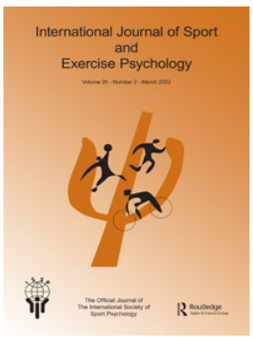

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Study-to-sports spillover among competitive athletes: a field study

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ABSTRACT

Combining academics and athletics is challenging but important for the psychological and psychosocial development of those involved. However, little is known about how experiences in academics spill over and relate to athletics. Drawing on the enrichment mechanisms proposed by the Work-Home Resources model, we posit that study crafting behaviours are positively related to volatile personal resources, which, in turn, are related to higher athletic achievement. Via structural equation modelling, we examine a path model among 243 student-athletes, incorporating study crafting behaviours and personal resources (i.e., positive affect and study engagement), and self- and coach-rated athletic achievement measured two weeks later. Results show that optimising the academic environment by crafting challenging study demands relates positively to positive affect and study engagement. In turn, positive affect related positively to self-rated athletic achievement, whereas – unexpectedly – study engagement related negatively to coach-rated athletic achievement. Optimising the academic environment through cognitive crafting and crafting social study resources did not relate to athletic outcomes. We discuss how these findings offer new insights into the interplay between academics and athletics.

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Athletic achievement; spillover; student-athletes; study crafting; work-home resources model

Student-athletes are active in two central life domains – academics and athletics. They spend a considerable amount of time in each domain and form identities in the academics as well as the athletics domain (Van Rens et al., 2019) and their experiences may spill over from one life domain to the other (e.g., Staines, 1980). Spillover occurs when demands or resources in one domain hinder or facilitate one's functioning in the other domain (Ten Brummelhuis & Bakker, 2012). When experiences in one domain are negatively related to experiences in the other domain, this is called negative spillover or interference. Such interference can occur in both directions: Athletics-to-academics interference

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occurs, for example, when a person misses classes and fails on a study exam because of time spent on a sports training camp. In the opposite direction, academics-to-athletics interference would occur when a student-athlete must attend a mandatory lab class and therefore misses sport practice and is consequently excluded from the team line-up for a subsequent competition. In contrast, when one life domain influences the other in a positive way, this is called positive spillover or enrichment. Again, enrichment can go from the athletic to the academic domain or from the academic to the athletic domain. An example of athletics-to-academics enrichment is when a supportive coaching style of the trainer during morning practice enhances a student-athlete's positive mood, which he carries with him into that day's classes, helping him to focus on the lecture. Finally, enrichment from academics to athletics occurs, for example, when receiving positive feedback from a teacher boosts a student-athlete's confidence and gives her the energy she needs to beat her opponent during a sports competition. In this last case of academics-to-athletics enrichment, the academic environment provides academic resources that facilitate student-athletes' functioning in the athletic domain (cf., Stambulova et al., 2020).

In the current study among student-athletes, we focus on enrichment from the academic to the athletic life domain. It is important to note that research has shown that combining education and high-level sports can be overwhelming and challenging (e.g., Pink et al., 2018; Wylleman et al., 2004), as an effective combination requires that student-athletes meet attendance and performance requirements in both the academics and athletics environment. Other research, however, has suggested that combining academics and athletics provides many benefits on the longer term. For example, it helps athletes develop multiple personal identities and facilitates a smoother transition into sports retirement (e.g., Torregrosa et al., 2015). We aim to extend the current literature by investigating potential benefits of combining study and sports, focusing on more short-term enrichment processes. It is likely, for example, that student-athletes develop other skills that may be essential and beneficial on the shorter-term as well, such as time management or the ability to prioritise.

A general theoretical basis for understanding spillover between life domains is presented by the Work-Home Resources (W-HR) model (Ten Brummelhuis & Bakker, 2012), which differentiates between antecedents, mechanisms, and outcomes of enrichment and interference. We aim to contribute to the literature by extending the W-HR model to the academics–athletics interface, adopting an enrichment perspective. The combination of academics and athletics is important, as most talented athletes have little chance on a future as a full-time professional athlete. Yet, very little is known about the occurrence and mechanisms of positive study-to-sports spillover among student-athletes. It would thus be highly relevant to identify whether and how these athletes might use their dual-career status to their benefit. In the current study, we therefore examine specific antecedents (i.e., study crafting behaviours) and mechanisms (i.e., positive affect and study engagement) of positive academics–athletics spillover. Specifically, we investigate crafting behaviour as an important aspect in the enrichment process. Thus, in our current enrichment perspective, we focus on student-athletes as active agents who can shape their own environment and mobilise their own resources (cf. Hirschi et al., 2019). By examining this study-sports enrichment process, we aim to enhance current understanding of the possible benefits of combining academics and athletics

and identify avenues for helping student-athletes make the best of this challenging situation.

In addition, we present a relatively rigorous approach to the study of cross-domain spillover, by collecting separate measures of experiences in the two domains, and assessing spillover in terms of the statistical connection between those experiences. In this approach, enrichment is implied when experiences in the study domain relate positively to experiences in the sports domain (cf. Du et al., 2018). Most previous studies used evaluative spillover measures, asking participants to reflect on the spillover process (e.g., "Do you feel that, because of your sports, your study engagement is suffering a decline?"; Brustio et al., 2020, p. 181). This approach requires that individuals evaluate their behaviour, thoughts, and feelings in both domains, as well as the extent to which the two are connected, which is a complex cognitive task. Moreover, this method potentially increases common-method bias (Podsakoff et al., 2003). By adopting the separate-measures approach, we aim to also contribute to the development and advancement of spillover research methodology.

The road to enrichment

In the W-HR model, Ten Brummelhuis and Bakker (2012) use a demands and resources perspective to detail mechanisms that trigger both positive and negative spillover processes. For example, a depleting spillover process can occur when study demands (e.g., too many or too difficult tasks) drain personal resources (e.g., energy), limiting the potential for high performance in the athletic domain. An enriching work-home process, on the other hand, can occur when contextual resources (e.g., positive feedback from a fellow student) in one domain facilitate outcomes and functioning in another domain (e.g., better execution of technique), through gains in personal resources (e.g., confidence). As the key mechanism for the occurrence of enrichment, the W-HR model (Ten Brummelhuis & Bakker, 2012) thus highlights the role of personal resources; personal resources – either domain-specific such as self-efficacy, or general such as positive affect – function as the linking mechanism between two domains.

Specifically, enrichment may occur when a person's actions or experiences (i.e., antecedents) in a specific domain enable them to enhance their personal resources such as specific knowledge, skills, positive affect, or energy (i.e., personal resource accumulation). These personal resources, in turn, will stay with the person and can boost their experiences and outcomes in the other domain. To illustrate, a study among cyclists showed that passion about cycling (i.e., a domain-specific antecedent) was positively related to life satisfaction (i.e., personal resource), which, in turn, facilitated work performance and innovativeness (i.e., outcomes; Clohessy et al., 2020).

