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Choices and changes: Eccles' Expectancy-Value model and upper-secondary school students' longitudinal reflections about their choice of a STEM education

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ABSTRACT

During the past 30 years, Eccles' comprehensive social-psychological Expectancy-Value Model of Motivated Behavioural Choices (EV-MBC model) has been proven suitable for studying educational choices related to Science, Technology, Engineering and/or Mathematics (STEM). The reflections of 15 students in their last year in upper-secondary school concerning their choice of tertiary education were examined using quantitative EV-MBC surveys and repeated qualitative interviews. This article presents the analyses of three cases in detail. The analytical focus was whether the factors indicated in the EV-MBC model could be used to detect significant changes in the students' educational choice processes. An important finding was that the quantitative EV-MBC surveys and the qualitative interviews gave quite different results concerning the students' considerations about the choice of tertiary education, and that significant changes in the students' reflections were not captured by the factors of the EV-MBC model. This questions the validity of the EV-MBC surveys. Moreover, the quantitative factors from the EV-MBC model did not sufficiently explain students' dynamical educational choice processes where students in parallel considered several different potential educational trajectories. We therefore call for further studies of the EV-MBC model's use in describing longitudinal choice processes and especially in investigating significant changes.

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Expectancy-Value; educational choice processes; significant change

Introduction

A mismatch exists between on the one hand students' insufficient inclination to pursue study programmes and careers within Science, Technology, Engineering and Mathematics (STEM) and, on the other, the belief that STEM-related activities will be pioneers of innovation and economic growth. This has caused a sustained concern in most Western countries and sparked a substantial amount of research and numerous recruitment activities (e.g. Advisors on Science and Technology, 2012; Bøe, Henriksen, Lyons, & Schreiner, 2011; Lyons & Quinn, 2010).

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Much research has sought to identify the elements influencing students to opt away from STEM at various decision points. Reviews (Archer, 2013; Lyons & Quinn, 2010) point to an increased curricular competition from new and fashionable subjects, and to science teaching failing to engage students' interest and unwittingly installing perceptions of science as difficult. Other elements are students' and parents' inadequate knowledge of STEM careers and job potential, the influence of socio-cultural norms and capital, and stereotypical images concerning students engaged in tertiary STEM (Archer, DeWitt, & Osborne, 2015; Archer et al., 2012a, 2012b).

A range of qualitative studies have applied an identity lens to explore how elements like these affect students' educational choices (Cleaves, 2005; Holmegaard, Ulriksen, & Madsen, 2014; Krogh & Andersen, 2013). From an identity perspective, choice of education is fundamentally a question of who, rather than what, to become (Simonsen, Illeris, Ulriksen, & Katznelson, 2002). Studies have furthermore found that just as identity is a continuous and dynamic personal construction, so is the educational choice process. It may continue even after the student has entered tertiary education as an ongoing reflection about whether it was the right educational decision or if the student should opt out and make another choice (Holmegaard, Madsen, & Ulriksen, 2014). Even in their senior year studying STEM, more than a fifth of all students question whether they want to become a scientist (Seymour & Hewitt, 1997, p. 184). This, in combination with the individual's continuous revision of the choice narrative (Holmegaard, 2015), implies that what in the students' retrospective accounts of their educational choices appears as a singular and definitive event may rather be the result of a series of decisions and changes occurring over a long period of time and with the student considering several different possible educational trajectories.[1] This suggests that longitudinal studies of students' educational choice processes would capture the complexity of the choice better than retrospective studies.

In terms of theoretical models for studying students' educational choices, the 'Expectancy-Value Model of Achievement-Related Choices' proposed by Eccles (1983) has gained attention within science education (Tytler, 2014). During the past 30 years, the model has been used in a range of contexts and on a variety of samples (Eccles & Wigfield, 1995; Updegraff, Eccles, Barber, & O'brien, 1996; Wigfield et al., 1997), and it has proven suitable for studying STEM-related educational choices and for understanding students' responses to different recruitment initiatives (e.g. Andree & Hansson, 2013; Bøe et al., 2011).

In the present paper, we use the more general term 'Expectancy-Value Model of Motivated *Behavioural* Choices' (EV-MBC model) coined by Eccles in a more recent paper (Eccles, 2009).

Theoretical framework: Eccles' EV-MBC model

The EV-MBC model is a comprehensive, socio-psychological model that was first validated with data from 1978 to 1979 in a math study (Eccles, 1983). The model was derived from motivational theory with expectancies of success and subjective valuing of the behaviour/choice as the essential motivational constructs. The model has been slightly changed over the years, but the basic layout with expectancies of success and subjective valuing as the two main components of Motivated Behavioural Choices (MBCs) (Wigfield

& Eccles, 2000) has remained unchanged. The subjective valuing is made up of four different value components:

- the 'intrinsic value' (inner valuing, interests and afflictions that relate to inner motivation),
- the 'attainment value' (the personal importance ascribed to doing well in a given task to maintain self-image),
- the 'utility value' (the perceived usefulness that relates to external motivation), and
- the 'relative costs' (choice-related limitations) (Wigfield & Eccles, 1992, 2000).

All five EV-constructs (the Expectancies of success and the four Value components) can affect the MBC either in a positive or in a negative way. In an educational choice situation, the subjective values are thought to have a greater influence than the expectancies of success (Eccles & Wigfield, 2002). However, both theoretically and empirically the overall subjective value is positively correlated with the expectancies of success (Eccles & Wigfield, 1995).

Furthermore, the model suggests that the EV-factors are affected by a number of elements from the student's previous life experiences. These elements include cultural milieu, socialisers' behaviours and beliefs about the characteristics of the student, and furthermore the student's own perception of these elements as well as his/her goals and self-schemata. Expectancies and values are also affected by the student's previous experiences related to achievement, his/her interpretations of these experiences and his/her affective reactions on them. Hence, the model acknowledges the role of the student's socio-cultural background and environment, including the assumptions and expectations of parents, peers and cultural stereotypes, in the formation of the students' expectations and values (Eccles, 1983).

It is easy to see how expectancies of success relate to perceptions of science as difficult, and how subjective valuing comprises perceived interest, utility and internalised norms of what is important. In other words, the EV-MBC model—even in its simplest form—touches upon most of the factors that the research mentioned previously found to make students less inclined to choose STEM (e.g. in the ASPIRES project: Archer & DeWitt, 2015; Archer et al., 2010, 2012b, 2015). This indicates the relevance of the model for studies of students' educational trajectories.

The point that students' educational choices occur over time has, however, been less clearly addressed by the model. The model contains an implicit time component moving from the milieu, socialisers, etc. onwards to the time of the actual choice, but it is not until articles published from 2002 and onwards that some versions of the model include an arrow indicating a feedback loop from the choice and back to the background, experiences and environment of the student. In most of the articles, this feedback loop goes uncommented, but in one paper, Eccles writes that she and her colleagues have been aware that goals, self-schemata and identity formation change over time and that these changes are related to new experiences, biological changes, changes in the social context and 'the accumulation of the consequences of prior choices' (Eccles, 2011, p. 197).

Eccles points out that the expectation of success and subjective values underpinning choices are subject to change in relation to both space and time. Similarly, a second paper states:

> Since the model plays out over time, I have included one arrow to illustrate the fact that **today's choices become part of tomorrow's history of experience. This arrow includes the agentic effects of individual's choices on subsequent behaviors of socializers and the larger cultural milieu**. (Eccles, 2009, p. 81, (bold added))

Here it is emphasised that the feedback of the choice acts on both the student and on the social and cultural environment. In other words, understanding a student's choice requires more than merely following the influence of background and context on the student's expectancies and values—it requires consideration of the choice as an ongoing process developing over time and being affected by decisions and experiences made along the way.

