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TRANSFER EFFECTS OF CHILDHOOD EXTRACURRICULAR ACTIVITIES ON UNIVERSITY STUDENTS' RESILIENCE AND ACADEMIC PERFORMANCE

A QUANTITATIVE STUDY AMONG ARCHITECTURE STUDENTS

Abstract

This study presents the results of quantitative empirical research examining the relationships between childhood extracurricular activities – music, visual arts, and sports – and the resilience and academic performance of university students. The theoretical framework is grounded in the theory of psychological transfer effects and the multidimensional model of resilience. Data were collected from 197 architecture students at the Faculty of Engineering and Information Technology of the University of Pécs using a structured survey questionnaire incorporating the Connor–Davidson Resilience Scale (CD-RISC 25). Participants were analysed across eight activity-combination groups. Results indicate that students engaged in all three activities show significantly higher resilience scores (M = 77.31; SD = 14.61) compared to the control group (M = 64.46; SD = 18.61; t(40) = 2.42; p = .020; d = 0.81). Secondary school GPA was also significantly higher (t(40) = 2.77; p = .009; d = 0.92); however, the current semester average did not differ significantly (p = .207). A significant positive Pearson correlation was found between number of activities and resilience (r = .149; p = .037), confirmed by dose-response analysis ($\chi^2(3) = 7.86$; p = .049; V = .200). Sport participation is the strongest resilience predictor in the sample (d = 0.61, medium effect; p = .001), while visual arts activity is significantly associated with better academic performance (d = 0.44; p = .006) but shows no main effect on resilience (p = .856). The research confirms the synergistic transfer effects of combined activities and highlights the need for integrated pedagogical models in higher education.

Keywords: resilience; transfer effects; architecture students

Introduction

One of the most pressing challenges of 21st-century higher education is student mental health and academic performance. According to global surveys, the prevalence of anxiety, burnout, and mental health problems among university students continues to rise (WHO, 2022; Auerbach et al., 2018). Architecture students constitute a particularly affected group: studio-based education, the distinctive atmosphere of design critique, and high-performance expectations place unique psychological demands that require exceptional adaptability (Ayalp & Civici, 2021; Cuff, 1991).

Resilience – an individual's capacity to successfully cope with stress and adapt flexibly – is not an innate trait but a set of developable, learnable capacities (Connor & Davidson,

2003; Masten, 2014; Rutter, 2012). Pedagogical and psychological research is devoting increasing attention to the long-term developmental effects of extracurricular activities – particularly music, visual arts, and sport – collectively referred to as transfer effects (Perkins & Salomon, 1992).

This study presents the results of the empirical investigation of a doctoral research project. The leading research question is: How do the type and combination of childhood extracurricular activities relate to the resilience and academic performance of architecture students? The study involved 197 architecture students and is organised around the following hypotheses:

(H1) Students who participated in all three activities (music, visual arts, sport) show significantly higher resilience and better academic performance than the control group (0 activities).

(H2) The number of activities pursued is positively associated with resilience and academic performance indicators.

(H3–H4) Individual activity types (music, visual arts, sport) and their combinations show differentiated associations with resilience scores and academic performance.

(H5–H6) The manifestation of transfer effects is independent of sociodemographic background and cultural socialisation.

Theoretical Background

The Concept, Models, and Measurement of Resilience

The Development of the Concept of Resilience

The concept of resilience has been discussed systematically in the psychological literature since the 1970s, primarily following the landmark Kauai longitudinal studies by Werner and Smith (1982, 1992). These pioneering studies tracked children born into adverse conditions on the Hawaiian island of Kauai over several decades and identified a subset who thrived despite significant risk factors – thereby establishing the empirical basis for resilience research. Early approaches treated resilience primarily as a stable personality trait or a fixed individual characteristic; however, this view has been substantially revised in subsequent decades.

Contemporary perspectives interpret resilience within a dynamic, systems-oriented framework: as an adaptive capacity emerging from the interaction between the individual and their environment (Luthar et al., 2000; Masten, 2014; Rutter, 2012). This relational and developmental view has important implications: resilience is not simply something a person has or lacks, but a process that can be cultivated through appropriate social, educational, and psychological conditions. Masten's (2014) influential metaphor of 'ordinary magic' highlights that resilience arises not from exceptional or heroic qualities, but from the normal functioning of human psychological systems – including the capacity to form attachment relationships, regulate emotion, and find meaning in experience. These capacities are, crucially, developable and teachable.

Bonanno (2004) further refines the conceptual landscape by distinguishing resilience from recovery: whereas recovery implies a measurable return to a prior level of functioning after a period of disruption, a resilient individual never fully departs from their baseline – they experience otherwise disruptive events with relatively low levels of distress and maintain stable functioning throughout. This distinction has practical relevance for educational settings, where the goal of resilience-building programmes is not to help students 'bounce back' from failure, but to equip them with the psychological resources to navigate challenges without significant impairment in the first place.