Antecedents in the study domain include, for example, social support (e.g., from a professor or classmate) or opportunities for learning and development (e.g., organising a student event). These aspects contribute to an individual's personal resources by enhancing positive psychological states, such as energy, self-efficacy, or positive affect. Positive psychological experiences can be conceived as personal resources that are bound to the individual rather than to a specific domain; they can be carried into other life domains as the individual moves across domains (Hirschi et al., 2019; Ten Brummelhuis & Bakker, 2012). Enhanced personal resources can

then trigger outcomes in the other domain, for example, achievement outcomes such as productivity, efficiency, or effectivity.

In the current study, we focus on domain-general positive affect and more domain-specific study engagement as central personal resources that link the academic and athletic domains. Positive affect can be defined as a general positive mental state that reflects enthusiasm and activation (Watson et al., 1988) and is not restricted to specific events or objects (Weiss & Cropanzano, 1996). Study engagement is a positive, affective study-related state that consists of vigour (i.e., feeling energetic), dedication (i.e., feeling enthusiastic about study-related tasks), and absorption (i.e., feeling concentrated when performing study-related tasks; Schaufeli et al., 2002). Previous research – usually conducted in one specific life domain, e.g., only in athletics, or only in academics – has shown that positive affect and engagement are important personal resources that facilitate performance (e.g., Borst et al., 2020; Lyubomirsky et al., 2005).

Crafting as a strategy to acquire personal resources

An important antecedent of the accumulation of personal resources (i.e., positive affect and study engagement) is crafting. Individuals may engage in crafting behaviours in any domain (e.g., study, leisure; De Bloom et al., 2020), but the concept of crafting originates from research among individuals in work organisations, where *job crafting* refers to employee behaviour aimed at creating an optimal fit between an individual's skills, needs, and abilities and the work environment (Tims et al., 2016). Job crafting is aimed at changing tasks and relationships at work, physically or cognitively, to create purposefulness (Wrzesniewski & Dutton, 2001). For example, a janitor working at a university may cognitively change the meaning of his job by realising that hygienic university buildings provide many human beings with an optimal study environment and thus opportunities for a brighter future. Researchers have found that job crafting is positively related to various volatile personal resources, including positive affect (Van den Heuvel et al., 2015) and work engagement (Oprea et al., 2019).

Applying the knowledge about job crafting to the study domain, we define study crafting as behaviour that refers to shaping the study environment to create a better fit between a student's skills, needs, and abilities and the study environment, and create a feeling of purposefulness. Just like job crafting may target different aspects of work life (Zhang & Parker, 2019), study crafting may target different aspects of academic life. In the current study, we focus on cognitive study crafting, crafting social study resources, and increasing challenging study demands, as these strategies seem most relevant for student-athletes. Cognitive crafting (Wrzesniewski & Dutton, 2001) occurs when students change the way in which they think about their education to enhance the meaning of studying. For instance, a medical student might create a sense of purpose by focusing on how he might be able to save lives in the future during studying for an exam. Crafting social resources (Tims et al., 2012) refers to changing social aspects and actively seeking social interactions. A student, for example, could ask feedback from a professor or take the initiative to collaborate with other students. Lastly, increasing challenging demands (Tims et al., 2012) refers to changing tasks or activities such that they stimulate growth and development. For example, students could seek extra-curricular activities or read additional literature about topics discussed in class.

Although research on crafting cognitions and behaviours in a study context is largely lacking, De Bloom et al. (2020) propose that this type of crafting behaviour can be expected to have similar positive outcomes in the study domain as in the work domain. We argue that study crafting enables students to create an optimal academic environment that matches their needs, skills, and interests, thereby allowing them to accumulate personal resources. Furthermore, students who seek study resources and challenges have a positive end-state or certain goal in mind (Zhang & Parker, 2019). Anticipation of positive end-states (e.g., feedback from a professor, support from a fellow student) that accompany crafting behaviours boosts motivation and energy levels (Lichtenthaler & Fischbach, 2019), resulting in higher levels of positive affect and study engagement. Thus, we argue that students who change their academic environment experience higher levels of positive affect and study engagement.

Hypothesis 1: Study crafting is positively related to (a) positive affect and (b) study engagement.

How resources acquired in the academic domain relate to athletic achievement

The enhanced levels of positive affect and study engagement that result from study crafting can then act as the linking mechanism in the academics–athletics enrichment process (Ten Brummelhuis & Bakker, 2012). Thus, positive affect and study engagement act as boundary-spanning resources that aid the accomplishment of both academic and athletic goals (Hirschi et al., 2019). The importance of these resources has been shown by previous studies in the spillover literature (for a meta-analysis, see Lapierre et al., 2018). Positive affect and engagement can be taken from the academic domain and transferred to the athletics domain, with positive implications for athletic achievement. Student-athletes who have accumulated personal resources in the academic domain via study crafting, then carry these personal resources into the athletic domain when starting their sports training. The enhanced levels of positive affect and study engagement can now release energy and widen athletes' capacity to see and seek opportunities, thereby facilitating their training performance.

Positive affect reflects an affective personal resource (Greenhaus & Powell, 2006) that is context-free and helps to reach goals, as positive affect broaden one's scope of attention, cognition, and actions (Fredrickson & Branigan, 2005). This broadened, context-free positive state of mind may cross domain boundaries (Edwards & Rothbard, 2000). For example, research among PhD students shows that positive affect in the home domain relates to higher goal attainment at work (Du, 2018). Moreover, positive mood is positively related to the perception that work improves the quality of private life (and vice versa; Kempen et al., 2019).

Whereas positive affect is context-free and reflects an affective pathway to enrichment; study engagement is contextualised and may enrich the athletic domain through affective, behavioural, as well as cognitive pathways. Suggested by Greenhaus and Powell (2006), when the resource is affective, positive mood that is experienced in one domain is transferred to the other domain. For a behavioural resource, skills developed in one domain can also be used in the other domain. Finally, cognitive resources refer to values and positive thoughts in one domain that may be transferred to and capitalised

upon in the other domain. Individuals who are highly engaged, simultaneously experience physical, emotional, and cognitive resources, and may be able to invest these resources more effectively in a subsequent domain (cf. Eldor et al., 2020). Indeed, research shows that work engagement is positively related to life satisfaction and involvement in the community (Eldor et al., 2020) and increases time investment in personal relationships at home (Bakker et al., 2012). In the present study, we argue that *study* engagement enriches athletics because the simultaneous experience of physical, emotional, and cognitive resources is a fertile starting point for each training. Highly engaged students are enthusiastic and full of energy which can be invested in their training session. Taken together, we argue that positive affect and study engagement may act as boundary-spanning resources and enrich the athletic domain.

Hypothesis 2: (a) Positive affect and (b) study engagement are positively related to athletic training performance.

Together, Hypotheses 1 and 2 form an academics–athletics spillover model (see Figure 1).