What is less clear is the time frame of the feedback that Eccles has in mind. Is it the effect of choices made at one transition point (e.g. of advanced subjects in upper-secondary school) on choices to be made at a later transition. (e.g. which university programme to enter)? Or does it refer to short-term feedback during an ongoing choice process (e.g. the choice of advanced subjects) in which the student's reflections integrate experiences of how peers and the social environment react on preliminary decisions and thereby affecting the eventual choice of the student?

Additionally, Eccles' EV-MBC model has mainly been employed in studies using a single EV-measurement and only measuring the student's attitudes to a single study programme of the student's interest. This may be too simplistic. Eccles and others (Updegraff et al., 1996) argue that often 'it is assumed that the decision to take advanced math is based primarily on variables related to math', but to fully understand the dynamics of the choice we need 'to understand the psychological meaning of the roads taken, as well as the roads not taken' (Eccles, 1994, p. 591). The choices made concerning one subject also involve concerns and decisions regarding other disciplines as well as elements outside school (relations to peers, time for other activities, etc.).

Understanding individuals' choices therefore 'makes within-person comparisons much more relevant to understanding individual's decisions than between-group mean level comparisons. Unfortunately, very little work has taken such a pattern-centred approach' (Eccles, 2014, p. 24). Similarly, Bøe and colleagues state that since

> young people's educational choices are likely to be shaped in various complex ways over time […] it will be valuable to complement research that concern young people's expectations of success and subjective values at one point with qualitative in-depth and longitudinal studies, to assess how expectations and subjective task values develop and affect choices over time. (Bøe et al., 2011, p. 43)

That choices are made over time rather than at particular points and that choices involve a complex web of different concerns, interests etc. is not as such in conflict with the EV-MBC model, but it has scarcely been addressed in previous studies, not least because most studies using the model choose a statistical focus on the model structures rather than focusing on individual students' educational choice processes.

By adopting a longitudinal, mixed-methods approach our study offers insights into the usefulness of Eccles' EV-MBC model for understanding dynamic aspects of students' individual, educational choice processes. Because the study is person-centred and takes into account the fact that most students consider more than one future educational trajectory at the same time, it allows us to investigate whether Eccles' EV-MBC model could statistically explain significant changes in the students' educational choice processes.

This study addresses the following research question:

What are the possibilities of using Eccles' EV-MBC model to describe changes in individual students' ongoing educational choice processes?

Research design

The study builds on data from an outreach initiative targeting STEM-oriented upper-secondary school students from less-privileged socio-economic backgrounds. In total, 79 students from 10 different upper-secondary schools applied for and were selected to participate in a mentoring programme that involved five visits to the Science Faculty at the University of Aarhus during their final 18 months in upper-secondary school. The students all took advanced mathematics, which is mandatory for admission to tertiary STEM studies in Denmark (for further details about the project, see Lykkegaard & Ulriksen, 2016).

A purposive sample of 15 project participants aged 17–19 was selected. The selection aimed to capture participants displaying a broad variety of different reflections concerning possible educational choices and hence different possible future educational trajectories. The students' reflections regarding tertiary programmes were investigated using a longitudinal design allowing students to present and reflect on multiple possible educational trajectories.

The students were interviewed five times (June, September, November, February and June) during their final year in upper-secondary school. The interviews were individual, qualitative, semi-structured and theoretically informed by the EV-MBC model. Each interview took as its starting point the thread and theme from the previous interview and focussed on students' educational choice processes in general and towards tertiary STEM studies in particular.

At each of the five interviews, the students completed a number of EV-MBC surveys. The number depended on how many different study programmes the student at the time of the interview was considering as a possible educational trajectory. The EV-MBC survey used (see Appendix 1) was inspired by Eccles. The present study is highly aligned with Eccles and Wigfield (1995), but not all questions are replicates. However, divergences are estimated to be within the variability introduced by Eccles and her co-workers themselves.

The EV-MBC survey contained 17 items: three related items for each of the five EV-constructs (expectancies, intrinsic value, attainment value, utility value and relative costs) and two items aimed directly at the MBC. The surveys were answered by hand on a seven-point Likert scale.

The fact that the EV-MBC surveys were carried out as part of the interviews accomplished two specific purposes:

1. *Each student selected which and how many study programmes were relevant.* Students included all of their educational interests in the discussion of their future aspirations. The students completed one EV-MBC survey for each of the study programmes they were considering. Hence, which and how many programmes the students decided to include was entirely up to them, but they were encouraged to include as many studies as they showed interest in at that specific moment of time. Several students considered a wide range of studies, as Benji articulated when completing the first survey:

> Right now, nanoscience is the thing I think the most about really wanting to do after upper-secondary school. And I have also thought a lot about engineering, I also think that sounds very interesting […] Then I also thought that teaching, either in primary or secondary school, might be an alternative if I studied some physics […] Yeah, and that realtor might also be fine.

Therefore, Benji completed EV-MBC surveys for four different studies (nanoscience, engineering, teacher and realtor). At subsequent interviews, students explained about their current reflections concerning their choice of study, but they were also presented with the EV-MBC surveys they completed during the previous interview. The students then decided which studies they would fill out surveys for this time, and which they would leave out. Benji, as an example, at the second interview decided not to fill out an EV-MBC survey for becoming a teacher, but once again completed the survey for nanoscience, engineering and realtor and moreover added one for studying physics.

2. *Only students' conscious changes in educational trajectories were accounted for*. Presenting the students with their previous responses had the advantage of making students reflect on previous ideas and comment on changes in their reflections. This emphasised the continuity in their reflections. The disadvantage may be that students in order to perceive a sense of coherence could hold on to previous ideas that would otherwise have been discarded. Therefore, there is a danger of over-estimating the continuity in the students' educational reflections.

As the students completed new EV-MBC surveys, they were asked to comment on the changes. The completion of the EV-MBC surveys thus benefited from being carried out as part of an interview, giving room for qualitative elaborations and clarification, but also making students take their old responses into account. This method made students examine their own educational choice processes; it highlighted critical moments and required students to discuss underlying incidences that made them change their EV-MBC responses. It also offered an opportunity for us to probe into their persistence and changes in educational reflections.

Over the course of our study, each student considered between three and six different study programmes. Students jointly considered entering 74 different study programmes. Of these programmes, 62 were within the field of STEM. A total of 270 EV-MBC surveys were collected.

We wished to investigate the factor structure of these EV-MBC surveys to examine the construct validity of Eccles' EV-MBC model for this study's dataset and subsequently compare the found structure to our qualitative interview data. The repeated measurement design was used in the qualitative analysis. The nested structure of the data is, however, ignored in the quantitative analysis, as the individual survey responses are assumed to be independent in order to conduct factor analysis. Limitations of this approach are that single student responses could have a relatively large impact on the factor structure, and that structural changes over time are ignored.

Testing the EV-construct's internal consistency

Descriptive item statistics are presented in Appendix 2. The Kaiser–Meyer–Olkin measure verified the sampling adequacy for factor analysis (KMO >0.5) (Field, 2009).

An exploratory factor analysis of each group of items was made in SPSS (IBM, 2012) to check whether each construct was one-dimensional. Promax oblique rotation was chosen, and Kaiser's criterion (eigenvalues above 1) was used to decide the number of factors (Field, 2009).