A further theoretical development is the shift from unidimensional to multidimensional conceptualisations of resilience. Earlier models focused on a single latent factor of psychological hardiness; more recent frameworks, including the one operationalised by Connor and Davidson (2003), recognise resilience as a multifactorial construct encompassing cognitive, emotional, social, and even spiritual dimensions. This theoretical pluralism is reflected in the diversity of measurement tools currently in use, each capturing slightly different facets of the construct.

The Connor–Davidson Resilience Scale (CD-RISC 25)

Connor and Davidson (2003) developed the CD-RISC 25 as a psychometrically robust instrument capable of capturing the multidimensional nature of resilience. Their five-factor model distinguishes the following components: (1) personal competence, high standards, and tenacity – reflecting confidence in one's abilities and persistence in the face of setbacks; (2) trust in one's intuitions, tolerance of negative affect, and strengthening effects of stress – capturing the capacity to tolerate uncertainty and convert adversity into growth; (3) positive acceptance of change and secure relationships – reflecting adaptability and the protective function of social connectedness; (4) control – encompassing a sense of agency and the belief that one can influence outcomes; and (5) spiritual influences – reflecting the capacity to draw meaning from transcendent or value-based frameworks.

The CD-RISC 25 questionnaire contains 25 items rated on a five-point Likert scale (0–4), yielding a total score of 0–100. The scale has excellent psychometric properties in its original English-language validation: Cronbach-α = 0.89, and test-retest reliability of r = .87. It has been used extensively in clinical, occupational, and educational contexts, and has been validated in numerous language versions. Its Hungarian adaptation was conducted by Kiss and colleagues (2015), who demonstrated satisfactory factorial validity and internal consistency in a Hungarian population. The internal consistency measured in the present study is Cronbach-α = 0.917, exceeding the threshold for excellent reliability (Nunnally & Bernstein, 1994), which supports the suitability of the instrument for this specific student population.

Transfer Effects in Extracurricular Activities

The Concept and Types of Transfer

Transfer refers to the application of knowledge, skills, or attitudes acquired in one learning context to another context (Perkins & Salomon, 1992). The theoretical study of transfer has a long history in educational psychology, dating back at least to Thorndike and Woodworth's (1901) 'identical elements' theory, which proposed that transfer occurs to the extent that two tasks share common components. Subsequent research expanded this view substantially: Barnett and Ceci (2002) proposed a multidimensional taxonomy of transfer that distinguishes near and far transfer along multiple dimensions, including the surface similarity between tasks, the temporal gap between learning and application, and the social context of the transfer situation.

In the context of extracurricular activities, the concept of far transfer is particularly relevant. Far transfer describes the generalisation of learning across contexts that are superficially dissimilar – for example, the application of rhythmic discipline acquired through musical training to the management of academic deadlines, or the use of spatial reasoning developed through drawing practice in architectural design problems. Transfer research concerning extracurricular activities identifies effects primarily in three domains: cognitive (including executive functions, spatial reasoning, and working memory), emotional-social (including self-regulation, empathy, and prosocial behaviour), and motivational (including growth mindset, goal orientation, and persistence) (Hallam, 2010; Tomporowski et al., 2011; Winner et al., 2013).

A crucial distinction must also be drawn between specific and non-specific transfer. Specific transfer refers to the direct application of a particular skill or piece of knowledge – for instance, visual-spatial competence acquired through drawing being applied to architectural representation. Non-specific transfer refers to the generalisation of broader cognitive strategies, habits of mind, or affective dispositions – for instance, the self-discipline and frustration tolerance developed through years of musical practice being applied to demanding academic coursework. The present study provides evidence for both types within a specialised higher education context.

Transfer Effects of Music Education

The cognitive transfer effects of music training constitute one of the most thoroughly researched areas in educational psychology. A foundational study by Schellenberg (2004) demonstrated, through a randomised controlled experiment with children, that music lessons produced significant IQ gains compared to control conditions receiving drama lessons or no instruction – with the effect being most pronounced in the area of spatial-visual reasoning. This finding generated considerable scholarly debate and subsequent replication efforts, with a meta-analysis by Hetland (2000) confirming a reliable positive relationship between sustained music instruction and spatial-temporal reasoning.

Hallam (2010) provided a comprehensive synthesis of the intellectual and social effects of music education, concluding that the evidence base supports positive transfer to language development, mathematics, reading, and general cognitive ability, while noting

that effect sizes vary according to the duration, intensity, and pedagogical approach of music instruction. Particularly relevant to resilience is the finding that music education is associated with improved self-esteem, reduced anxiety, and enhanced emotional regulation – capacities that are theoretically central to the construct of resilience as measured by the CD-RISC 25. Relatedly, music-making in ensemble contexts fosters cooperation, attentive listening, and the capacity to subordinate individual expression to a collective goal – skills with clear relevance to the team-based nature of architectural practice.