The indirect relation between study crafting and athletic achievement

We argue that study crafting is a resource-generator in the academics–athletics enrichment process. Through study crafting, student-athletes can boost their positive affect and study engagement. Students may fill up their "resource reservoir" with these positive feelings and carry this positive mindset into the athletics domain. These personal resources can then be used when needed and connect the academic domain with the athletic domain, facilitating athletic experiences and outcomes, which results in higher athletic training achievement. Research on the enrichment process separating antecedents, mechanisms, and outcomes regarding the academics–athletics interface is missing, but similar mechanisms have been investigated and supported in the realm of

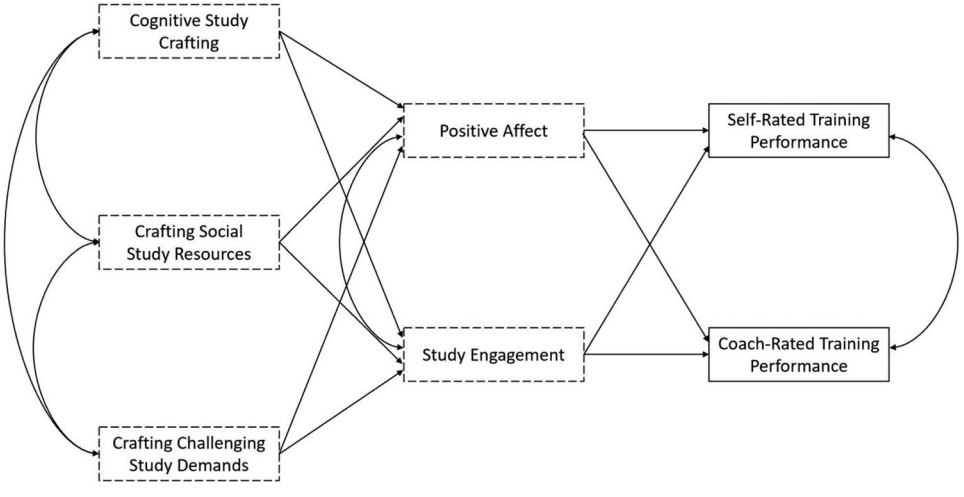

Figure 1. The hypothesised study-sports spillover model. Note: Dashed squares indicate observed variables based on factor scores.

work-sports enrichment. For example, Postema et al. (2021) found that individuals who craft their job more (i.e., antecedent), experience more work engagement (i.e., mechanism), and, consequently, are better able to regulate their running pace (i.e., outcome).

We thus argue an indirect relation between behaviour in the academic domain and outcomes in the athletic domain. Specifically, student-athletes may proactively engage in study crafting behaviours to experience more positive affect and study engagement. In turn, these states positively relate to athletic training performance.

Hypothesis 3: Study crafting is indirectly positively related to athletic training performance, via (a) positive affect and (b) study engagement.

Method

Participants and procedure

We developed and conducted this study in accordance with our university's ethics guidelines and recruited athletes through universities, sports clubs, and personal networks. Athletes could participate in the research if they were enrolled at a university and competed (inter)nationally in their sports. Specifically, we recruited athletes competing in, at least, national competitions. We required athletes to be active in both domains (i.e., no school holiday or rest week). Eligible participants the informed consent form and were then directed to an online survey. This first survey included items about study crafting, positive affect, and study engagement. Two weeks later, athletes received a second survey, which included items about training performance[1] only.

Each athlete's primary coach was also asked to fill out a survey at the same time as their athlete, which included athlete performance ratings. Coaches were invited either directly by the researchers or indirectly via their athletes. Coaches received an email with a link to the online survey. We ensured athlete and coach survey matched and dates on which athlete and coach completed the surveys were no more than three days apart. To reduce common method bias (Podsakoff et al., 2003), we used a two-week time lag to temporally separate our measurement of key variables (antecedents and mechanisms at the beginning, performance ratings two weeks later) and collected other-ratings of training performance. Furthermore, we used the two-week time lag to ensure survey questions referred to a different time period. We also aimed to ensure that possible effects of antecedents and mechanisms could develop but were still proximate enough to make statements about relationships with outcomes.

In total, 272 athletes participated in the study. To be included in the final sample, participants had to complete the first survey, at least, and meet the inclusion criteria. Based on these criteria we excluded 29 athletes (10.7%). The mean age of the participants in the final sample (89.3%, $n = 243$, 139 female, 94 male) was 21.3 years (SD = 2.6). Of all participants, 22.6% were in the first year of their study programme, 19.3% in their second year, 20.2% in their third year, and 18.1% in their fourth year. The remaining participants were doing a master's degree (11.1%), something not specified in the answer categories (e.g., sixth year; 4.5%), or had missing values on this question (4.1%).

Participants were active in a range of different sports, including tennis (14.0%), gymnastics (10.6%), track and field (8.6%), hockey (7.4%), golf (7.0%), soccer (5.8%), volleyball (4.9%), but also handball, cheerleading, swimming, rowing, basketball, and baseball. Most

of the participants (65.8%) had more than 10 years of experience in their sports; 39 athletes (16.0%) had seven to nine years of experience. Regarding training hours per week, participants provided a wide range of answers: 1–4 hours (4.5%), 5–8 hours (14.8%), 9–12 hours (25.5%), 13–16 hours (23.5%), 17–20 hours (17.3%), and 21 hours or more (10.3%). Approximately 80% of the athletes competed in the United States of America, predominantly in Division 1 (i.e., the highest level of intercollegiate athletics in the US), but also in Division 2, Division 3, and the National Association of Intercollegiate Athletics (NAIA). The remaining group of athletes reported to compete in another category (e.g., world level).

Measures

All surveys were distributed in English. The first student-athlete survey included all measures as described below and asked about their experiences in the previous two weeks, while the second student-athlete survey, administered two weeks later, included only the performance measure and referred to the student-athletes' experiences in the two weeks since the first survey. Unless indicated otherwise, items were answered on a 7-point Likert scale ranging from 1 (*strongly disagree)* to 7 (*strongly agree)*. Given the sample size-to-parameters ratio (Kline, 2011), we calculated the (higher-order) measurement model of study crafting, positive affect, and study engagement in Step 1. In Step 2, we performed a path analyses based on the factor scores from Step 1, rather than run a comprehensive structural equation model.

Study crafting

We included three types of study crafting: cognitive crafting, crafting social study resources, and increasing challenging study demands. All items were adjusted to fit the study context and the two-week timeframe that we adopted in the current study. The 5-item cognitive crafting measure was based on the cognitive crafting subscale from the Job Crafting Questionnaire (Slemp & Vella-Brodrick, 2013; e.g., "In the past two weeks, I thought about how my studies give my life purpose"). Cronbach's alpha for this scale was .71, omega[2] was .69. Our measures of crafting social resources and increasing challenging demands (each 5 items) were both based on the respective subscales of the Job Crafting Scale (Tims et al., 2012). Example items are "In the past two weeks, I took the initiative to ask fellow students for advice" (social crafting; $\alpha = .80$, $\omega = .78$) and "In the past two weeks, I took the initiative to seek out activities that could enhance my academic performance" (increasing challenging demands; $\alpha = .75$, $\omega = .75$).