We found that all groups of EV-items were in fact one-dimensional. The internal consistency of the three related items aimed at each of the five EV-constructs was indicated by Cronbach's Alpha (expectancies of success $\alpha = 0.603$, intrinsic value $\alpha = 0.537$, attainment value $\alpha = 0.837$, utility value $\alpha = 0.609$ and relative costs $\alpha = 0.575$). Utility value was the only scale on which dismissing one item would clearly improve the internal consistency. Removing the item related to good jobs (question 7 in Appendix 1) would improve α to 0.802. Intrinsic value, relative costs and expectancy of success however, still have relatively poor Cronbach's alpha's ($\alpha < 0.6$), which calls for some modification to the EV-structure for this data set.

Testing and modifying the theoretical EV-MBC model for the present study

The iterations made in order to modify the model are sketched in Figure 1 and will be described in detail in the following.

Testing the theoretical EV-MBC model (Figure 1(a))

The suitability of the theoretical EV-MBC model was tested using confirmatory factor analysis in SPSS-AMOS (Arbuckle, 2012) to determine whether the theoretical EV-constructs were distinguishable components in the present study.

The solution was not admissible, and Bartlett's test of sphericity χ^2 (270) was not calculated, as the covariance matrix was not positive definite. This was also reflected in poor Model Fit measures (see Appendix 3). Hence, modifications of the theoretical EV-MBC structure were required for our purposes.

Modifying the theoretical EV-MBC model quantitatively

To establish possible, relevant modifications of the theoretical EV-MBC model (Figure 1 (a)) for this study, an exploratory factor analysis was conducted in SPSS of the set of 12 items that were supposed to span the value construct for the four theoretical value

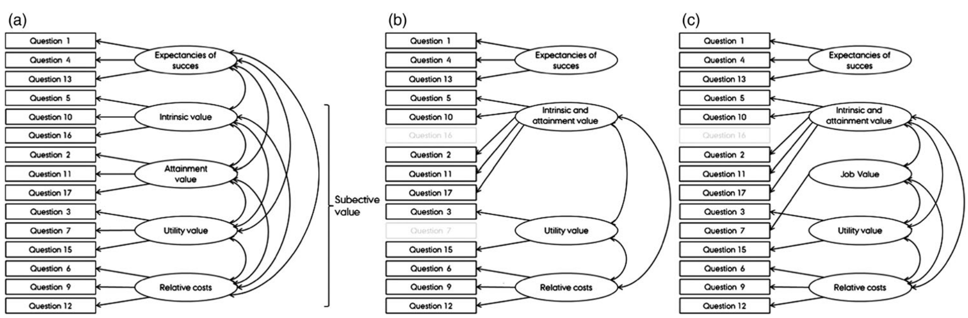

Figure 1. The iteration of the EV-MBC model to make it fit this study's data. (a) The theoretical EV-MBC model. (b) The quantitative, empirical, modified model that best fits this study's quantitative data. (c) The model that best describes this study's quantitative and qualitative data.

components. Value components and expectancies of success were not allowed to mix, based on the recommendation of Eccles and Wigfield: 'Our results concerning achievement task values argue strongly for distinguishing task values from expectancies' (Eccles & Wigfield, 1995, p. 221). A Promax rotation was used again, and Kaiser's criterion helped determine the number of factors. This resulted in the factor structure presented in Table 1, accounting for approximately 58% of the variance.

Table 1 clearly illustrates that only three factors are relevant, a fact which runs contrary to the theoretical EV-MBC model (Figure 1(a)), in which the value component is conceptualised as four constructs. It is also noteworthy that two items (questions 7 and 16) somewhat confuse the factor structure, loading considerably on two different factors (bolded loadings >0.30). Recalling that the exclusion of question 7 would enhance the consistency of the Utility scale, we concluded that removing these two items (questions 7 and 16) would improve the model. From this point, the intrinsic and attainment value components merged into one factor (also seen in other studies (Battle & Wigfield, 2003; Updegraff et al., 1996)) encompassing five items. The utility value now consisted of only two items, and the relative costs remained unchanged with three items (and compared to the other factors still a relatively poor Cronbach's alpha) as represented in Figure 1(b).

Testing the modified EV-MBC model (Figure 1b)

The quality of the modified model (Figure 1(b)) was tested using a confirmatory factor analysis in SPSS-AMOS. See loadings in Appendix 4. This time χ^2 (270) = 272,935 and thus still too big to display *p*-values >.000 (in SPSS). Additional test statistics were also moderate (see Appendix 3). Consequently, the modified model required further adjustment in order to describe our data.

Adjusting the modified EV-MBC model qualitatively

The final adjustment of the model was made by including results from the qualitative part of the study. As will become evident when we present the findings, the issue

Table 1. Pattern matrix explorative factor analysis of the task value components from the EV-MBC model (*N* = 270).

	Factors		
	Intrinsic and attainment value	Utility value	Relative costs
Question 2	**0.898**	0.019	0.005
Question 11	**0.803**	−0.031	0.095
Question 17	**0.757**	0.038	0.053
Question 5	**0.720**	−0.048	−0.053
Question 10	**0.663**	0.097	0.030
Question 15	0.082	**0.811**	−0.086
Question 3	0.170	**0.801**	−0.226
Question 12	−0.052	0.066	**0.797**
Question 6	0.166	−0.238	**0.695**
Question 9	0.025	0.101	**0.640**
Question 7	−0.**342**	**0.590**	0.275
Question 16	0.157	**0.464**	**0.310**
Eigenvalues	3.894	1.763	1.352
% of variance	32.447	14.693	11.264
Cronbach's alpha (*α*)	0.842	0.802	0.575

Note: Bolded loadings >0.30.

regarding good jobs (which question 7 addressed) was indeed a relevant issue in the students' reflections and choices. Therefore, we decided to maintain question 7 as a one-item factor 'job value' in the remaining analysis. This resulted in the model presented in Figure 1(c).

Calculating EV-components and MBC

MBC was calculated as the mean value of the two survey items addressing it (question 8 and question 14), and 'expectancy of success' was likewise calculated as the mean of questions 1, 4 and 13—See Appendix 1. The individual value components in Figure 1(c) were calculated as: 'Intrinsic and Attainment Value', the mean of questions 2, 5, 10, 11 and 17; 'Utility value', the mean of questions 3 and 15; 'Relative costs' as the mean of questions 6, 9 and 12 and finally 'Job value' was merely question 7.

For each of the students, the MBC and the five calculated EV-factors were plotted as a function of time for each of the study programmes they had completed EV-MBC surveys for. This allowed us to track the development in the MBC and EV-factors for each student in relation to each of the study programmes he or she considered entering, and to establish how the values changed (or not) over time.

Locating and analysing significant changes in the students' educational reflections

The focus of our analysis is how well the EV-MBC model can detect *changes* in students' individual motivation for pursuing particular study programmes over time. Therefore, we are interested in the cases where students expressed interest for the same study programme at two different points in times.

As mentioned, the students completed EV-MBC surveys in connection with five interviews conducted over the course of a year. At each interview the students explained about which study programmes they considered choosing as their future educational trajectory, and they decided which of these study programmes they would complete a survey for. At the following interviews the students once again decided which programmes they would complete surveys for, depending on which programmes they were considering choosing after upper-secondary school.

Consequently, a student can complete between one and five surveys concerning the same study programme, depending on whether he/she considered it as a possible choice at each of the five interviews. Likewise, the magnitude of the EV and MBC related to a particular study programme can be the same through all of the surveys, or it can change from a survey completed at one interview to the one completed during the following interview(s).

In total, the students completed 270 EV-MBC surveys. Since we focus on the *changes* in the students' individual motivation, the following analysis only concerns the 194 responses where students completed a survey for the same study programme at two (or more) subsequent interviews. In some cases, a study programme appears only twice during the interviews while others appear all five times. This means that we may be able to detect changes in the EV-MBC scores from one to four times.

