparison from Finnish achievement to math intrinsic value and cost: students with higher grades for Finnish in Grade 7 subsequently reported less interest ($\beta = -0.14$, $p = .005$) and higher cost ($\beta = 0.12$, $p = .04$) in math. However, no significant paths were found from math grades to Finnish values, providing no evidence of dimensional comparison from math to the verbal domain in our sample.

3.3. The role of gender

Our second research question concerned the processes contributing to gender differences in task values. We tested two processes posited to contribute to gendered values: (1) the moderating role of gender in the effects of achievement on task values, and (2) the mediating role of achievement between gender and task values.

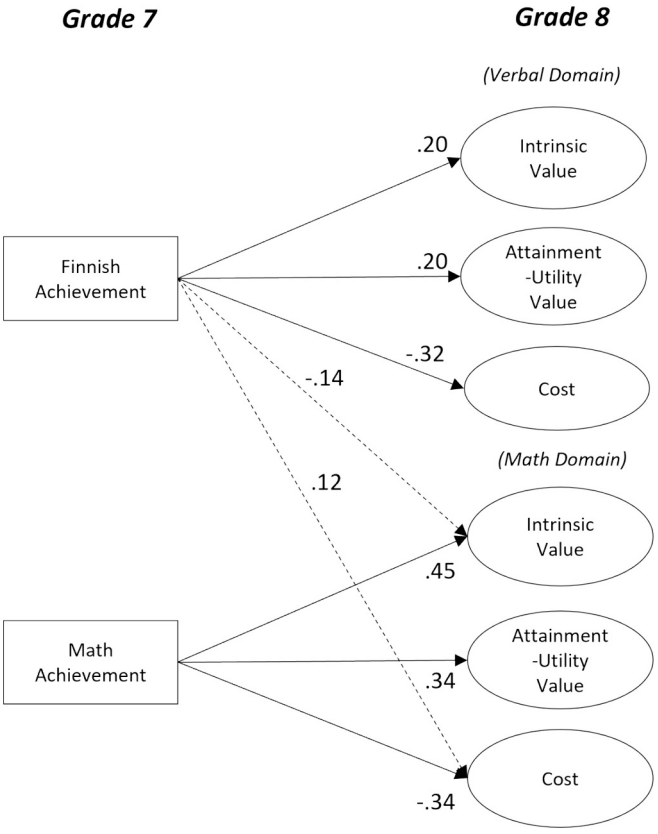

Fig. 2. A summary of the significant paths between achievement and values.
Note. This figure summarizes significant regression paths from the main model ($p < .05$). Detailed information about the regression coefficients and standard errors of all the paths tested in the main model is given in Supplementary Table 2.

The moderation model did not support the gender moderating effect (see Supplementary Table 3 for the model fits and chi-square comparisons). No significant differences in the fit statistics emerged when we compared models with gender-varied paths between achievement and values to the constrained model. This result indicates that the strength and/or direction of relationships between achievement and task values did not differ between boys and girls.

In the mediation model (summarized in Fig. 3), gender influenced task values through social comparison, but not dimensional comparison. Girls had higher grades in both Finnish and math, which in turn were associated with higher values and lower cost. Furthermore, we found a significant direct effect of gender on intrinsic value and cost in math, such that girls tended to report lower intrinsic value ($\beta = -0.17$, $p < .001$) and higher cost ($\beta = 0.20$, $p = .007$). Supplementary Table 4 describes the significant direct, indirect, and total effects of the model in more detail.

4. Discussion

The focus of the current study was on how students' achievement comparisons influence subsequent task value development across domains. Following a sample of students from Grades 7 to 8, we investigated the social and dimensional comparison processes and its implications for gendered values development. The effect of within-domain or social comparison was visible for all facets, whereas the only effect of cross-domain or dimensional comparison on the values was for math-related intrinsic value and cost. Furthermore, the value differences we observed between male and female students most likely developed through the influence of other factors beyond the comparison of individual achievements. In the following, we discuss the implications of these findings as well as their limitations and include suggestions for future studies and practice.