Positive affect

We measured positive affect with the 10-item positive affect subscale from the Positive and Negative Affect Schedule (Watson et al., 1988). Based on previous research (Tuccitto et al., 2010; Zevon & Tellegen, 1982), we distinguished between three separate dimensions To represent positive affect as an overall concept (e.g., Hogue, 2020; Maher et al., 2021), we fitted a higher-order factor model based on the three underlying dimensions: attentive ("In the past two weeks, I felt attentive/alert"; $\alpha = .71$, $\omega = .71$), excited ("In the past two weeks, I felt enthusiastic/excited/inspired/interested"; $\alpha = .81$, $\omega = .81$), and strong ("In the past two weeks, I felt strong/proud/determined/active"; $\alpha = .66$, $\omega = .67$).

Study engagement

We measured study engagement with the nine-item Utrecht Work Engagement Scale for Students (Schaufeli et al., 2002, 2006). The survey included three items for each dimension of study engagement, for example, "In the past two weeks, when I was doing my work as a student, I felt bursting with energy" (vigour; $\alpha = .74$, $\omega = .72$), "In the past two weeks, I was enthusiastic about my studies" (dedication; $\alpha = .77$, $\omega = .80$), and "In the past two weeks, I was immersed in my studies" (absorption; $\alpha = .52$, $\omega = .57$). In our analysis we used study engagement as an overall concept (e.g., Salmela-Aro & Upadyaya, 2014), modelled by fitting a higher-order factor model based on the three underlying dimensions.

Self-rated training performance

To measure training performance, we used the following item: "Based on the past two weeks, on a scale from 1 to 10, I would grade my sport performance as … " (cf. Bakker et al., 2011), with 1 (*worst possible)* to 10 (*best possible)*.

Coach-rated training performance

Coach-rated training performance was measured based on the same procedure, but now referring to the athlete rather than to the self: "Based on the past two weeks, on a scale from 1 to 10, I would grade my athlete's sport performance as … " (cf. Bakker et al., 2011), with 1 (*worst possible)* to 10 (*best possible)*.

Strategy of analysis

We used the lavaan package (Rosseel, 2012) in R (R Core Team, 2019) and applied full information maximum likelihood estimation to deal with missing data (Arbuckle, 1996). As indicated, we used a two-step approach with measurement model tests in Step 1 and the hypotheses tests in Step 2.

In Step 1, we ran factor analyses to test the measurement models, distinguishing between our latent variables: cognitive crafting, crafting social resources, crafting challenging demands, study engagement, and positive affect. This step produced factor scores as estimates for the score on the latent variables. When using factor scores instead of sum scores, factor loadings and error variances are not constrained to be equal (i.e., all items uniquely contribute to the latent variable score) and reflect a more precise representation of the latent variable score than would be obtained with raw item scores.

In Step 2, we tested our hypotheses via path analysis in the structural equation modelling framework (see Figure 1), based on the factor scores resulting from the Step 1 measurement models. Path analysis is a form of structural equation modelling that includes observed variables rather than latent variables (Kline, 2011). We tested an integral indirect path model from study crafting, via study engagement and positive affect, to self-rated and coach-rated performance two weeks later, which provided simultaneous tests for all three hypotheses.

To evaluate model fit of the model, we follow Hu and Bentler's (1999) recommendations and evaluate the comparative fit index (CFI; ≥ 0.95), the Tucker–Lewis index (TLI; ≥ 0.95), the Root Mean Square Error of Approximation (RMSEA; ≤ 0.05), and the Standardised Root Mean square Residual (SRMR; ≤ 0.06). To test the indirect effects, we used bootstrapping (1000 iterations).

Results

Descriptive statistics

Table 1 presents for the goodness-of-fit statistics of our measurement models (for visual representations, see Appendix). The goodness-of-fit statistics of the study crafting scale consisting of the three subscales showed an adequate fit: χ^2 (84, 243) = 129.36, p = .001; CFI = 0.949; TLI = 0.937; RMSEA = 0.051, SRMR = 0.057. Table 2 displays the means, standard deviations, and correlations of the study variables.

Hypothesis testing

We tested the hypotheses with an integral indirect path model of the study variables. We included covariances among the predictors, intermediary variables, and outcomes, as these were related. This model fit the data well: χ^2 (6, 243) = 4.74, p = .578; CFI = 1.000; TLI = 1.020; RMSEA = 0.000, SRMR = 0.022.

According to Hypothesis 1, study crafting is positively related to (a) positive affect and (b) study engagement. As shown in Figure 2, crafting challenging study demands was indeed positively related to positive affect, while cognitive study crafting and crafting social study resources were not. These results provide only mixed support for Hypothesis 1a, showing that students feel better when they more often take the initiative to create their own study challenges. Further, cognitive study crafting and crafting challenging study demands were both positively related to study engagement, but crafting social study resources was not, partly confirming Hypothesis 1b.

Table 1. Step 1: goodness-of-fit statistics for confirmatory factor analyses of the measurement models.

Variable	χ^2	df	CFI	TLI	RMSEA	SRMR
Cognitive crafting	0.33	4	1.000	1.023	0.000	0.005
Crafting social resources	5.09	4	0.996	0.989	0.034	0.021
Crafting challenging demands	4.09	4	1.000	0.999	0.010	0.017
Positive affect	86.27***	32	0.926	0.896	0.085	0.052
Study engagement	59.91***	23	0.943	0.910	0.082	0.048

Notes: χ^2: chi-square; df: degrees of freedom; CFI: comparative fit index; TLI: Tucker–Lewis index; RMSEA: root mean square error of approximation; SRMR: root mean square residual.
***p < .001.

Table 2. Means, standard deviations, and correlations of the study variables.

Variable	*M*	SD	1	2	3	4	5	6
1. Cognitive crafting	5.32	0.95						
2. Crafting social resources	4.31	1.19	.26***	–				
3. Crafting challenging demands	4.02	1.24	.36***	.38***	–			
4. Positive affect	5.07	0.84	.13	.20*	.30***	–		
5. Study engagement	4.20	0.95	.30***	.18*	.47***	.47***	–	
6. Self-rated training performance	7.15	1.41	.06	.04	.03	.23*	.09	–
7. Coach-rated training performance	7.22	1.76	–.11	.05	–.06	.10	–.11	.35***

Note: We used factor scores for variable 1–5 and observed scores for variable 6 and 7.
*p < .05.
***p < .001.

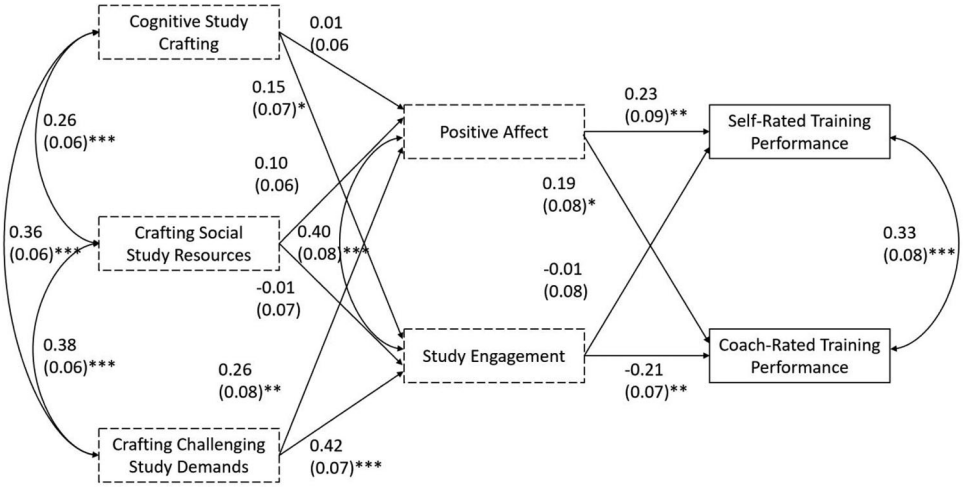

Figure 2. Step 2: path model of the study-sports spillover model. Notes: Path coefficients are presented as standardised coefficients, standard errors in parentheses. Dashed squares indicate observed variables based on factor scores. *$p < .05$, **$p < .01$, ***$p < .001$.