For each survey, the values of EV and MBC were calculated as means for students' responses to particular questions (as described above), and the size and direction of the change from one survey to the following were quantified for the MBC and the five EV-factors, respectively.

We define *a significant change of the MBC* to be a situation in which the mean of the student's response to questions 8 and 14 changes with 1 or more from one survey to following. As the students responded to the questions on a Likert scale ranging from 1 to 7 (see Appendix 1), this equals a change of least 17%.

We defined a significant change of each of the five EV-factors to be when the mean changed with 0.5 or more from one survey to another. The reason why we consider the change of the EV-factors as significant at half the value of the MBC limit is that changes in the EV-factors could be caused by changes in more than one of the five underlying EV-factors.

Following this, we compared the changes in the student's MBC concerning a particular study programme from one point to another with the changes in the individual EV-factors concerning the same study programme. If the magnitude of the MBC and of the individual EV-factor changed in the same direction or if none of them changed, we talk of a *model confirmatory case*, because we find consistency in the motivational beliefs and in that particular EV-factor. If the values of the MBC and the particular EV-factor in question, however, change in opposite directions or if one but not the other changes, we talk about a *model non-confirmatory case*.

Qualitative triangulation

The three students with the greatest changes in MBC changed with respectively 3, 3.5 and 4 from one survey to the following. Interview data from these students were analysed in order to qualitatively evaluate the suitability of the EV-MBC model to describe these significant changes in MBC.

Findings

Significant changes in students' reflections concerning their choices of study programme

We found significant changes (defined as a change in mean MBC of at least 1) in one-third of the 194 responses in which surveys concerning the same study programme were completed at two or more subsequent interview sessions (Figure 2).

In Table 2, we show the changes in MBC related to changes in the five individual EV-factors in the model (Figure 1(c)).

The table shows the relation between changes in the MBC value and changes in each of the five EV-factors as well as the average across the five factors. For instance, the first column shows that in 95% of the cases where there were no or non-significant changes in MBC (the change being 0 or 0.5) there were no or non-significant changes in the EV-factor 'expectancies of success' either—hence confirming the model (Figure 1(c)). The column to the far right shows that in 86% of the cases where there were significant changes in the MBC, there were no or non-significant changes in the EV-factor 'expectancies of success'—which does not confirm the model, because changes in MBC were not accompanied by a change in this EV-factor.

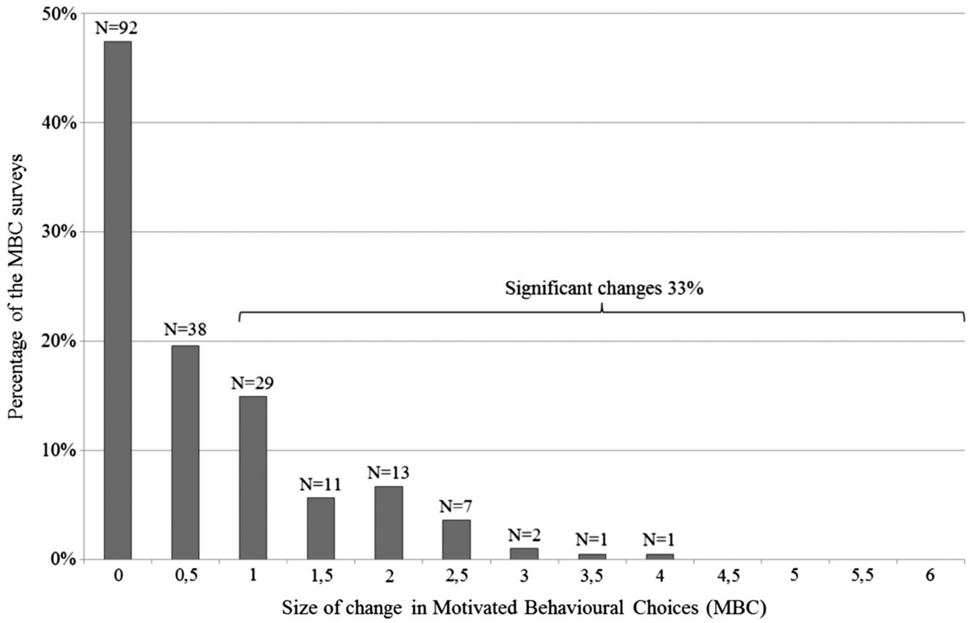

Figure 2. Distribution of changes in MBC according to the size of the changes. The *X*-axis indicates the change in the MBC value between two surveys. The numbers refer to a seven-point Likert scale. The *Y*-axis indicates how many (in percentage) of the completed surveys that changed with 0, 0.5, etc. on the Likert scale.

We find that the EV-factors from the model proposed in Figure 1(c) are very suitable for explaining the MBC when MBC remained constant. On average, 89% of the no/non-significant changes in MBC likewise had no/non-significant changes in the EV-factors, which confirms the model (first column in Table 2). However, the model failed to account for the majority of significant changes in students' MBC (last column in Table 2). In more than three out of four significant changes in MBC, the EV-factors were either changing in the opposite direction or remained constant. Our model thus failed

Table 2. Changes in MBC compared to changes in the individual EV-factors: In model confirmatory cases, MBC and the individual EV-factors in question changed in the same direction or none of them changed at all. In model non-confirmatory cases, MBC and the EV-factor in question changed in opposite directions or only one of them changed.

	No/non-significant changes in MBC ($N = 130$)		Significant changes in MBC ($N = 64$)	
Individual EV-factors	No/non-significant changes in EV-component Model confirmatory cases	Significant changes in EV-component Model non-confirmatory cases	Significant changes in EV-component Model confirmatory cases	No/non-significant changes in EV-component Model non-confirmatory cases
Changes in expectancies of success	95%	5%	14%	86%
Changes in intrinsic and attainment value	88%	12%	33%	67%
Changes in job value	87%	13%	23%	77%
Changes in utility value	83%	17%	25%	75%
Changes in relative costs	92%	8%	19%	81%
Average	89%	11%	23%	77%

to explain the significant changes in the students' educational reflections. In the following section, we will scrutinise this further by analysing the qualitative data.

Three cases of large and significant changes in students' MBC

The four largest changes in MBC (changes of −3, +4, −3.5 and +3, respectively, see Figure 2) are found among three students: Mary, Ajya and Peter.

Mary's motivation for studying physiotherapy drops three points

The results from Mary's responses concerning the study programmes she considered pursuing are presented in Figure 3. The MBC is in Figure 3(A) and the EV-factorisation is in Figure 3(B)–(F). During the first four survey responses, Mary had a consistent, high motivation to study physiotherapy (scored 7 out of 7 on the Likert scale—dark-blue dots), but in the survey response during the fifth interview, this motivation drops and a motivation to study dentistry appears (green dot).

In the interview, Mary explained her drop in motivation for pursuing physiotherapy by referring to the job value (June 2012):

> You have begun to hear that you also have to work a lot with old people [as a physiotherapist], it isn't just things like injuries […] I have started to really change what I want to study. I have begun to consider studying to be a dentist instead. I have begun to find it really interesting, or, I have always thought so, but earlier I thought it was disgusting to touch people's mouths […] But I think that when it comes to teeth, people are a bit more alike, it is different to have to work with old people as a physiotherapist than as a dentist.

However, comparing this to her survey scorings (Figure 3), the job value attributed to physiotherapy remains unchanged and does not reflect the change that Mary explained here. This will be discussed further later on.

Ajya's motivation for studying molecular biology is raised four points

Figure 4(A) shows the MBC values of Ajya's survey responses for medicine, molecular biology and biology, and the EV-factorisation is represented in Figure 4(B)–(F).