4.1. Achievement comparisons based on GI/E and SEVT

The first research question in this study examined to what extent verbal and math achievements influence subsequent task value facets. We observed that students' achievement experience indeed influenced their subsequent task values as predicted by GI/E: fully through within-domain associations, but only partially through cross-domain comparisons affecting math intrinsic value and cost.

Our observation of positive within-domain relationships for task values in both math and language supports the GI/E prediction that social comparisons influence the formation of multiple constructs, including all facets of task value. Following Hypothesis 1a, students with higher achievement levels in both Finnish and math reported higher subsequent intrinsic, attainment, and utility values and lower cost in the same domain. This positive within-domain effect is similar to what Gaspard et al. (2018) have reported, although the average path coefficient we observed (average of $\beta = 0.33$ for intrinsic value, $\beta = 0.27$ for attainment-utility value, and $\beta = 0.33$ for cost, see Fig. 2) is lower than the average of what Gaspard and colleagues observed (average of $\beta = 0.54$ for intrinsic value, $\beta = 0.28$ for attainment-utility value, and $\beta = 0.49$ for cost). Nevertheless, the pattern suggests that students are likely to engage in positive within-domain association when they experience high achievement, regardless of the domain. This process can be interpreted as evidence of social comparison that leads students to believe that this subject is more enjoyable, important, useful, and less costly.

On the other hand, we found limited support for GI/E prediction on cross-domain achievement comparison in task value formation. Partially aligned to Hypothesis 1b, we observed that students with higher achievements in Finnish reported lower intrinsic value and higher cost for math. The path coefficients ($\beta = -0.15$ for intrinsic value and $\beta = 0.13$ for cost) were comparable to those Gaspard et al. (2018) reported ($\beta = -0.16$ for intrinsic value and $\beta = 0.15$ for cost). Our observation