According to Hypothesis 2, (a) positive affect and (b) study engagement are positively related to athletic training performance. Positive affect was indeed positively related to both self-rated and coach-rated training performance. These results support Hypothesis 2a. Counter to Hypothesis 2b, study engagement was not significantly related to self-rated training performance, and *negatively* related to coach-rated training performance. See Figure 2 for all standardised path coefficients.

Hypothesis 3 states that study crafting is indirectly positively related to athletic training performance, via (a) positive affect, and (b) study engagement. See Table 3 for an overview of all indirect effect estimates. Results indicate that crafting challenging study demands was indirectly related to training performance, via positive affect and study engagement. Specifically, the indirect relationship via positive affect was positive and significant for self-rated training performance. Contrary to expectations, the indirect relationship of crafting challenging study demands via study engagement was negative and significant for coach-rated training performance. Cognitive crafting and crafting social study resources had no significant indirect relation with training performance. These results provide partial support for Hypothesis 3a and no support for Hypothesis 3b.

Discussion

In this study, we examined whether study crafting behaviour is related to athletic training performance via positive affect and study engagement. With this, we extended the W-HR model (Ten Brummelhuis & Bakker, 2012) to the academics–athletics context and regarded students as active agents who can shape their study environment through study crafting (cf. Hirschi et al., 2019). Most studies looking into the combination of academics and athletics have found long-term beneficial effects related to career transitions (e.g., Torregrosa et al., 2015). However, until now, the few studies on short-term effects mainly focused on hindrances involved in the combination (e.g., Pink et al., 2018). With

Table 3. Results of the bootstrapped standardised indirect effects.

Predictor	Via	Outcome	β	*SE*	95%-CI
Cognitive	Positive affect	SR performance	0.002	0.015	−0.027; 0.030
Social	Positive affect	SR performance	0.023	0.016	−0.008; 0.053
Challenging	Positive affect	SR performance	0.059*	0.029	0.001; 0.116
Cognitive	Positive affect	CR performance	0.001	0.012	−0.022; 0.025
Social	Positive affect	CR performance	0.019	0.014	−0.009; 0.047
Challenging	Positive affect	CR performance	0.049	0.027	−0.003; 0.102
Cognitive	Study engagement	SR performance	−0.002	0.011	−0.024; 0.020
Social	Study engagement	SR performance	0.000	0.001	−0.002; 0.003
Challenging	Study engagement	SR performance	−0.006	0.031	−0.067; 0.055
Cognitive	Study engagement	CR performance	−0.031	0.016	−0.062; 0.000
Social	Study engagement	CR performance	0.002	0.014	−0.026; 0.030
Challenging	Study engagement	CR performance	−0.087*	0.036	−0.157; −0.017

Notes: Cognitive: cognitive study crafting; Social: crafting social study resources; Challenging: Crafting challenging study demands; SR: self-rated; CR: coach-rated.
*$p < .05$.

the current study, we took a more positive perspective and argued that study crafting enriches the athletic domain because it enables athletes to accumulate personal resources. Our findings showed that crafting challenging study demands was positively related to positive affect, and that cognitive study crafting and crafting challenging study demands were positively related to study engagement, suggesting that students can gain personal resources when they engage in crafting behaviours (cf. Wrzesniewski & Dutton, 2001). Furthermore, supporting spillover theories (e.g., Greenhaus & Powell, 2006; Ten Brummelhuis & Bakker, 2012), positive affect and study engagement were linked to training performance in the athletic domain. This link was, however, not unequivocally advantageous. While positive affect contributed positively to subsequent athletic training performance as rated by the athlete, against expectations, study engagement was *negatively* related to coach-rated training achievement. Our results also yield some support for the role of study crafting in the spillover process, showing that crafting challenging study demands benefits self-perceived training performance via positive affect, but harms coach perceptions of training performance via study engagement. Results did not support a role for cognitive crafting and crafting social study resources in such a spillover process.

Contributions to theory

It should be noted that this study involves only a small piece of the academics–athletics spillover process and that there is still much to be investigated. Nevertheless, our study contributes to the literature in three ways. First, we extend the W-HR model (Ten Brummelhuis & Bakker, 2012) to the academics–athletics interface. Most research testing the process of enrichment has focused on the work-family interface (e.g., Ilies et al., 2017) and to our best knowledge, research on short-term academics–athletics enrichment is largely lacking. The present study shows that antecedents in the academic domain relate to personal resources, which, in turn, relate to outcomes in the athletics domain. Extending the W-HR model, the crafting of challenges in the study domain fostered positive affect, which promoted self-rated achievement in the athletic domain. Inconsistent with the W-HR model, however, the personal resource of study engagement was

related to lower coach-rated training achievement, which we will reflect on later. Nevertheless, in support of the basic mechanisms outlined in the W-HR model, our findings suggest that some degree of academics–athletics spillover does occur. Given the unexpected mix of cross-domain enrichment and interference that we observed, and the lack of support for the role of especially social study crafting, more spillover research among student-athletes is needed, and the W-HR model offers a tool to guide such future research efforts. Such future research endeavours could include additional factors in the study domain that may trigger spillover mechanisms. Research in the work-family interface, for example, suggests an important role for social support from family or at work (Lapierre et al., 2018). Such support factors might also be influential in spillover among student-athletes.

We also illuminated the mechanism of spillover by examining positive affect and study engagement as the boundary-spanning resources that link academics and athletics. Positive affect was associated with higher self- *and* coach-rated training achievement. The literature suggests that this positive outcome occurs because context-free positive affect broadens the scope of attention and cognition (Fredrickson & Branigan, 2005) in the student-athletes. This positive state can then trigger the generation of new resources (Hobfoll, 2002) that can be invested in other roles (Greenhaus & Powell, 2006), in our case enhancing training performance. Future research could shed further light on additional explanatory mechanisms and examine additional personal resources, such as flow or needs satisfaction (e.g., Kim & Beehr, 2020). An extended set of potential key resources might be deduced from the General Resistance Resources (GRRs), that originate from the health sciences domain. GRRs are attributes of individuals or their environment that enable the individual to manage challenges (cf. Antonovsky, 1979). Especially GRRs that reflect individual attributes that can be volatile and hence affected by fluctuations in academic or athletic experiences over time could contribute to the occurrence and nature of spillover.