Ajya also completed EV-MBC surveys for the study programmes molecular medicine (all five times) and medical chemistry (the first four times). However, these survey completions coincided with her completions for medicine and molecular biology, and did not add new understanding. For reasons of simplicity and clarity they were therefore excluded from Figure 4.

There is a consistently high MBC for medicine (6 out of 7) in all five surveys, but the MBC for molecular biology changes significantly over the period, and biology emerges at the last interview. In the fifth interview, Ajya explains her increase in motivation for studying molecular biology in this way (June 2012):

> Medicine is the dream study, and if I don't get the grade point average to get in, I will just have to choose something else […] Then I thought that if I do not have the GPA (grade-point average from the final exam in upper-secondary school) to get into medicine, […] then what do I do? And then I started to look and look and look, just looking at something which might interest me […] And then molecular biology, there I could specialise in molecular medicine later on […] so if I can specialise in molecular medicine, then I could still be connected with hospitals, I mean just working in a lab, and that is good enough for me.

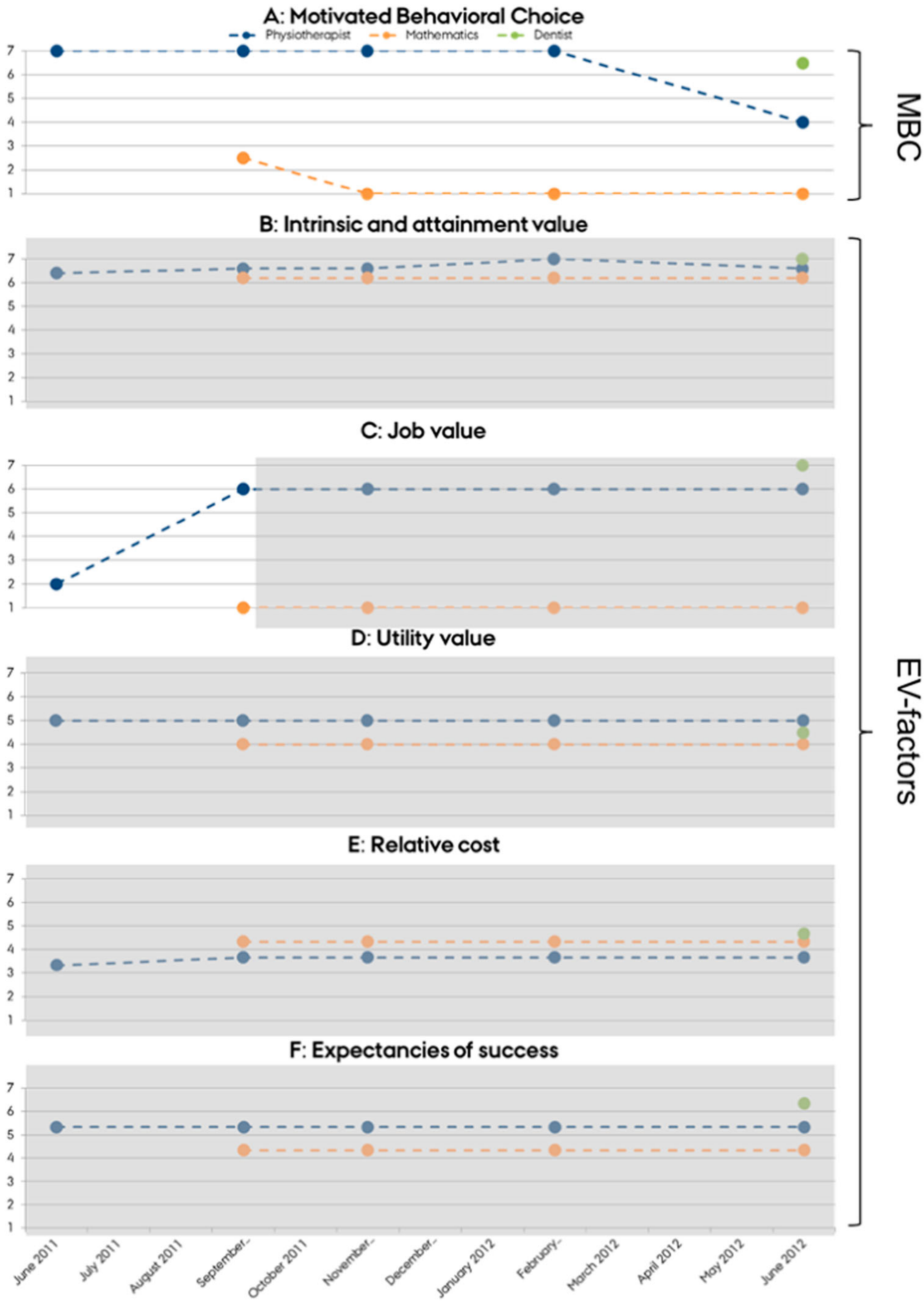

Figure 3. (Colour online) The results from the five surveys completed by Mary during her last year in upper-secondary school. (A) MBC. (B–F) The five separate EV-factors. Periods without significant change in survey responses (changes <0.5) are shaded.