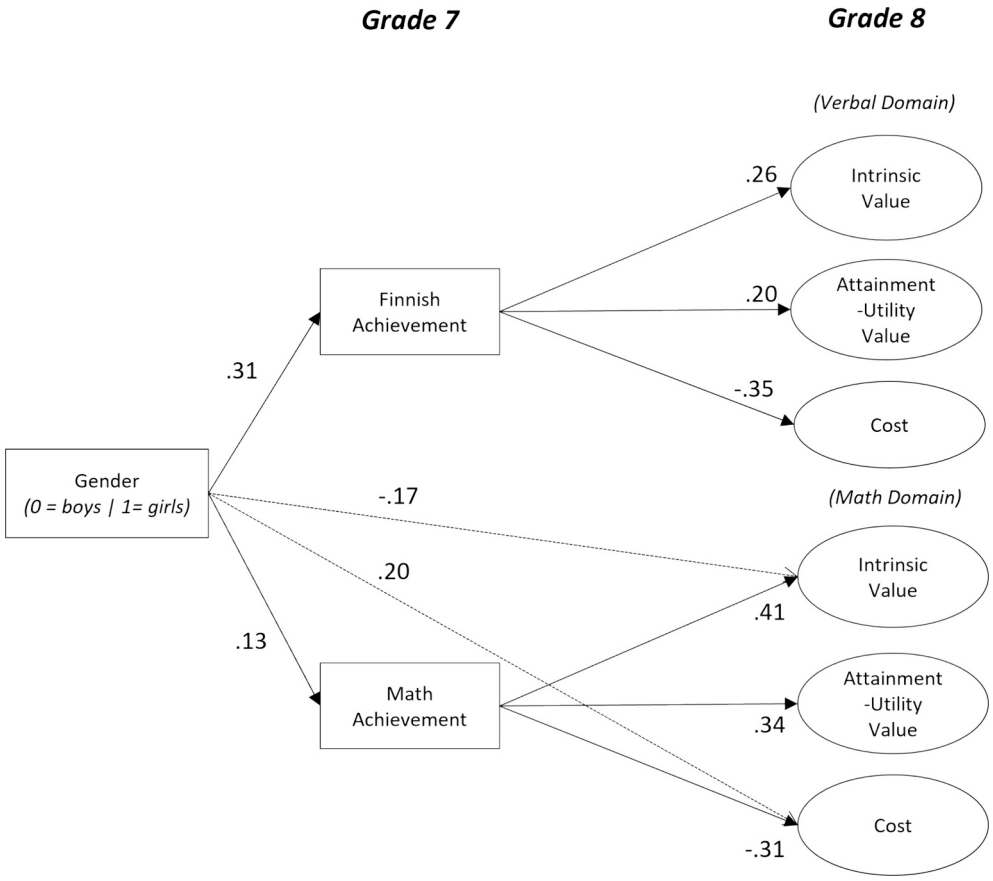

Fig. 3. A summary of the significant direct paths between gender, achievement, and values.
Note. This figure summarizes significant direct regression paths for the mediation model ($p < .05$): see Supplementary Table 4 for detailed information about the regression coefficients and standard errors of all the paths.

that there is no cross-domain association between math achievement and Finnish values seems to indicate that students selectively rely on dimensional comparison of achievement when developing their values for specific domains.

The math-specific dimensional comparison may stem from the different processes through which students develop their math and language skills, a phenomenon particularly evident in the Finnish educational context. Past studies have observed that the nature of the Finnish language made it easier for students to develop different language skills faster and earlier (Aunola et al., 2002; Seymour et al., 2003), and highlight that students usually receive broader exposure to tasks and skills related to language beyond the school context. The wider opportunities for language-related experience and the relatively late exposure to numeric grades most likely provided students with more sources of information beyond academic achievement to form their language values. Such context may have influenced them to put less reliance on cross-domain comparison of achievement in shaping their values, as they potentially compare other experiences outside of school. On the other hand, an average student will be primarily exposed to the math domain through academic settings. Such limited opportunity likely leads to a greater reliance on academic achievements as their primary source of information to develop perceptions of whether they enjoy the tasks or find them exhausting. Previous findings (Viljaranta et al., 2014) supported this notion: the influence of achievement on Finnish students' interest is more prominent in years when they have to learn skills that are primarily taught at school. Such a pattern may also explain the inconsistent dimensional comparison observed in studies focusing on non-academic domains, such as music (Lohbeck, 2022) and physical education (Arens & Preckel, 2018).

These results suggested a more complex view of GI/E assumptions regarding the effect of achievement comparisons on task values. In domains where students primarily rely on academic achievement to develop their values, students potentially engage more in cross-domain comparisons. However, in domains where students have broader experiences beyond school, cross-domain comparisons of achievement may not necessarily be the primary information used by students to develop their task values. This is further illustrated in the next section, where we discuss the influence of social and dimensional comparisons for each specific task value facet.

4.2. Achievement comparisons for each task value facets

On top of the domain-specific effect, we also observed adolescent students' facet-specific engagement with achievement comparisons. This was illustrated by the partial support for Hypothesis 1b, where the cross-domain effect was only observed for math intrinsic value and cost. This facet-specific effect indicates that dimensional comparison of achievement primarily influences students' affective perceptions, reflected through their intrinsic value and cost. Students develop such affective perceptions of a task primarily through observing their own experience, which could explain why students are more likely to rely on internal comparisons such as their own achievements across domains, similar to how they develop expectancies for success (Guo et al., 2016; Lee et al., 2023; Trautwein et al., 2012). On the other hand, attainment and utility values reflect one's identity and goals both personally and within a social context (Eccles, 2009). This contextual dependency may prompt students to rely more on social influence: they may compare input from other people, or compare their own experience to other people's experience, rather than relying solely on personal experiences. Moreover, during adolescence, students are still in the process of solidifying their personal identity and goals — which may result in lower domain-specificity in these values and less reliance on dimensional comparison of achievement to inform their attainment and utility values. As they progress in their education and begin to specialize, students tend to deepen their engagement in their specialization while also disengaging from other domains (Gaspard et al., 2020), which potentially leads to more domain-specific attainment and utility values. These findings therefore align with the assumption that some values are more externally regulated (Harackiewicz et al., 2014; Simons et al., 2004).