In the Hungarian context, the Kodály method occupies a special position in music pedagogy. Developed by Zoltán Kodály and his collaborators, this approach emphasises the use of folk song, relative solmisation, and rhythmic movement as primary tools for musical development. It has been shown to be particularly effective in developing auditory processing capacity, phonological awareness, and social cohesion – outcomes that extend well beyond musical skill in the narrow sense (Demorest & Morrison, 2000). The Kodály method's integration into the Hungarian primary school curriculum means that the music education experienced by the participants in the present study is likely to reflect its distinctive pedagogical features, including an early start, high frequency of instruction, and strong links between music and broader language and social development.

The age-differentiated findings of the present study – showing significant resilience correlations for music training at ages 6–10 and 11–14, but not 15–18 – are consistent with the broader literature on sensitive periods in musical development. The neurological plasticity of early and middle childhood creates particular responsiveness to the structural demands of musical learning, and it is during these periods that the foundational habits of sustained practice, attentive listening, and emotional expression through sound are most deeply consolidated (Schlaug et al., 2005). By adolescence, while musical skill may continue to develop, the formative psychological effects of early musical engagement appear to be largely established.

Effects of Sport on Resilience

The relationship between physical activity and psychological resilience is supported by a substantial body of neurophysiological and psychological evidence. At the neurobiological level, regular physical exercise has been shown to promote the release of brain-derived neurotrophic factor (BDNF), which supports neural plasticity, reduces stress reactivity in the hypothalamic-pituitary-adrenal (HPA) axis, and enhances the regulation of cortisol – the primary stress hormone (Cotman & Berchtold, 2002). These neurophysiological effects create a biological substrate for the psychological experience of greater resilience: lower baseline stress arousal, faster recovery from acute stressors, and more adaptive appraisal of threatening situations.

The meta-analysis by Tomporowski and colleagues (2011) demonstrated that regular physical activity significantly improves executive functions – including working memory, cognitive flexibility, and inhibitory control – as well as stress management capacity in children and adolescents. These effects are mediated in part by the neurophysiological

mechanisms described above and in part by the psychosocial demands of structured sport participation: learning to follow rules, cope with competitive pressure, manage victory and defeat, and coordinate with teammates all constitute forms of psychological training that transfer to non-sporting contexts.

Fletcher and Sarkar (2012, 2016) demonstrated in elite sport contexts that competitive athletic training is associated with significantly higher psychological resilience, mediated by protective factors including goal focus, self-regulation, and motivational persistence. Sarkar and Fletcher (2014) further systematised these protective factors, identifying goal focus and self-regulation as central mechanisms through which sport-related demands translate into durable psychological strengths. These findings are directly relevant to the present study's sample of architecture students, for whom the capacity to manage demanding deadlines, tolerate critical feedback on creative work, and persist through repeated revisions closely parallels the psychological demands of competitive athletic training. The large effect size observed in the present study (d = 0.61) for the resilience–sport relationship aligns with the magnitudes reported in the sport psychology literature (Fletcher & Sarkar, 2012; Sarkar & Fletcher, 2014), strengthening the empirical coherence of this finding.

Effects of Visual Arts Education

Research into the transfer effects of visual arts education has historically produced more equivocal findings than the music and sport literatures. Two factors account for this. Visual arts instruction is more heterogeneous in its aims and methods, and the outcome domains most plausibly affected – spatial reasoning, creativity, aesthetic perception – are more difficult to operationalise and measure. Winner and colleagues' (2013) comprehensive OECD-commissioned analysis examined this evidence base critically and concluded that while there is clear empirical support for positive effects of visual arts training on creativity, visual-spatial reasoning, and critical observation, claims of broad cognitive transfer to unrelated academic subjects are not consistently supported.

However, Winner et al. (2013) importantly distinguish between near and far transfer in the visual arts domain, noting that domain-specific transfer – the application of visual-spatial skills acquired through drawing and design to other spatially demanding tasks – is robustly supported. This is precisely the type of transfer most relevant to architecture students, for whom visual-spatial competence is not a peripheral skill but a central disciplinary demand. The finding in the present study that visual arts experience is significantly associated with better academic performance in the architecture programme (d = 0.44) but not with resilience represents a theoretically coherent pattern: visual arts training equips students with domain-relevant cognitive tools but does not primarily develop the stress-management and emotional regulation capacities that underlie resilience.