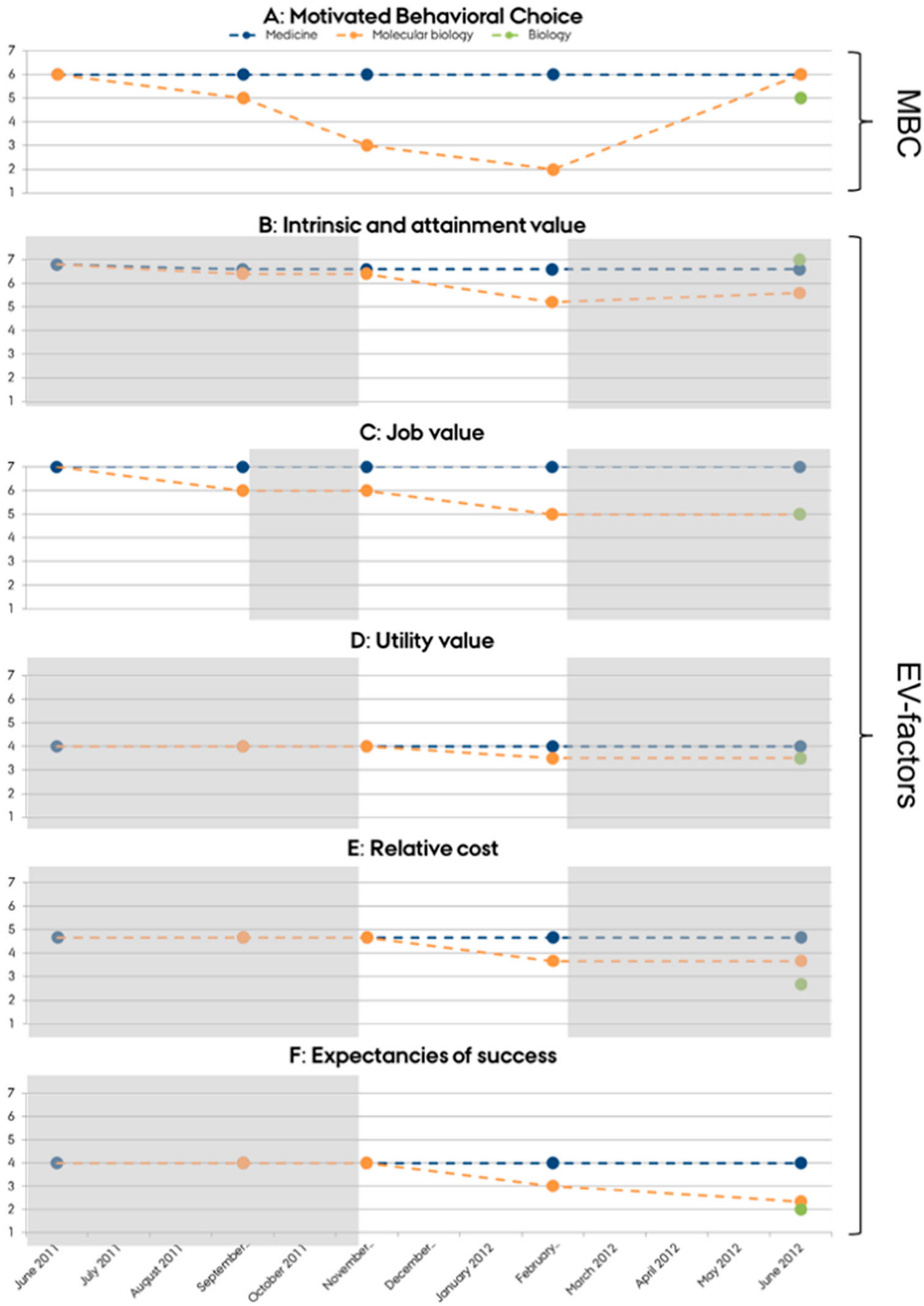

Figure 4. (Colour online) The results from the five surveys completed by Ajya during her last year in upper-secondary school. (A) MBC. (B–F) The five separate EV-factors. Periods without significant changes in survey responses (changes <0.5) are shaded.

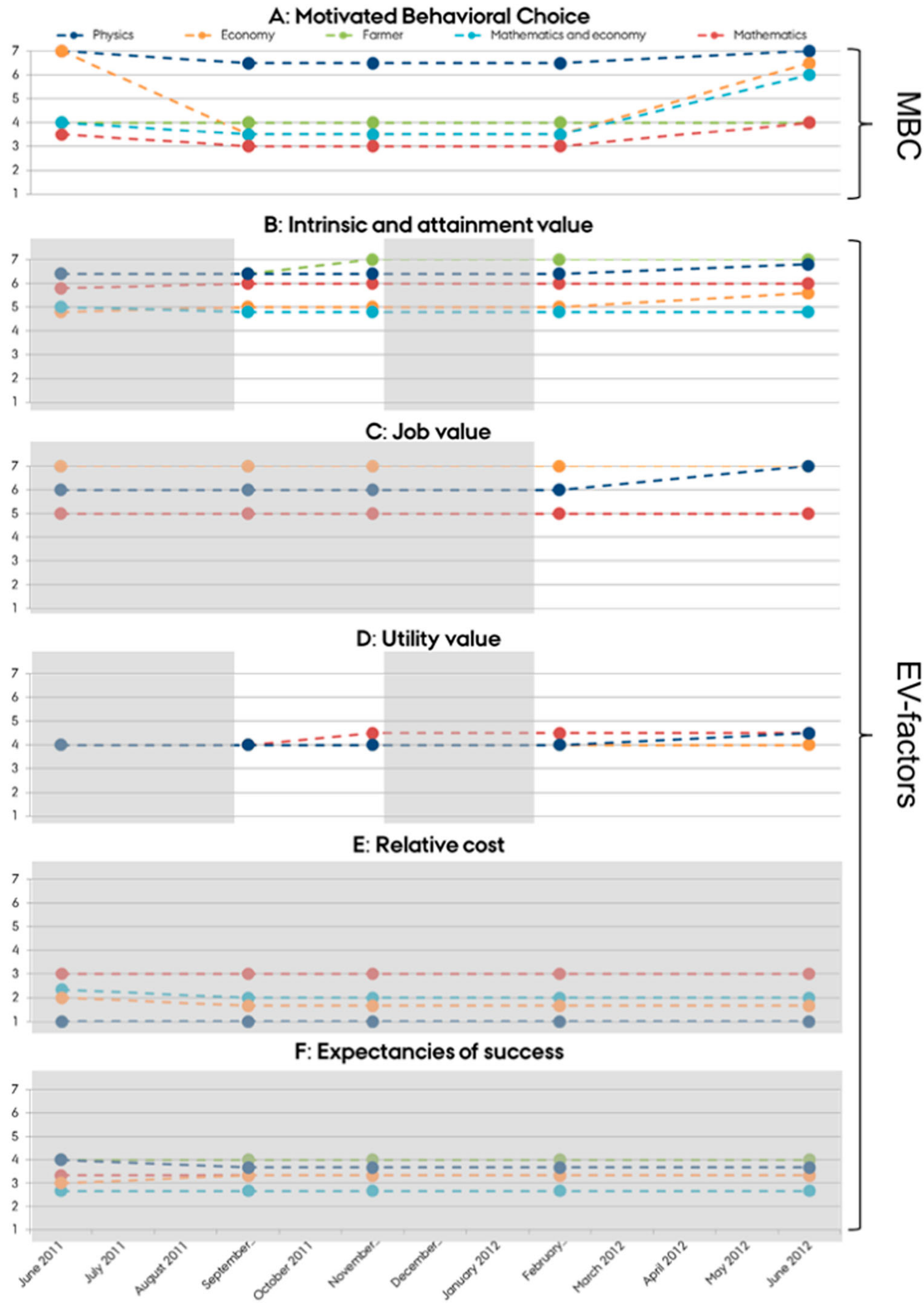

Figure 5. (Colour online) The results from the five surveys completed by Peter during his last year in upper-secondary school. (A) MBC. (B–F) The five separate EV-factors. Periods without significant changes in survey responses (changes <0.5) are shaded. In some cases the values for two different study programmes are identical, but graphically only one colour is shown although two dashed lines of different colour lead to the same dot (e.g. the red for mathematics and the green for farmer to the far right in (A).

Ajya's increase in MBC for choosing molecular biology is mainly reasoned by it being an alternative to medicine.[2] Furthermore, the rise is not accompanied by an increase in job value or utility value in Figures 4(C) and 4(D).

Peter's motivation for studying economics drops three points and is subsequently raised three and a half points

Peter's responses to the survey are presented in Figure 5(A), and the EV-factorisation of the MBC is in Figure 5(B)–(F).

Peter explains the drop in motivation for studying economics in September 2011 (second dot from the left):

> Well, [the order of the studies I am considering] has not been changed, physics has just been underlined a couple of times […] I am quite interested in economics and stocks [… but] I do not think I have the mentality to study anything other than science.

In June 2012 he reconstructs this argumentation and argues for an increased motivation for studying economics:

> What I would like to study is physics—there is no doubt about that. But the job opportunities I am beginning to think I would like to get—economics will bring me closer to them.

However, in contrast to what Peter articulates here, his job value for physics is raised in Figure 5(C) while the statement suggests that it should drop.

Discussing the structure of Eccles' EV-MBC model

In the three student cases presented in Figures 3–5, the changes in the MBC (A-figures) do not reflect changes in the EV-factors (Figures B–F).

Mary's steep drop in motivation for pursuing physiotherapy (from 7 to 4) between the two last survey points, as shown in Figure 3(A), is not reflected in Figure 3(B)–(F). Figure 3 raises questions concerning the EV-MBC model in three ways:

(1) Mary's drop in motivation for becoming a physiotherapist is based on the fact that she would rather become a dentist and thinks this job is more attractive. But this relative drop in job value for physiotherapy is not reflected in Figure 3(C), where the job value is stable.
(2) The EV-factors illustrated in Figure 3(B)–(F) furthermore fail to explain why Mary is relatively more motivated for pursuing dentistry than physiotherapy (Figure 3(A)).
(3) The steep increase in job value in Figure 3(C) for physiotherapy (from 2 to 6 from first to second survey) is not reflected in the MBC in Figure 3(A).