These observations could inform interventions to support students' value development and learning. First, we observed that students are more likely to engage in negative cross-domain comparisons for academic subjects such as math, as in such settings, their achievements are the most salient sources of information. Thus, interventions could facilitate students to identify the similarities of various subjects they learn at school (Helm et al., 2016; Sticca et al., 2023), such as what similar learning strategies, skills, and benefits of learning are translatable across domains. This approach could help students buffer the effect of dimensional comparisons on their self-beliefs, as they are introduced to other perspectives that support their learning across different subjects (Helm et al., 2016; Sticca et al., 2023). In addition, helping students to realize the relevance of academic domains to daily life (Gaspard, Dicke, Flunger, Brisson, et al., 2015; Hulleman et al., 2010) may help them to have less reliance on their achievement when developing what they find enjoyable, worth engaging, and even important for them and useful for their present and future goals (e.g., Acee et al., 2018; Gaspard, Dicke, Flunger, Brisson, et al., 2015; Linnenbrink-Garcia et al., 2018). Second, our results highlighted that students' math intrinsic value and cost are the values most influenced by dimensional comparisons. Given the impact of achievements on these beliefs, it is important for interventions to help students reframe their prior achievements in various domains. Instead of framing their "successes" and "failures" as a function of innate talent (Dweck, 2007) which easily leads to less interest and debilitating self-beliefs, support students to frame them as learning opportunities to improve their work (Hill et al., 2010). Lastly, we observed that dimensional comparisons were not the main factor that influenced attainment and utility value formation. This suggested that there is increasing importance for interventions that tap into social and contextual resources, as they are likely to be more beneficial for attainment and utility value formation. These can include, for instance, providing support for parents to understand the relevance of specific academic subjects, and thereby encourage their children (e.g., Harackiewicz et al., 2012), or leveraging cultural knowledge in teaching (e.g., Yu, Hsieh, et al., 2022).

Furthermore, our results highlight the need to consider other sources of information beyond achievement that shape students' values. Although comparisons of prior achievement influence the formation of subsequent values, the effects appear somewhat limited. This observation may indicate that this process should be examined alongside other inputs such as parental feedback and expectations (e.g., Bleeker & Jacobs, 2004; Harackiewicz et al., 2014; Simpkins et al., 2012), or differential teacher support (e.g., Dietrich et al., 2015; Helm et al., 2020; Yu, Kreijkes, & Salmela-Aro, 2022). These social factors are experienced routinely by students alongside their achievement experiences, and communicate the cultural/group identities together with expectations and opportunities (Eccles, 2009). Some recent studies indicate that students juxtapose social cues from different domains in forming their values, similar to the way they compare achievement experiences (see Dietrich et al., 2015; Helm et al., 2020). For example, those who perceived higher levels of teacher support (Dietrich et al., 2015) and lower levels of unfairness (Helm et al., 2020) in the math and language domains reported higher intrinsic value, interests, and subjective importance for the same subjects. On the other hand, when they noticed more teacher support and less unfairness in their math class relative to language class, they reported less values in language, and vice-versa. It thus seems that adolescents compare their teachers' beliefs and behavior in different subjects, which subsequently influences their own beliefs over time. In other words, their task values development appears to rely not only on comparisons of individual achievement but also on comparisons of social affordances. Exploration of these influences alongside prior achievement experiences, as encouraged by Wigfield and Eccles (2020), would therefore be a fruitful next step in mapping the

complexities of students' developmental reality.