In the Hungarian educational context, the Lantos–Apagyi integrative visual education method (Lantos, 1992) occupies a distinctive position. Developed by Ferenc Lantos and extended by Margit Apagyi, this approach is grounded in the principle that visual and musical experience are not separate domains but complementary modes of perceiving

and representing the world. By systematically linking visual observation, musical listening, and spatial exploration, the method aims to develop an integrated perceptual sensitivity that transcends the boundaries of individual art forms. For architecture students, this integrative orientation is particularly congruent with the discipline's own dual demands of technical spatial reasoning and aesthetic sensibility.

Traditions of Integrated Pedagogy

The theoretical case for integrated, multi-domain arts and physical education finds historical grounding in several influential pedagogical traditions. Waldorf pedagogy, developed by Rudolf Steiner (1919/1996), places artistic activity – including movement, music, visual arts, and drama – at the centre of the curriculum at every developmental stage, on the grounds that these activities cultivate not only aesthetic sensitivity, but the will forces and imaginative capacities that underlie all meaningful learning. Empirical studies of Waldorf graduates have found elevated levels of creative thinking and intrinsic motivation, though the distinctive organisational and philosophical features of Waldorf schools make causal attribution difficult (Randoll & Peters, 2015).

The Reggio Emilia educational philosophy, developed in the post-war Italian city of the same name and articulated by its founding theorist Loris Malaguzzi (1993), similarly emphasises what Malaguzzi termed 'the hundred languages of children' – the full range of symbolic, expressive, and physical modes through which children represent and communicate their understanding of the world. In the Reggio approach, the visual arts occupy a privileged position not as a subject of instruction but as a primary medium of inquiry, documentation, and community-making. Research on children educated in Reggio-inspired settings suggests enhanced narrative and representational capacity, as well as greater competence in collaborative problem-solving (Edwards et al., 2012).

The El Sistema music programme, originating in Venezuela under the leadership of José Antonio Abreu and subsequently adapted in numerous international contexts, provides perhaps the most extensively documented large-scale evidence for the transformative effects of intensive, socially embedded music education (Booth & Tunstall, 2016). El Sistema's model – which places group music-making rather than individual skill development at the programme's centre, and deliberately situates musical participation within the social fabric of disadvantaged communities – has been associated with improvements in cognitive functioning, social inclusion, and long-term educational outcomes, though critics have noted methodological limitations in the evaluation literature (Baker, 2014).

The Finnish educational system, frequently cited as a global benchmark for educational excellence and student wellbeing, incorporates phenomenon-based learning as a key structural principle (Niemi et al., 2012). Rather than organising knowledge into discrete disciplinary subjects, phenomenon-based learning invites students to investigate real-world phenomena through the integrated application of multiple knowledge domains and ways of knowing. The strong performance of Finnish students on international assessments, combined with their comparatively low stress and anxiety levels, provides indirect support for the proposition that integrated, multi-modal learning promotes not

only cognitive achievement but psychological resilience. These diverse traditions converge on a shared insight: that the deepest and most enduring learning occurs when cognitive, emotional, physical, and aesthetic dimensions of human experience are cultivated in concert rather than in isolation.

Method

Research Design and Ethics

The study employed a quantitative, cross-sectional design using SPSS 26.0 statistical software. Participants were informed of the research objectives and the option of voluntary participation through a detailed information letter. Data collection was anonymous, in accordance with GDPR requirements.

Sample

The study sample comprised 197 architecture students at the Faculty of Engineering and Information Technology of the University of Pécs (PTE MIK), enrolled in the undivided architecture programme. Gender distribution: women 68.0% (*n* = 136), men 29.5% (*n* = 59), other/no response 2.5% (*n* = 5). Year distribution: Year 1: 26.5% (*n* = 53), Year 2: 36.0% (*n* = 72), Year 3: 30.5% (*n* = 61), Years 4–5: 5.5% (*n* = 11).

Instruments

Connor–Davidson Resilience Scale (CD-RISC 25)

Resilience was measured using the CD-RISC 25 as part of a structured survey questionnaire. The Hungarian adaptation of the scale validated by Kiss and colleagues (2015), comprises 25 items rated on a 0–4 Likert scale, yielding a total score between 0 and 100. In the present sample, the scale demonstrated excellent internal consistency (*M* = 72.89; *SD* = 14.49; Cronbach-α = 0.917)

Table 1. Descriptive Statistics of CD-RISC 25 Subscales

Subscale	**Items**	**Max**	***M***	***SD***	**α**
Personal competence	8	32	24.23	5.12	0.88
Trust in one's intuitions	7	28	19.52	4.71	0.85
Positive acceptance of change	5	20	15.61	3.06	0.79
Control	3	12	8.58	2.54	0.76
Spiritual influences	2	8	4.94	2.15	0.71
Total score	**25**	**100**	**72.89**	**14.49**	**0.917**

Note. N = 197. M = mean; SD = standard deviation; Max = maximum score; α = Cronbach's alpha.