Likewise, the steep increase in Ajya's motivation for pursuing molecular biology (from 2 to 6) between the two last surveys, as shown in Figure 4(A), cannot be retrieved from the EV-factors in Figure 4(B)–(F). Ajya speaks in positive tone about the job possibilities linked to studying molecular biology, but an increase in job value is not evident in Figure 4(C). It is clear from the qualitative analysis that Ajya's first priority is to study medicine, but when she realised she would not get the grades to enter medicine, studying molecular biology was her second priority. However, in Figure 4(A) she indicated that her motivations for pursuing medicine and molecular biology were the same. To maintain a positive self-narrative, Ajya must have re-evaluated the attractiveness of the molecular biology study programme. The increased motivation for pursuing molecular biology as plan B is based on influences which the EV-factors in Figure 4(B–F) do not seem to capture.

Peter's two jumps in motivation for pursuing economics (−3.5 and +3) between the two first and two last survey points, shown in Figure 5(A), cannot be recovered in Figure 5(B)–(F). The quotations indicate that Peter's intrinsic value and attainment value were higher for physics than economics (which is plausible according to Figure 5(B)), but that the job value was higher for economics than for physics. The latter cannot be confirmed by Figure 5(C)—in fact, the job value for physics is increased at the last survey point, reaching the same level as economics. For Peter, as for Mary, it is obvious that the drop in MBC for one study programme is associated with an increase in MBC of another study programme that they consider entering and which gains the highest priority. However, the EV-MBC model cannot capture this.

The fact that 'job value' plays an important part in all three students' educational reflections (and is the EV-factor that is most at odds with the MBC) is most likely a sample effect.

The EV-MBC model to some extent captures intrinsic reasoning, but falls short when it comes to describing extrinsic parameters like Ajya's too low grade point average (or other students' health problems)—not least when extrinsic limitations are adopted and reinterpreted by the individual as a free choice. The EV-MBC model focusses on the students' individual free choices, and the extrinsic parameters included in the model are those that relate to the formation of the students' values and identities (e.g. the cultural milieu and the socialisers' beliefs). However, our research shows that other extrinsic elements such as institutional conditions linked to the admission system are important aspects of actual educational choices as well.

The present study uses a sample of non-typical students, which might have influenced the results since age group and development matters when it comes to the structure of the EV-factors (see e.g. Wigfield et al., 1997, p. 454)). However, the three student cases presented here question the explanatory power of the EV-structure in relation to MBC. Reviewing other studies dealing with the structure of the EV-MBC model in general, and the subjective value components in particular, it becomes clear that the theoretical structure is often not reproduced empirically. For instance, Wigfield and Eccles (1992) did not find relative costs and expectancies of success to be separate factors of the MBC, and Eccles and Wigfield (1995) only found the EV-factors (except for the relative costs) as separate factors by forcing expectancies of success and the value components to not correlate. Further analytical restriction was made when Wigfield et al. (1997) decided to use the theoretical structure even though 'task values did not always factor into separate usefulness-importance and interest factors' (footnote, p. 454). Empirically, all EV-factors thus sometimes mix if no theoretical constraints are made. This questions how important the factor division is in the theoretical EV-MBC model.

In this study, the intrinsic value and the attainment value merged, illustrating how students do not distinguish what they find interesting and what is important for their self-perception in their ongoing educational choice processes. Battle and Wigfield argue that 'the separation of enjoyment (intrinsic value) from personal salience (attainment value) may be more difficult when the task in question is separated by years from matters of more immediate concern in participants' lives' (Battle & Wigfield, 2003, p. 68), which questions the universality of the EV-MBC model's factor structure.

In our study, the job value ended up being a one-item factor (which is methodologically questionable, but empirically validated by all three case students and several of the other participants). Looking back at the original utility value items, it is not surprising that the job value separates from 'everyday' utility value. Battle and Wigfield also find that 'items that addressed more specific utility concerns, e.g., the value of making more money, meeting other successful people, providing better job opportunities, etc.' (Battle & Wigfield, 2003, p. 69) did not load on the utility value. Again, they argue that this could be due to the long-term nature of the educational choice process and thus implicitly challenge the EV-MBC model's factor structure for purposes of studying changes over time. Table 2 illustrates that the EV-MBC model seemed able to capture students' preferences in situations with little change in educational preferences over time, but it failed to explain significant changes in choice situations that were less stable. This is a serious shortcoming when educational choices are assumed to be constructed continuously and often with dynamic shifts between several different considerations concerning the educational trajectory.

Conclusions

This study explored how well Eccles' acknowledged EV-MBC model captures changes in students' reflections and preferences concerning which tertiary programme to choose after upper-secondary school. This was done by having a group of 15 students completed EV-MBC surveys five times during one year. Further, we used qualitative interviews in addition to quantitative surveys. The findings underline that surveys and qualitative interviews capture quite different and sometimes even conflicting results. This questions the validity of the often-used EV-MBC model.

We found that the EV-MBC model succeeds in capturing students' reflections in stable choice situations, but it fails to capture significant changes in educational choices over time. The dynamic process in which students consider several different possible study programmes to enter, and hence various potential educational trajectories, seems to be too complex to be captured by quantitative analysis of the EV-MBC model's factors alone. The EV-factors do not seem to explain changes in MBC sufficiently. One reason is that extrinsic factors such as health or grade point average requirements are not accounted for in the model.

The factor structure of students' MBC is problematised as well. The division between the individual subjective value components is called into question. In the case of long-term choices, students do not distinguish between the individual subjective value components as the EV-MBC model presumes.

When the survey results were compared to the qualitative interviews, we often found that students talked about reflections that ran contrary to the results of the survey. Furthermore, the EV-factors of the three case students were fairly stable unlike the MBC and the qualitative reflections. One obvious explanation for this could be that for the students, the MBC is more than the sum of the EV-factors.

Although the EV-MBC model in many studies has proven valuable for capturing students' choices of higher education, we have shown that there are important aspects that need to be considered further and in relation to which the model needs to be supplemented by, for instance, qualitative data related to; the model's feedback loop; its ability to capture changes over time or the complexity of students' choice processes.

As such, the present study not only raises the question of what the EV-MBC can inform us about and what it cannot, but also a more general concern about what insights are offered by quantitative and qualitative methods, respectively. Common concerns when it comes to qualitative studies are that they usually have small samples and that the studies are difficult to reproduce because the interpretation of the data, it is claimed, appears to be affected by researcher subjectivity.

However, the present analysis reveals similar concerns to be raised about quantitative approaches. In order to manage large samples, the quantitative approach needs to standardise the questions in isolated items and it needs to isolate parameters in order to perform statistical analysis. However, it seems that these two approaches may reduce the validity of the overall conclusions. The fundamental problem is that in order to make the data suitable for quantitative analysis, the researcher separates different elements that the qualitative analyses find to be closely interwoven. In brief, in order to analyse a phenomenon, the quantitative approach changes the very phenomenon it aims at studying.

This has implications for the production as well as the interpretation of data. In the data production, the students are required to respond to questions addressing different elements in isolation from each other. If the elements in the students' perspectives are related to each other in a web where reflections and decisions concerning one element are inevitably linked and balanced with the other elements, then their replies to each item in isolation may be truthful enough, but the replies will not reflect the way that the items are present in the students' reflections. This could be the reason why the individual EV items do not reflect the students' educational reflections (MBC).

In the data analysis, it may be that the results are valid from a statistical point of view, but if they fail to take the interactions in the 'web of concerns' into account, then the validity of the conclusions related to the students' choice processes and eventual decisions are less convincing.