Against our initial expectations, study engagement related negatively to coach perceptions of athletic training performance. We argued that engaged students simultaneously experience physical, emotional, and cognitive resources that can then be invested in the athletic domain (cf. Eldor et al., 2020). However, results regarding study engagement hint towards a negative boundary-spanning effect of study engagement when looking at coaches' evaluation of their athletes. It is conceivable that coaches view highly study-engaged athletes as athletes who prioritise academics and deprioritise athletics. This might not correspond with the coach' preference and raise doubts about the athlete's training commitment. Previous research indeed suggests that sports coaches tend to evaluate school as a back-up plan and not always fully facilitate athletes' participation in education, even though they do recognise that academics is important for personal development (Ronkainen et al., 2018). When considering this explanation, it is important to note that the model we tested included both positive affect and study engagement. Our own correlations as well as previous research (e.g., Ouweneel et al., 2011) indicate that engagement and positive affect are related. As such, our results reflect the effect of study engagement while controlling for positive affect, and vice versa, meaning the general positive affective component of study engagement is excluded in the reported relationship between study engagement and athletic achievement. However, the bivariate correlation between study engagement and coach-rated training performance was

also negative (albeit not significant), suggesting the observed negative spillover pattern cannot fully be explained by the control for positive affect. To our knowledge, however, this is the first spillover study to hint towards an interfering effect of engagement in the one domain with achievement in the other domain. This outcome is fascinating but exploratory, and more research is needed to verify whether it replicates in a new study. Additionally, as research has shown that juggling the roles of student and (elite) athlete can be challenging (e.g., Pink et al., 2018), it would be interesting and relevant to investigate additional mechanisms of academics–athletics interference.

Lastly, we contribute to the literature by assessing spillover with a statistical connection between separate measures of experiences in the academic as well as athletic domain. Most previous research on the work-home and academic-athletics interface relied on explicit measures of spillover, asking participants to self-report their spillover experience (e.g., Brustio et al., 2020). An example of such complex measures is: "What are some of the experiences of balancing school and sport you are willing to share?" (Tshube & Feltz, 2015). Although this method offers insight in people's spillover experiences, it requires that they evaluate their own spillover experience, which is a complex, mostly unconscious process, involving a thorough evaluation of behaviour, thoughts, and feelings in *both* domains as well as their connections. To avoid such demands on participants and decrease susceptibility to biases (e.g., common-method bias), we established a statistical connection between separate measures of antecedents, mechanisms, and outcomes of the spillover process. Spillover is then indicated by a statistical connection between variables from both domains, and not by complicated cause–effect inferences of participants about their cross-domain experiences (Du et al., 2018). This approach results in a conservative test of the spillover effect, as student–athletes' training performance is likely affected by a wide range of factors unrelated to the study domain. This might explain the small effect sizes and possibly part of the lack of support for some of the expected relationships in the current study.

Strengths, limitations, and future research

Our study should be viewed in light of some limitations. A first limitation is that we cannot be certain about the causal ordering in our model. Although we temporally separated the academic and the athletic measures, study crafting, positive affect, and study engagement were measured at the same time. Future research could use a training intervention in which students learn to craft their own study. Follow-up measurements could then test the effect of study crafting on outcomes for the intervention group compared to a control group. Comparable crafting interventions have been shown beneficial in the work context (for a meta-analysis, see Oprea et al., 2019). Future quasi-experimental research could also directly intervene on positive affect and/or study engagement and evaluate the implications for athletic achievement over time. Moreover, with longitudinal analyses, we would be better able to examine causal relationships, which might allow us to uncover continuous cycles of bidirectional spillover processes. That is, we may be able to discover that behaviour and experiences in the academic domain affect the athletic domain, and vice versa. For example, it is conceivable that athletes participating in high-level sports gain some specific resources, such as discipline, leadership, or persistence, that are highly relevant in all domains of life.

A second limitation is that we examined one domain-specific personal resource and one domain-general personal resource and did not take into account other potentially relevant variables. It is, for example, well conceivable that key resources – i.e., personal resources that reflect stable individual traits such as emotional stability and conscientiousness (Hobfoll, 2002) – also play an important role in the spillover process (Ten Brummelhuis & Bakker, 2012). Key resources may explain why some individuals experience more or less enriching or interfering effects. To illustrate, academics–athletics enrichment may be more likely to happen for conscientious student-athletes who are good planners, whereas interference between both life domains may be more likely for less conscientious students. In addition, individuals with a high sense of coherence are able to successfully manage stress outcomes (Eriksson & Lindström, 2006); academics–athletics interference might thus be less likely to happen for individuals with a high sense of coherence because they feel more equipped in dealing with challenging situations (e.g., a tough coach, combining athletic and academic schedules).

Furthermore, the results or our study are mainly based on data from the US academics–athletics system. However, research has indicated that culture is an important factor in dual career environments (Kuettel et al., 2020), and spillover may take different forms in other cultural contexts. For example, Ten Brummelhuis and Bakker (2012) have argued that macro resources such as general wealth conditions, public policies, and social equality (e.g., absence of racism) may facilitate positive spillover between various life domains. In the context of the present study, it is conceivable that social equality facilitates positive spillover effects from the academic to athletic domain because the means to combine academics and athletics are more widely available. It could thus be interesting to investigate whether academics–athletics spillover differs, depending on social equality, general wealth, and other macro resources.

Another limitation in our study is the negligible link of crafting social study resources with positive affect and study engagement, and spillover. This is interesting, as research among student-athletes indicates that social contact with peers in academics and athletics was important in dealing with challenges related to combining social life with the demands of combining academics and athletics (Linnér et al., 2019). Drawing on self-determination theory (Ryan & Deci, 2000), we argue that it is possible that athletes satisfy their need for relatedness in athletics. Therefore, the need for relatedness within the study domain might be less relevant for student-athletes, which could explain the null result regarding crafting social study resources and study engagement. Crafting challenging demands (i.e., seeking growth and development) was the most influential crafting dimension. It is possible that this was because the need for competence might be especially important within the academic domain because this need might not be met as easily in the athletic domain. In athletics, athletes are continuously fighting for their spot on the team, whereas studying might be a more personal battle. However, we did not measure needs satisfaction in either domain, so future research is needed. The null results in this study might also be explained by the relatively small sample size and power. As this study is the first to investigate academics–athletics spillover in this manner, we do value the results but replication of our findings is recommended.

Furthermore, although our current focus was on athletes who combine their athletic career with education, the W-HR model can also be used to study spillover mechanisms among other groups of elite athletes. Central life domains besides sports can also include

leisure or family and it would be interesting to examine the role of leisure or family time activities and behaviour in relation to athletic achievement. Proactive leisure activities (i.e., leisure crafting; Petrou & Bakker, 2016), for example, may generate personal resources, such as self-efficacy, that may benefit athletic achievement. To illustrate, an elite swimmer could spend some time each week serving coffee at the local nursing home. By providing elderly with drinks and conversation, the swimmer may feel more fulfilled. This positive feeling could enhance his motivation and possibly contribute to athletic achievement.