Source: Author's own data

Academic Performance

Academic performance was operationalised using three indicators: the average of secondary school grades (M = 4.43; SD = 0.46), the average of school-leaving examination results (M = 4.47; SD = 0.50), and the GPA of the last university semester (M = 4.27; SD = 0.67). In the analysis of hypotheses, the primary indicator was the secondary school average, which reflects stable long-term academic performance; the current semester GPA is included for informational purposes.

Measurement of Extracurricular Activities

Data on extracurricular activities were collected via retrospective self-report (regular: at least 2 sessions per week). In the sample: 81.7% (n = 161) participated in sport, 46.7% (n = 92) studied music, and 28.4% (n = 56) engaged in visual arts activities. Based on the eight possible activity combinations, participants were assigned to eight groups.

Data Analysis

Analyses were conducted using SPSS 26.0. The methodological decisions are presented below in the order of the procedures applied.

Descriptive statistics and distribution analysis. The normal distribution of variables was assessed using the Shapiro–Wilk test and visual inspection of Q-Q plots (CD-RISC 25: W = 0.969, p < 0.001; negative skewness = −0.715). Skewness and kurtosis indicators were compared against the threshold |z| > 3.29 (Tabachnick & Fidell, 2019).

Internal consistency. The reliability of the scale and subscales was characterised using Cronbach's α and McDonald's ω (≥ 0.70 acceptable, ≥ 0.80 good, ≥ 0.90 excellent; Nunnally & Bernstein, 1994). Within the item analysis, corrected item-total correlations (CITC) were examined, and items with values below 0.30 were flagged.

Group comparisons. One-way ANOVA was applied to compare the eight activity-combination groups (with Games-Howell post-hoc procedure where homogeneity of variance was not met) and a combined four-group analysis (0/1/2/3 activities). For pairwise comparisons, Welch's independent-samples t-test was used. Effect sizes were calculated as Cohen's d (small ≈ 0.20; medium ≈ 0.50; large ≥ 0.80) and η^2 (small ≈ 0.01; medium ≈ 0.06; large ≥ 0.14) (Cohen, 1988).

Correlation analyses. Pearson's correlation coefficient was used to examine associations between variables. In cases of non-normal distribution, Spearman's rank correlation coefficient (ρ) was applied.

Dose-response analysis. Cross-tabulation analysis was conducted using a dichotomised resilience variable (≤74 vs. >74 points) with number of activities (χ^2 test, Cramér's V). The significance level was α = 0.05. Where p < 0.10, results are described as trend-level associations (†).

Results

Activity Profile of the Sample

6.6% of participants (n = 13) had not engaged in any of the studied activities during childhood (control group). The detailed distribution of the sample's activity profile across the eight activity combinations is presented in Table 2. The highest resilience mean was shown by the group engaging in all three activities (M = 77.31), and the highest academic average by the visual arts + music combination (M = 4.80). The lowest resilience value was shown by the visual arts only group (M = 54.60), and the lowest academic average by the sport + music group (M = 3.96).

Table 2. Distribution of the Sample Across the Eight Activity-Combination Groups

Activity group	***n***	**%**	***M* (CD-RISC) *SD***	**Academic avg. *M* *(SD)***
None (control)	13	6.6	64.46 (18.61)	4.15 (0.55)
Sport only	70	35.5	74.14 (15.37)	4.29 (0.59)
Music only	13	6.6	71.00 (13.13)	4.54 (0.52)
Sport and music	45	22.8	74.29 (11.31)	3.96 (0.80)
Visual arts only	5	2.5	54.60 (5.94)	4.40 (0.89)
Sport and visual arts	17	8.6	71.41 (13.61)	4.53 (0.51)
Visual arts and music	5	2.5	67.20 (8.96)	4.80 (0.45)
All three	**29**	**14.7**	**77.31 (14.61)**	**4.41 (0.63)**
Total	**197**	**100.0**	**72.89 (14.49)**	**4.27 (0.67)**

Note. N = 197. Academic average refers to the last semester's university GPA (1–5 scale). M = mean; SD = standard deviation; CD-RISC = Connor–Davidson Resilience Scale.

Source: Author's own data

Hypothesis H1: The Combined Effect of Three Activities

To test Hypothesis H1, the control group (n = 13) and students who participated in all three activities (n = 29) were compared. The results are summarised in Table 3.