We are not making the point that quantitative studies of students' attitudes and choice processes should necessarily be discarded altogether. The point we wish to make is that quantitative methods, even though they appear to be valid and controllable, in fact have difficulties in offering insights into the more complex processes that are usually at stake when we explore individual students' experiences, their attitudes and decisions. There is a risk that the quantitative approach in its eagerness to provide a clear and statistically valid result, at the end of the day, obscures the very phenomenon it seeks to unveil.

Notes

1. With the expression 'educational trajectory', we refer to the possible paths that students consider following after upper-secondary school. The trajectory involves applying for and entering a study programme and the reflections and considerations of the students about their educational trajectory deal with the pros and cons, the possibilities and consequences following a trajectory into a programme, and often comparisons to following the trajectory into another programme.
2. In Denmark, admission to higher education is offered based on the students' grade-point average from upper-secondary school. If there are more applicants than study places offered, the students with the highest GPAs will be offered admission.

3. The item directs utility in the original model (Figure 1(a)), and in the modified model (Figure 1(c)) it is used as 'job value'.

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Appendix 1. Expectancy-Value and behavioural educational choice survey

Three items directing each of the expectancies of success (Expectancy), the intrinsic value (Intrinsic), the attainment value (Attainment), the utility values (Utility), and the perceived relative costs (Costs) constructs and two items directing the MBC construct.

Statements supposed to influence the MBC negatively are marked (R), because the scores were later reversed.

Your own specific study programme of interest:	Strongly disagree			Neither agree nor disagree		Strongly agree		This question addresses:
1. I imagine that I will do better in this study programme than in most other studies.	❑	❑	❑	❑	❑	❑	❑	Expectancy
2. In comparison with other things in my life, it is very important for me to do well in this study programme	❑	❑	❑	❑	❑	❑	❑	Attainment
3. I expect that what I will learn if I choose this study programme will also be beneficial in my everyday life	❑	❑	❑	❑	❑	❑	❑	Utility
4. I imagine that I will have problems learning what I have to in this study programme	❑	❑	❑	❑	❑	❑	❑	Expectancy (R)
5. I expect to thrive in this study programme	❑	❑	❑	❑	❑	❑	❑	Intrinsic
6. I imagine that if I choose this study programme, I will have less time for family, friends, boyfriend/girlfriend and leisure activities than if I had chosen another study programme	❑	❑	❑	❑	❑	❑	❑	Cost (R)
7. I expect this study programme to lead to many good jobs	❑	❑	❑	❑	❑	❑	❑	Utility[3]
8. It is highly probable that I will end up taking this study programme	❑	❑	❑	❑	❑	❑	❑	MBC
9. If I choose this study programme I expect that it will require more work than many other studies	❑	❑	❑	❑	❑	❑	❑	Cost (R)
10. I imagine that it will be interesting to take this study programme	❑	❑	❑	❑	❑	❑	❑	Intrinsic
11. It means a lot to me to be good at studying during this study programme	❑	❑	❑	❑	❑	❑	❑	Attainment
12. If I choose this study programme I expect my financial situation to be worse than if I had chosen another study	❑	❑	❑	❑	❑	❑	❑	Cost (R)
13. If I choose to start this study programme, I expect to do better than most of my fellow students	❑	❑	❑	❑	❑	❑	❑	Expectancy
14. I am highly motivated to take this study programme	❑	❑	❑	❑	❑	❑	❑	MBC
15. I imagine that what you learn during this study programme is less usable in your everyday life than what you learn during many other studies	❑	❑	❑	❑	❑	❑	❑	Utility (R)
16. I expect it to be more meaningful and relevant to take this study programme than many other studies	❑	❑	❑	❑	❑	❑	❑	Intrinsic
17. It means a lot to me to have completed this study programme	❑	❑	❑	❑	❑	❑	❑	Attainment

Appendix 2. Descriptive statistics mean values, standard deviations and a correlation matrix

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	Item 13	Item 14	Item 15	Item 16	Item 17
Mean value	5.03	5.08	5.91	5.56	5.97	5.33	5.63	3.88	5.36	5.93	5.49	5.30	3.52	4.77	5.83	4.85	5.45
Standard deviation	1.36	1.26	1.20	0.83	1.04	1.02	1.49	1.91	0.96	1.02	1.29	1.14	1.35	1.76	1.14	1.31	1.40
Correlation matrix																	
Item 1	1.00	0.47	0.20	0.31	0.53	0.21	−0.15	0.29	−0.07	0.46	0.47	0.20	0.41	0.29	0.12	0.21	0.37
Item 2	0.47	1.00	0.32	0.31	0.43	0.16	−0.05	0.37	0.08	0.54	0.68	0.10	0.38	0.51	0.30	0.34	0.48
Item 3	0.20	0.32	1.00	0.01	0.25	−0.03	0.17	0.07	0.10	0.32	0.38	−0.02	0.00	0.18	0.68	0.33	0.33
Item 4	0.31	0.31	0.01	1.00	0.22	0.15	−0.27	0.01	0.16	0.15	0.20	0.24	0.25	0.11	−0.04	0.24	0.12
Item 5	0.53	0.43	0.25	0.22	1.00	−0.02	−0.09	0.23	0.10	0.34	0.53	0.07	0.37	0.34	0.30	0.16	0.44
Item 6	0.21	0.16	−0.03	0.15	−0.02	1.00	0.06	−0.03	0.21	0.07	0.11	0.37	−0.15	0.04	0.03	0.09	0.10
Item 7	−0.15	−0.05	0.17	−0.27	−0.09	0.06	1.00	0.22	0.19	0.08	0.01	0.21	−0.29	0.26	0.20	0.18	0.08
Item 8	0.29	0.37	0.07	0.01	0.23	−0.03	0.22	1.00	−0.05	0.48	0.38	−0.05	0.23	0.67	−0.04	0.29	0.39
Item 9	−0.07	0.08	0.10	0.16	0.10	0.21	0.19	−0.05	1.00	0.10	0.12	0.35	−0.24	0.07	0.12	0.23	0.19
Item 10	0.46	0.54	0.32	0.15	0.34	0.07	0.08	0.48	0.10	1.00	0.56	0.00	0.23	0.63	0.21	0.36	0.42
Item 11	0.47	0.68	0.38	0.20	0.53	0.11	0.01	0.38	0.12	0.56	1.00	0.03	0.33	0.45	0.33	0.25	0.77
Item 12	0.20	0.10	−0.02	0.24	0.07	0.37	0.21	−0.05	0.35	0.00	0.03	1.00	−0.07	0.07	0.13	0.30	0.02
Item 13	0.41	0.38	0.00	0.25	0.37	−0.15	−0.29	0.23	−0.24	0.23	0.33	−0.07	1.00	0.18	0.04	0.14	0.19
Item 14	0.29	0.51	0.18	0.11	0.34	0.04	0.26	0.67	0.07	0.63	0.45	0.07	0.18	1.00	0.10	0.43	0.35
Item 15	0.12	0.30	0.68	−0.04	0.30	0.03	0.20	−0.04	0.12	0.21	0.33	0.13	0.04	0.10	1.00	0.33	0.26
Item 16	0.21	0.34	0.33	0.24	0.16	0.09	0.18	0.29	0.23	0.36	0.25	0.30	0.14	0.43	0.33	1.00	0.25
Item 17	0.37	0.48	0.33	0.12	0.44	0.10	0.08	0.39	0.19	0.42	0.77	0.02	0.19	0.35	0.26	0.25	1.00

Appendix 3. Test statistics of the different models

Models	χ^2 (270)	p-value	TLI	CFI	RMSEA
Figure 1(a)	Not calculated	–	0.718	0.785	0.12
Figure 1(b)	272,935	<.000	0.769	0.825	0.119

Appendix 4. Confirmatory factor analysis testing the modified EV-MBC model