Moreover, our current focus was on positive spillover in the academics-to-athletics direction. We fully acknowledge several additional perspectives that are equally relevant. Previous research has uncovered challenges that come with combining academics and athletics (e.g., Pink et al., 2018), suggesting that interference or negative spillover mechanisms also warrant attention. Additionally, as outlined by the W-HR model, spillover occurs in both directions. Spillover antecedents and mechanisms can originate in the academic as well as in the athletic domain. We already reviewed several additional factors in the academic domain, but what would be potential antecedents in the athletic domain? Parallel to our current focus on study crafting it would be interesting to apply the crafting concept to the athletic domain. That is, could sports crafting be an instigator of positive athletics-to-academics spillover? Crafting behaviour in the athletic domain may similarly relate to more positive affect and engagement, which may consequently have a positive impact on the academic domain. Sports crafting would reflect proactive behaviours focused on changing tasks and relationships in one's sports setting to create purpose and enhance the fit between the individual and their athletic environment (cf. Tims et al., 2016; Wrzesniewski & Dutton, 2001). Athletes could, for example, cognitively reframe adverse events into learning experiences or ask their coach for feedback. In addition, De Vries et al. (2021) have found that satisfaction with sports performance during lunch breaks was related to vigour, and, in turn, more creativity at work. These types of antecedents rely on athletes' behaviour and attitude, whereas other antecedents might be more dependent on coaches' behaviour, such as coaching style. For example, a need-supportive coaching style may also increase athlete's engagement levels (e.g., De Muynck et al., 2021), and possibly transfer to more positive experiences in the academic domain.

On a final note, it is conceivable that spillover from athletics to academics is stronger than from academics to athletics; it is possible that the athletic career is more decisive and important for student-athletes than their academic career. That is, an athletic career might be a shorter-term path (e.g., due to physical disadvantages when older and more immediate demands and also potential return on investment posed by competitions and tournaments), whereas an academic or professional career is a longer-term path and could also be developed further later in life (e.g., with a traineeship). Consequently, when individuals are unsatisfied with their athletics (e.g., due disappointing results, little playing time, or conflicts with coach or teammates), this might have more invasive consequences because the timespan of possible success is shorter, possibly reducing engagement in the classroom.

It is also important to discover which personal resources contribute to enrichment or interference, and to study enrichment and interference in concert. For example, what is the role of domain-specific personal resources versus more domain-general personal

resources? Is there an overarching role for key resources (e.g., sense of coherence) and macro resources? What is the relative impact of enrichment versus interference? What conditions or interventions can help promote enrichment and/or suppress interference? For example, some intervention programmes for coaches have been successful in training coaches to adopt a need-supportive coaching style – a style that has been found to increase motivation and engagement in athletes (Reynders et al., 2019), which are possible boundary-spanning resources promoting athletics-to-academics enrichment. By addressing such questions, future research may progress towards a more comprehensive framework of spillover among student-athletes.

Practical implications

Our current results should be replicated and extended to allow strong practical recommendations. Still, we would like to offer some directions to highlight the practical relevance and applicability of our main findings suggesting that individuals who study and sport simultaneously can enhance their sports outcomes by crafting their study domain. First, the present findings can be used to educate the parties involved (e.g., student-athletes, coaches) about the potential implications of study crafting. Student-athletes could be educated about study crafting and other forms of proactive behaviour. Information sessions may refer to the possible benefits of optimising one's study demands and resources, and provide concrete examples of successful study crafting in the form of increasing study resources and challenges. Examples of study crafting are proactively asking for feedback about a course assignment from other students and from teachers; proactively asking for social support from other students to finish a project task; as well as proactively following interesting additional courses outside one's study domain to get more inspired. Study crafting presumably increases the fit between the student-athlete and the study environment, a fit that might initially be suboptimal because of the challenges involved in active participation in both life domains – academics and athletics. Knowledge about ways to optimise this fit has the potential to help student-athletes function well in both domains.

Second, since our findings suggest that crafting the challenges of academics to fit one's needs and abilities is an important pathway to enhanced positive affect and study engagement, we recommend that universities offer study crafting interventions in which students learn to modify their own study demands and resources. Previous studies in a work context have shown that such interventions can help enhance job crafting, with ensuing benefits for individual well-being (e.g., Gordon et al., 2018). A study crafting intervention will help students map their study tasks, demands, and resources and have them identify when and where they could craft their academics. Students may then learn how to set study crafting goals (e.g., asking for support and feedback, initiating collaborations with other students) and make a plan to effectively implement these goals. Given the promising results of previous job crafting interventions in the work domain (Oprea et al., 2019) and our current findings, it is likely that a study crafting intervention can boost students' positive affect and study engagement. An important step in this process could be to involve deans, academic advisors, teachers as well as coaches and Student-Athlete Academic Support Services in student-athletes' study crafting plans. It is important for such stakeholders to give student-athletes sufficient autonomy to craft their

study. A student dean, for example, might encourage crafting a challenge by stimulating a student-athlete to think outside of the box while looking for an internship (e.g., choose the government instead of a sports club).

Third, communication between athletes, coaches, and Student-Athlete Academic Support Services could be stimulated. Coaches should be aware that engagement for an activity in another domain could also be used as an asset and does not inherently mean that the athlete is not engaged in or does not prioritise sports. For example, athletes and their coaches could engage in "biweekly planning meetings"; the athlete may take the coach through the weeks, and the coach may take this into account and personalise the training schedule if needed. Moreover, the coach as well as the athlete may initiate regular conversations about motives, priorities, and balance. That is, combining two demanding life domains and engaging in crafting behaviours is challenging and can deplete energy as well (Bakker & Oerlemans, 2019). It is thus vital that coaches and athletes keep each other in the loop on what they see and feel regarding the academics–athletics combination.

On a broader level, as we have outlined above, combining academics and athletics will involve obstacles and challenges as well as benefits. From a practical perspective, it is highly relevant to gain more insight into intervention strategies that can help prevent or overcome obstacles and promote benefits. We have shown that aspects of academic involvement can enrich the athletic experience. Vice versa, we have argued that athletic involvement might also enrich the academic experience. As such, both worlds stand to gain from optimising the academics–athletics interface for student-athletes. Further research is needed to design and evaluate evidence-based strategies for helping student-athletes optimise the academics–athletics interface.

Conclusion

With the present study, we show that crafting behaviours in the academic domain – in particular crafting challenging study demands (e.g., organising an event) – generates volatile personal resources that can positively as well as negatively spill over to athletic training achievement. Our findings provide more insight into specific antecedents, mechanisms, and outcomes of the academics–athletics spillover process, offering practical directions to athletes, universities, and sports clubs. However, our study, represents only one piece of the spillover puzzle. Despite this study's limitations, our approach lays a foundation for future studies seeking to further explore the benefits as well as obstacles involved in combining academics and athletics.