Table 3. Comparison of the Control Group and Students Engaging in All Three Activities

Variable	Group	*n*	*M*	*SD*	*t*(40)	*p*	*d*
CD-RISC total score	Control	13	64.46	18.61	2.42	.020	0.81
	All three	29	77.31	14.61			
Secondary school avg.	Control	13	4.33	0.47	2.77	.009	0.92
	All three	29	4.63	0.24			
Current sem. avg. (informational)	Control	13	4.15	0.55	1.28	.207	0.43
	All three	29	4.41	0.63			

Note. N = 42. Secondary school average refers to the mean grades across secondary school years (1–5). The university semester average is included for informational purposes. d = Cohen's d.

Source: Author's own data

Regarding resilience, the group engaging in all three activities shows significantly higher values (M = 77.31 vs. M = 64.46; t (40) = 2.42; p = .020; d = 0.81) – a large effect size. A significant difference also appears in secondary school GPA (M = 4.63 vs. M = 4.33; t (40) = 2.77; p = .009; d = 0.92) – a large effect size. It is important to note, however, that the difference in current semester GPA is not statistically significant (t (40) = 1.28; p = .207; d = 0.43), suggesting that the effects of activities are primarily measurable in long-term academic performance. Hypothesis H1 was confirmed regarding resilience and secondary school GPA, but not regarding current semester GPA. In both confirmed cases, large effect sizes were observed.

Hypothesis H2: The Effect of Number of Activities – Dose-Response Relationship

Students were divided into four groups according to the number of activities pursued (0, 1, 2, or 3 activities). The results are presented in Table 4.

Table 4. Resilience and Academic Average by Number of Activities – ANOVA Results

No. of activities	**n**	**Resilience *M (SD)***	**Sec. sch. avg. *M (SD)***	**Sem. avg. *M (SD)***	**ANOVA Resilience**	**ANOVA Sec. sch. avg.**
0 – Control	13	64.46 (18.61)	4.33 (0.47)	4.15 (0.55)	F (3,193) =2.43	(3,193) =2.77
1 – One activity	88	72.57 (15.29)	4.51 (0.43)	4.33 (0.60)	p=.066 †	p=.043 *
2 – Two activities	67	73.03 (11.80)	4.60 (0.32)	4.16 (0.77)	η^2=.036	η^2=.041
3 – All three	29	77.31 (14.61)	4.63 (0.24)	4.41 (0.63)		

*Note. N = 197. The 1- and 2-activity categories show weighted aggregate means. | † p < .10 (trend level). * p < .05.*

Source: Author's own data

Resilience shows a monotonically increasing trend with the number of activities (64.46 → 72.57 → 73.03 → 77.31; total difference: +12.85 points). However, the one-way ANOVA confirms only a trend-level main effect (F(3, 193) = 2.43; p = .066; η^2 = .036) – the difference is not statistically significant. The analysis examining eight activity combinations confirms a significant between-group difference (F (7, 189) = 2.59; p = .014; η^2 = .088). For secondary school GPA, the linear trend is clear, and the one-way ANOVA shows a significant main effect (F(3, 193) = 2.77; p = .043; η^2 = .041). The dose-response cross-tabulation analysis confirms the progressive relationship: the proportion of high resilience (>74 points) is 15.4% in the control group, 48.9% in the one-activity group, 47.8% in the two-activity group, and 62.1% in the all-three-activities group (χ^2(3) = 7.86; p = .049; Cramér's V = .200). The number-of-activities–resilience Pearson correlation: r = .149; p = .037.

Hypotheses H3–H4: Effects of Individual Activity Types

The effects of sport, music, and visual arts activity are summarised in Table 5.

Table 5. Associations of Individual Activity Types with Resilience Score and Academic Performance

Activity	**CD-RISC *r/d***	***p***	**Acad. avg. *d***	***p***
Music ages 6–10 (H3)	*r*= .220	.035*	–	–
Music ages 11–14 (H3)	*r*= .234	.025*	–	–
Music ages 15–18 (H3)	*r*=.052	.620	–	–
Visual arts (H4)	*d*=−0.03	.856	*d*=0.44	.006**
Sport vs. non-sport (H3a)	*d*=0.61	.001	–	–

Note. N = 197 (sport, visual arts); n = 92 (music age groups). r = Pearson correlation coefficient; d = Cohen's d. Dashes indicate that the association was not tested for this variable.

** p < .05. ** p < .01.*

Source: Author's own data

The resilience mean of groups including sport (n = 161) was significantly higher ($t(195) = 3.31$, $p = .001$, $d = 0.61$–medium effect). Music lessons at ages 6–10 showed a significant positive correlation with resilience ($r = .220$, $p = .035$, $n = 92$), as did lessons at ages 11–14 ($r = .234$, $p = .025$, $n = 92$), but not at ages 15–18 ($r = .052$, $p = .620$). Visual arts activity has no significant main effect on resilience ($t(195) = -0.18$, $p = .856$, $d = -0.03$), but shows a significant positive effect on current semester GPA ($t(195) = 2.81$, $p = .006$, $d = 0.44$ – medium effect) and secondary school GPA ($t(195) = 2.40$, $p = .017$, $d = 0.38$).