4.3. Influence of prior achievement on gendered values

In addressing our second research question we analyzed the role of prior achievement in the formation of gendered values. We examined two potential processes through which prior achievement could contribute to gender differences in task values. The results indicate that gender did not moderate the strength or direction of the relationships between achievement and task values. Instead, it influenced math-related intrinsic value and cost directly, and indirectly only through achievement within the same domain.

Findings from the moderation model showed comparable results among boys and girls: the relationships between achievement and each value facet in the different subject domains were similar in strength and direction across genders. This result could imply that boys and girls indeed utilize comparable strategies when interpreting their achievement. Another possible implication of this is that in the Finnish schooling context, adolescents from both gender groups did not experience the need to rely on their achievement differently. This may mean that we might still observe such moderation in more specialized subjects, or in subjects where more gender stereotypes are more prevalent, as Nagy et al. (2006) observed. Taken together, our results point to another potential pathway for the development of gendered values.

The mediation model demonstrated that girls' and boys' differing achievement affected their gendered values through comparisons within the same domain. We observed that female students outperformed male students in Finnish and math. However, the higher achievement only enhanced the values of these students in the same domains but did not affect them across domains. This result shows that, even though girls have higher achievement in language, it does not necessarily lead to gender-specific de-valuing of the subjects in which they perform more weakly. Our result differs from results from previous studies where both within- and cross-domain comparisons of achievement were observed, and significantly influenced the formation of gendered intrinsic value (e.g., Jansen et al., 2021). We only observed partial dimensional comparison which suggests that students showed limited reliance on their achievement across domains. We interpret this as evidence that adolescent students are more likely to utilize a different pathway to develop their gendered task values. Our findings hint that although partially influenced by gendered achievement, there are more factors contributing to students' gendered value development than just girls' advantage in languages (e.g., Wang et al., 2013).

Beyond the hypothesized pathways, we observed a direct effect of gender on math-related intrinsic value and cost, above and beyond the influence of prior achievements. These direct effects revealed that girls showed lower intrinsic value and higher cost in math, regardless of their prior achievement. This result further emphasizes the more direct and critical role that other sources of information play in shaping students' values than individual students' perceptions of prior achievement alone. As outlined previously, although task values development is influenced by comparisons of individual achievement, students also rely strongly on their social affordances. Girls and boys may put varying emphasis on others' interpretations rather than transferring their individual achievements into task values differently. This may be especially true for input from critical socializers such as parents, teachers, and peers. This assumption aligns with previous research findings that students' beliefs about themselves are influenced by their teachers' response to their performance (e.g., Dickhäuser et al., 2017; Yu, Kreijkes, & Salmela-Aro, 2022), which may differ based on their gender (Robinson-Cimpian et al., 2014). Taken together, the findings from the gender models also demonstrate the importance of not only considering the effect of individual achievement comparison. In providing appropriate support for adolescent students in their learning, it is critical to examine and disentangle social and contextual sources alongside the individual factors that shape their values.

4.4. Limitations and suggestions for future studies

Our study complements previous research in enhancing the understanding of how social and dimensional comparisons of achievement contribute to the development of all facets of task value within a unified model. However, a few limitations should be considered in interpreting the results, which we elaborate with our suggestions for future studies.

