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Research paper

Autonomy-supportive teaching leads to autonomy-supportive parenting: A teacher-to-parent relationship spillover effect

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A R T I C L E I N F O

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A B S T R A C T

We investigated for a teacher-to-parent relationship spillover effect in which students who received year-long autonomy-supportive teaching at school then received greater year-end autonomy-supportive parenting at home. Using a randomized control trial research design, teachers from 44 physical education classes and their 1185 secondary-grade students either did or did not participate in an autonomy-supportive teaching workshop. Over one academic year, students in the experimental group reported increased autonomy-supportive teaching, need satisfaction, prosocial behavior, and then greater year-end autonomy-supportive parenting. A multilevel structural equation modeling analysis identified the explanatory mechanism: Autonomy-supportive teaching increased students' mid-year prosocial behavior, which increased end-year autonomy-supportive parenting.

Students benefit from having a highly autonomy-supportive teacher. For instance, students with highly autonomy-supportive teachers tend to display numerous personal and academic benefits (e.g., need satisfaction, engagement, learning, wellbeing; Assor et al., 2002; Fin et al., 2019; Reeve & Cheon, 2021; Reeve et al., 2022; Stroet et al., 2013). These same students further experience gains in their social competencies and positive peer-to-peer relationships, such as greater prosocial behavior (e.g., helping, sharing, including others; Cheon et al., 2018, 2019; Kaplan & Assor, 2012). This means that autonomy-supportive teaching not only improves students' motivation and academic functioning, but it also improves students' social interactions and interpersonal relationships.

1. Relationship spillover effect

In a pair of investigations, van der Kaap-Deeder and colleagues showed that receiving autonomy support in one relationship can spill over to encourage the receiver to give greater autonomy support in a second relationship (Van der Kaap-Deeder, 2021; van der Kaap-Deeder et al., 2015). In the first study, these researchers showed that children who received maternal autonomy support began to relate to their sibling in a more autonomy-supportive way (van der Kaap-Deeder et al., 2015). In the second study, these researchers replicated their earlier finding and showed further that children who received paternal control began to relate to their sibling in a less autonomy-supportive way (Van der Kaap-Deeder, 2021). Together, these studies showed that the motivating style one receives in a parenting relationship tends to spillover or feed into the motivating style one then employs in a sibling relationship. This spillover effect represents a "pay it forward" effect.

To explain the mechanism behind this "pay it forward" relationship spillover effect, Van der Kaap-Deeder and colleagues showed that it was the child's experience of psychological need satisfaction (i.e., autonomy, competence, and relatedness) that linked the two relationships. That is, maternal autonomy support allowed the child to experience need satisfaction, which then fueled or empowered the child's greater giving of autonomy support in a different relationship. Alternatively, a second interpretation of the Van der Kaap-Deeder et al. finding might be a modeling effect, such that a child tends to relate to a sibling in a similar way that he or she observes the parent relating to them. Both mechanisms seem possible, but the key finding was that a relationship spillover

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effect does sometimes occur.

Inspired by van der Kaap-Deeder and colleagues' findings, we were interested in a similar but different relationship spillover effect. While van der Kaap-Deeder illustrated how receiving autonomy support can lead to giving autonomy support, we were interested in whether receiving high autonomy support in one relationship might lead to receiving high autonomy support in another relationship. This second effect represents a "spreading" or a "the rich get richer" effect (to borrow a phrase from Skinner & Pitzer, 2012). Our question was whether receiving autonomy-supportive teaching at school would lead to receiving more autonomy-supportive parenting at home. This is an important phenomenon to investigate because receiving autonomy-supportive parenting is just as beneficial to the child as is receiving autonomy-supportive teaching (Grolnick & Ryan, 1989; Joussemet et al., 2008; Soenens & Vansteenkiste, 2010).

2. Mechanism to explain the school-to-home relationship spillover effect

If such a school-to-home relationship spillover "spreading" effect was to occur, we reasoned (following Skinner et al., 2009) that the initial autonomy-supportive teaching must generate some easily observable change in the students' behavior. This is because a teacher's autonomy-supportive motivating style tends to rise and fall in response to changes in their students' classroom behavior, such as their engagement or prosocial behavior (Jang et al., 2020, 2024). Once such a constructive and observable behavior change occurs, it might then catalyze a change in the parent's motivating style toward the child. As we explain below, one candidate for such a behavior change catalyst might be the student's greater display of prosocial behavior, though we recognize that other behavioral change catalysts are also possible (e.g., the student's academic motivation, school engagement, homework completion rate, and so forth).

A student's prosocial behavior and a teacher's autonomy support are closely associated (Gregory et al., 2010; Jang et al., 2020; Pavey et al., 2011). Abundant evidence confirms that greater autonomy-supportive teaching leads to greater prosocial behavior (Cheon et al., 2018; 2019, 2022; Gagne', 2003), but there is also evidence for the reciprocal relationship—namely, that students' prosocial behavior tends to pull out a more autonomy-supportive teaching style (Jang et al., 2020). For instance, Jang and her colleagues showed that early-year prosocial behavior predicted a longitudinal increase in teachers' late-year autonomy-supportive teaching. This reciprocal effect suggests that if the student became increasingly prosocial, then perhaps others (e.g., teachers, parents, peers) might in turn increase their provision of autonomy support toward that student. If such a behavior change was substantial enough to be noticeable, then the child's parents might pick up on the increased prosocial behavior and adjust their parenting style accordingly—by becoming more supportive. In this way, autonomy-supportive teaching might lead to autonomy-supportive parenting—via the student's increased prosocial behavior.