Hypotheses H5–H6: Demographic Moderators

The effects of activities are significant and robustly independent of the examined sociodemographic variables as moderators. The main effect of parental education is not significant ($p = .666$), nor is the interaction ($p = .947$). Place of residence type shows no significant moderating effect, though it is a significant negative predictor in the regression model ($\beta = -.145$; $p = .046$): students from larger cities show lower resilience values. Cultural activity (attending classical music concerts, exhibitions) shows a mild positive

association with resilience (r = .138–.148), and cultural activity at ages 15–18 significantly correlates with secondary school GPA (r = .188; p = .008).

Discussion

Synergistic Effects of Combined Activities

The most important finding of the research is the empirical confirmation of the synergistic effects of combined activities. Students engaging in all three activities significantly exceed the control group in both resilience and secondary school academic performance – with large effect sizes in both cases (d = 0.81 and d = 0.92). These magnitudes are noteworthy in the context of educational psychology, where effect sizes of this magnitude are relatively rare in observational studies and are comparable to those produced by targeted psychological interventions (Hattie, 2009). The dose-response analysis further strengthens this finding. The proportion of high resilience increases from 15.4% in the control group to 62.1% in the three-domain group. This progressive gradient is consistent with a genuine cumulative effect rather than an artefact of group composition.

The theoretical interpretation of this synergistic pattern draws on the neurocognitive literature on multisensory and multimodal learning. Zatorre and Salimpoor (2013) have demonstrated that musical experience engages an unusually wide network of cortical and subcortical brain regions including those responsible for motor planning, auditory processing, emotional regulation, and reward. The simultaneous activation of these systems through music-making may promote more robust and flexible neural connectivity than domain-specific training alone. When musical experience is combined with the embodied, spatially rich demands of visual arts practice and the physiological and psychological conditioning of sport, the result may be a particularly broad and integrated set of neural resources available for adaptation to stress. This interpretation is consistent with the observation that the All-Three group's resilience advantage is substantially greater than the sum of the individual activity effects, pointing to a genuine interaction rather than mere additive combination.

Comparison with existing literature on resilience-building programmes further contextualises these findings. Structured mindfulness-based interventions in higher education typically produce effect sizes in the range of d = 0.40–0.60 for resilience outcomes (Galante et al., 2018), while cognitive-behavioural skills training programmes report comparable magnitudes. The effect size of d = 0.81 observed in the present study for the combined-activities group exceeds these benchmarks – though it should be noted that the nature of the comparison is fundamentally different: the present study measures the accumulated effects of years of childhood activity involvement rather than the acute effects of a structured intervention. This distinction suggests that the 'treatment' examined here is not a circumscribed programme but a formative developmental pathway, and that the resilience differences observed may reflect deeply consolidated psychological dispositions rather than recently acquired coping strategies.

Differentiated Effects of Individual Activities

Sport is consistently the strongest resilience predictor in the present study (d = 0.61, a medium effect by conventional criteria), a finding that aligns with the convergent evidence from neurophysiological and psychological research reviewed in Section 2. The neurobiological mechanisms through which sport builds resilience – including HPA axis regulation, BDNF-mediated neural plasticity, and the development of behavioural inhibition under pressure – are well-established (Cotman & Berchtold, 2002; Tomporowski et al., 2011). What is perhaps less appreciated is the degree to which structured sport participation constitutes a systematic form of psychological training. The repeated experience of managing competitive arousal, coping with defeat, and returning to practice after failure amounts to a graduated exposure to manageable adversity. This closely parallels the mechanisms identified in clinical resilience-building programmes.

For architecture students in particular, whose education involves regular exposure to critical assessment of their creative work, this capacity to receive and process negative feedback without catastrophising is of direct and practical relevance.

The age-differentiated pattern for music – significant correlations with resilience for early and middle childhood music participation, but not for adolescent music instruction – is consistent with the concept of sensitive developmental periods and with the broader literature on the timing of musical training effects. Schlaug and colleagues (2005) demonstrated that children who begin music lessons before the age of seven show distinctive neurological features – including a larger corpus callosum and greater bilateral representation of motor sequences – compared to those who begin later or not at all. These structural differences suggest that early musical training leaves a lasting neurological signature that may underlie the psychological resilience advantages observed in the present study. The absence of a significant resilience correlation for music training at ages 15–18 is also theoretically interpretable: by adolescence, musical participation may increasingly serve expressive and social functions – identity formation, peer affiliation, aesthetic exploration – rather than the structural psychological functions that appear to contribute to resilience.