Notes

1. We also measured performance in the first survey but did not use this data.
2. Measuring internal consistency with Cronbach's α can be problematic (Sijtsma, 2009). Therefore, methodologists (e.g., Hayes & Coutts, 2020) recommend the use of McDonald's omega (ω) as an alternative to measure reliability for multi-item measurement scales. Compared to Cronbach's α, ω is a more accurate measure of internal consistency because it does not make strict assumptions that are often violated (e.g., tau equivalence – similar factor loadings for all items; McNeish, 2018). Given current reporting conventions, we report both α and ω.

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No potential conflict of interest was reported by the author(s).

Data availability statement

The data and R scripts are available upon request from the corresponding author.

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Appendix. Visual representations of measurement models in Step 1

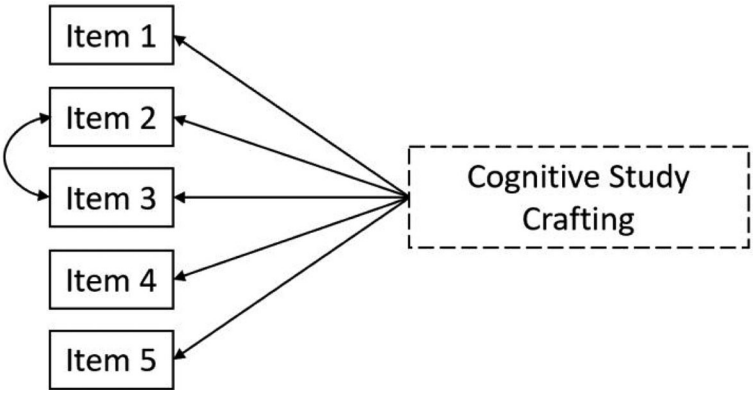

Figure A1. Visual representation of Step 1 measurement model of cognitive study crafting.

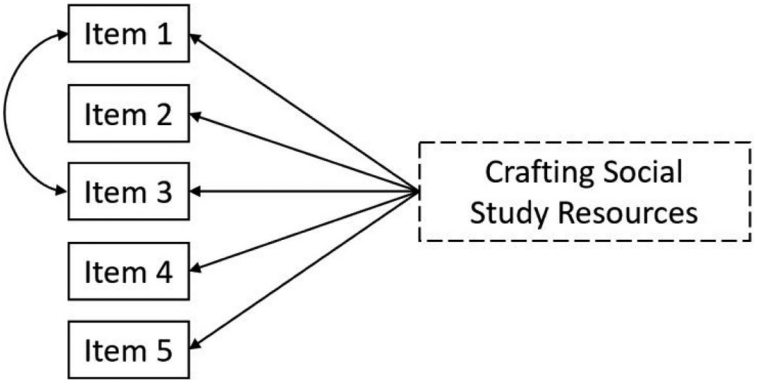

Figure A2. Visual representation of Step 1 measurement model of crafting social study resources.

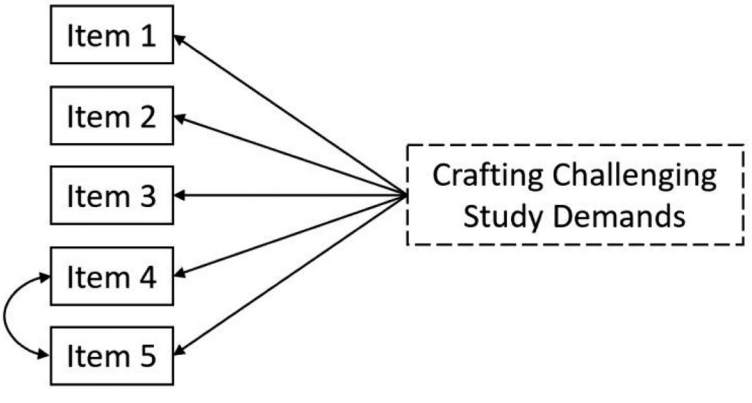

Figure A3. Visual representation of Step 1 measurement model of crafting challenging study demands.

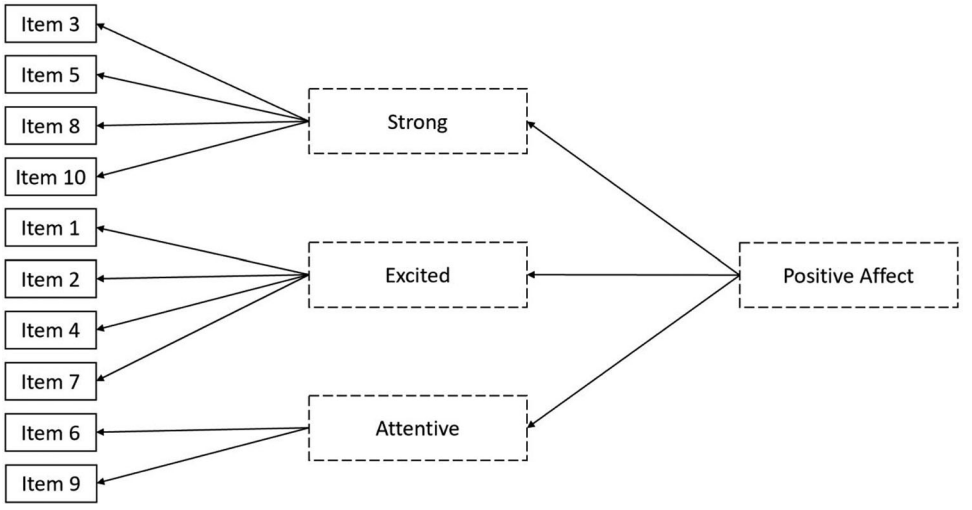

Figure A4. Visual representation of Step 1 measurement model of positive affect.

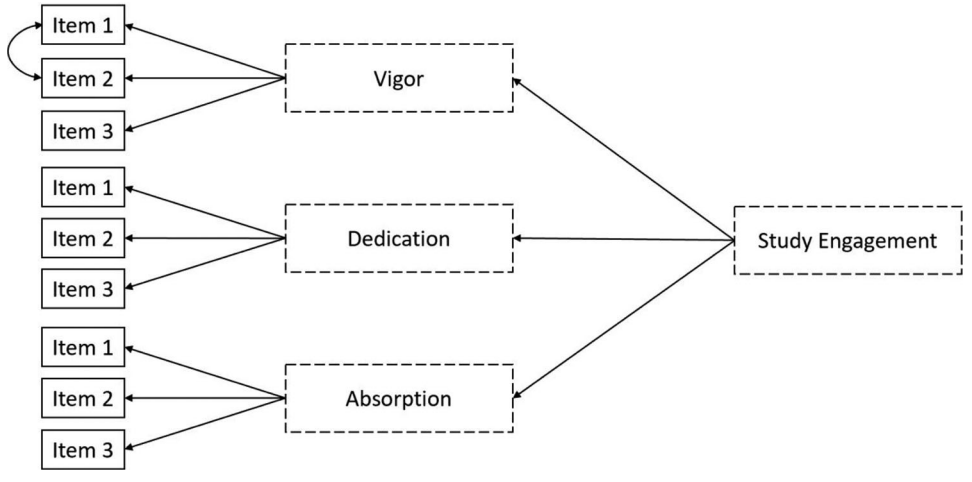

Figure A5. Visual representation of Step 1 measurement model of study engagement.