The limitations of our measurements and research design should inform future studies aiming to examine students' task value development. First, we utilized two-item scales to measure each value facet, reducing the reliability of the items (Nunnally & Bernstein, 1994), especially the cost items. To represent students' motivational beliefs more accurately, we recommend the use of longer scales in future studies, which provide a more holistic representation of their value dynamics (e.g., Beymer et al., 2022). Second, the items representing attainment and utility values correlated strongly with one another and formed a single factor. It is plausible that students interpreted statements such as "*This subject is useful for me*" similarly to "*This subject is important to me*". Thus, future studies could utilize measures that provide a better distinction of how each of the facets is understood by students. For example, further specifying attainment as personal importance or utility as utility for school or daily life could enhance clarity (e.g., Gaspard, Dicke, Flunger, Schreier, et al., 2015). Third, although we assessed student achievement and task values at two separate time points, they were not measured repeatedly. This means that our results could not shed light on the comparison processes after controlling for the longitudinal interrelations of the constructs. Given these points, there is still further work to be done to derive more nuanced causality claims concerning how achievement experiences shape values.

Moreover, to arrive at a full understanding of the relation between achievement and values, future studies should also pay specific attention to the potential mediating role of expectancy beliefs. It remains an open question to what extent expectancy mediates the influence of prior achievement on subsequent values. Recent studies reported inconsistent findings, with some suggesting full mediation (Gaspard et al., 2018), whereas others report only partial (van der Westhuizen et al., 2023) or even non-mediation (Arens & Niepel, 2023). This inconsistency may be linked to students' context, as we observed in this study. In contexts where achievement information is salient, students are more likely to rely on their comparisons of successes and failures to form their values. In such contexts, expectancy may play a bigger role as a mediator between achievement and task values. On the other hand, in contexts where there is less emphasis on academic achievement, such mediation by expectancy beliefs may not be as apparent. As this possibility has yet to be explored and measured explicitly, we recommend future studies to include the potential mediating effect of expectancies in students' varying academic contexts, to shed further light on the complex relations linking achievement, expectancy, and values.

Additionally, future studies would benefit from having a more representative sample. We utilized a convenience sample gathered from 31 schools in a specific city in Finland, which means that although we can confidently derive generalizability to students within the region, we are limited in our claim of generalizability to other populations. The limited sample also means that we could only provide limited insights into how much contextual factors, such as differences in cultural backgrounds, influenced our results. It would therefore be necessary to conduct further studies in broader contexts that could provide more nuance into factors influencing students' developing values and decisions.

Furthermore, this study represented a limited model of social comparison, which has yet to capture fully how students compare themselves with others in their proximity. We interpreted within-domain effect of achievement as students engaging in social comparisons – yet this operationalization potentially captures both students' self-enhancement alongside social comparisons. Recent studies based on the GI/E model have highlighted the importance of considering

aggregated achievement in schools and classrooms to better capture the dynamics of social comparison (e.g., Guo et al., 2017; Schurtz et al., 2014). Given that this study only modeled the impact of individual achievement, we recommend future studies to consider these broader factors and thereby provide deeper insights into student development.

4.5. Conclusion

Taken together, our study underscores the importance of understanding how students use achievement comparisons as an important information source to develop their task values. Most importantly, we demonstrated that dimensional comparison of prior achievement plays a role in shaping students' interests and perceived costs in math, but not in language. This observation highlights the possibility that the dimensional comparison process depends on whether academic achievements are considered as salient information in students' contexts. Our findings further show that male and female students form task values based on their achievement in a similar manner, with gender differences in task values only partially mediated by comparisons of prior achievement. These findings indicate that factors other than individual comparisons of achievement play a role in adolescents' task values development. Thus, future studies could explore contextual factors such as parental and teacher expectations as students' task values do not develop in a vacuum. In sum, our findings highlight that although students' task values are shaped by their achievements, they are not solely defined by them. Helping students make sense of their achievement experiences across different domains could be one important strategy in fostering their adaptive value beliefs.

CRediT authorship contribution statement

Kezia Olive: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Junlin Yu:** Writing – review & editing, Validation, Supervision, Methodology, Conceptualization. **Janica Vinni-Laakso:** Writing – review & editing, Project administration, Conceptualization. **Katariina Salmela-Aro:** Supervision, Project administration, Funding acquisition.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.lindif.2024.102534.

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