The result for visual arts activity represents perhaps the most theoretically interesting finding of the study, precisely because it departs from a simple additive model. The absence of a main effect on resilience (p = .856; d = −0.03) alongside a significant medium effect on academic performance (d = 0.44) constitutes a double dissociation that carries specific theoretical implications. It suggests that visual arts training operates through a distinct psychological pathway from sport and music – one oriented not toward stress regulation and emotional hardiness, but toward the development of domain-specific cognitive tools that facilitate performance in spatially demanding academic contexts. This is consistent with Winner et al.'s (2013) cautious conclusions regarding visual arts transfer: the evidence supports near transfer to visually and spatially similar tasks, but not the broader far transfer to social-emotional outcomes that advocates of arts education sometimes claim.

The additive value of the visual component within the All-Three group is further confirmed by the significant difference between this group and the Sport+Music group in

academic performance (Δ = +0.46; d = 0.62; p = .011). This finding implies that for architecture students specifically – unlike students in less visually oriented disciplines – visual arts experience constitutes a genuine and measurable academic advantage, one that complements rather than duplicates the contributions of sport and music. Taken together, these three activity domains appear to constitute a functionally complementary set of developmental inputs: sport building the psychological robustness needed to cope with stress; early music training building the attentional discipline, emotional regulation, and neural flexibility needed for complex cognitive work; and visual arts training building the spatial and perceptual competencies most directly applicable to architectural practice.

Resilience and Academic Performance: Distinct but Related Outcomes

A consistent pattern across the present findings is the partial independence of resilience and academic performance as outcome variables. While both are elevated in the All-Three group relative to the control group, the specific predictors of each differ: sport is the dominant resilience predictor, visual arts the dominant academic performance predictor, and music is associated with resilience in age-specific ways without showing a clear academic performance effect. This differentiation challenges simplistic assumptions that resilience and academic performance are interchangeable markers of student wellbeing and suggests that educational interventions targeting one outcome may not automatically produce gains in the other.

The finding that current semester GPA does not significantly differ between the All-Three and control groups (d = 0.43; p = .207), despite significant differences in secondary school GPA (d = 0.92; p = .009), raises an important question about the temporal dynamics of transfer effects in higher education. One interpretation is that the transition to university-level study introduces new contextual demands – unfamiliar social environment, increased autonomy, greater complexity of tasks – that temporarily attenuate the academic performance advantages conferred by prior activity involvement. An alternative interpretation is that secondary school GPA reflects a more stable composite of cognitive ability, motivation, and behavioural habits, while current semester GPA in an architecture programme is more sensitive to the specific technical demands of the curriculum at each level. Longitudinal research would be needed to distinguish these interpretations.

Methodological Limitations

The cross-sectional design does not allow for causal inferences. Retrospective self-report may introduce bias, particularly given the long retrospective timespan of childhood. The small sample sizes of the control group (n = 13) and some combination groups (n = 5) reduce statistical power. Single-faculty sampling limits generalisability. Future research should employ longitudinal designs, objective activity records, and multi-institutional samples to replicate and extend these findings.

Conclusions and Pedagogical Recommendations

Theoretical Contribution

The research makes three main contributions: (1) it empirically confirms the synergistic transfer effects of combined extracurricular activities in a higher education context, with large effect sizes (d = 0.81–0.92); (2) it provides a differentiated picture of the distinct mechanisms of individual activity types – sport primarily supports resilience, while visual arts education supports academic performance; (3) it provides data on the understudied population of architecture students.

Pedagogical Recommendations

Based on the findings, differentiated pedagogical recommendations can be formulated. For the development of resilience, multimodal programmes including sport are recommended, ideally integrating all three domains. For improving academic performance – particularly in architecture and engineering programmes – the combination of cognitive-aesthetic activities (music + visual arts) shows the best results. It may be useful for higher education institutions to develop induction processes that map students' prior activity profiles, and to incorporate integrated pedagogical approaches – particularly programmes similar to the Lantos–Apagyi method – into the foundational curriculum. Student counselling and academic support services might productively use activity-profile screening as an early indicator of students at risk of resilience challenges.

Summary

This study examined the associations between childhood extracurricular activities and the resilience and academic performance of architecture students using quantitative methods. The main findings: students who participated in all three activities (sport, music, visual arts) show significantly higher resilience and better secondary school GPA with large effect sizes (d = 0.81 and 0.92) – however, the difference in current semester GPA is not significant. The dose-response analysis confirms a progressive relationship ($\chi^2(3)$ = 7.86; p = .049; V = .200). Sport is the strongest resilience predictor (d = 0.61, medium effect), visual arts education is primarily associated with academic performance (d = 0.44) but shows no main effect on resilience. Transfer effects manifest independently of sociodemographic background. The research confirms the need to develop integrated pedagogical models in higher education.

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