Autonomy-supportive teaching expresses itself through need-satisfying instructional behaviors, such as taking the students' perspective, inviting students to pursue their interests, and providing an explanatory rationale for each engagement and behavior change request (Aelterman et al., 2019; Reeve & Cheon, 2021). It tends to increase students' need satisfaction and, in doing so, longitudinally increases students' prosocial behavior (Cheon et al., 2018, 2019, 2022; Jang et al., 2020; Kaplan & Assor, 2012; Tian et al., 2018). Importantly, autonomy-supportive teaching can be experimentally manipulated to a high level, and it can thus serve as a starting point to catalyze students' greater prosocial behavior (Cheon et al., 2018; 2019, 2022). Specifically, in our model, when teachers provide high autonomy support, students experience high need satisfaction, which promotes the greater prosocial behavior that parents may recognize and respond to with heightened autonomy support.

3. Hypotheses

We conducted a randomized control trial in which we invited teachers in the experimental group to participate in a previously-validated autonomy-supportive teaching (AST) workshop, while control group teachers taught in their "practice as usual" way. Teacher participation in the workshop (or not) was the manipulated independent variable. So, before testing our hypothesized model, we first tested for a pair of manipulation checks to confirm that teachers who participated in the AST workshop did indeed provide their instruction in a highly autonomy-supportive way. Specifically, we expected that (1) students of teachers in the experimental condition would report greater perceived autonomy-supportive teaching than would students of teachers in the control condition (manipulation check #1), and (2) classroom observers would rate teachers in the experimental condition as using more in-class autonomy-supportive instructional behaviors than teachers in the control condition (manipulation check #2).

For students, we collected three dependent measures over four waves—need satisfaction, prosocial behavior, and perceived autonomy-supportive parenting—to test the following hypothesized model: Experimental condition → T2 need satisfaction → T3 prosocial behavior → T4 perceived autonomy-supportive parenting. Within this hypothesized model, we hypothesized the following three specific paths:

H1. The experimental condition (i.e., teacher participation in the AST workshop) would increase students' in-class T2 need satisfaction, controlling for T1 need satisfaction (Hypothesis 1).

H2. Students' greater T2 need satisfaction would increase their in-class T3 prosocial behavior, controlling for T1 need satisfaction, T1 prosocial behavior, and experimental condition (Hypothesis 2).

H3. Students' greater T3 prosocial behavior would increase their T4 perceived autonomy-supportive parenting, controlling for T1 perceived autonomy-supportive parenting, T1 need satisfaction, T2 need satisfaction, T1 prosocial behavior, and experimental condition (Hypothesis 3).

Our hypothesized mechanism to explain the longitudinal rise in T4 perceived autonomy-supportive parenting was a longitudinal rise in T3 prosocial behavior. To confirm that T3 prosocial behavior mediated the direct effect of experimental condition on T4 perceived autonomy-supportive parenting, we conducted appropriate tests for mediation. To confirm that T3 prosocial behavior did change in an observable way for students in the experimental condition, we hypothesized that students in the experimental condition would report greater T3 prosocial behavior than would students in the control condition (Hypothesis 4). In addition, we asked teachers to rate the T3 prosocial behavior of each student in their class, so that we could test whether teachers would objectively rate students in the experimental condition as more prosocial than would teachers in the control condition (Hypothesis 5). Finally, to confirm convergence in the two prosocial behavior measures, we predicted that teachers' T3 prosocial behavior ratings would correlate significantly and positively with students' T3 self-reported prosocial behavior (Hypothesis 6).

4. Method

4.1. Participants

Teachers were 22 experienced, certified, full-time physical education (PE) teachers (17 males, 5 females) who taught in one of 22 different schools (13 middle schools, 9 high schools) throughout Seoul, South Korea. To increase our L2 sample size, we collected data from two classrooms for each teacher (i.e., our L2 unit of analysis was 44 classrooms rather than 22 teachers). All teachers were ethnic Korean. Teachers were, on average, 36.3 years old (SD = 5.2; *range* = 25–44) with 8.6 years (SD = 4.0; *range* = 1–14) of PE teaching experience. All 22 teachers completed all aspects of the study (retention rate = 100%). In appreciation of their participation, each teacher received a US$50 honorarium at the conclusion of the study (but were not told of the honorarium in advance). For statistical power, our sample of 44 classrooms (L2 units) with an average class size of 28.0 students/class generally met the guidelines for multilevel analyses that recommends 50 L2 units with at least 10–15 participants per L2 unit (per classroom) (Morin, Blais, & Chenard-Poirier, 2022).

In these 44 classrooms were 1185 ethnic Korean students who completed the study questionnaire during the first week of classes (T1, March). Of these 1185 students, 1137 (95.9%) completed the questionnaire again at T2; 1099 (92.7%) at T3; and 1067 (90.0%) across all four waves. Hence, both the missing cases (5.3%) and missing data (<0.1%) were quite low. The full student sample featured 634 (53.5%) females and 551 (46.5%) males, 633 (53.5%) middle and 552 (46.5%) high schoolers, and 594 (50.1%) experimental condition and 591 (49.9%) control condition.

4.2. Transparency and openness

This study was not preregistered. However, we make available all of the following on the study's Open Science Framework (OSF) project site, https://osf.io/g5wn8/?view_only=c79af500b7354f59bbc4d35849e41925: study questionnaire, dataset (SPSS and .dat formats), Mplus input and output files for the test of the measurement model, hypothesized model, and series of four growth models, and the detailed procedures from the autonomy-supportive teaching workshop.

4.3. Procedure, research design, and teacher workshop

The first author's University Research Ethics Committee approved the research protocol. Fig. 1 shows a schematic overview and timeline for the teacher-focused intervention and 4 waves of student data collection and the classroom observers' mid-semester 1 in-class behavioral ratings (based on the CONSORT 2010 Checklist). We recruited teachers for a study on "classroom instructional strategies" and then randomly assigned each teacher either to the experimental

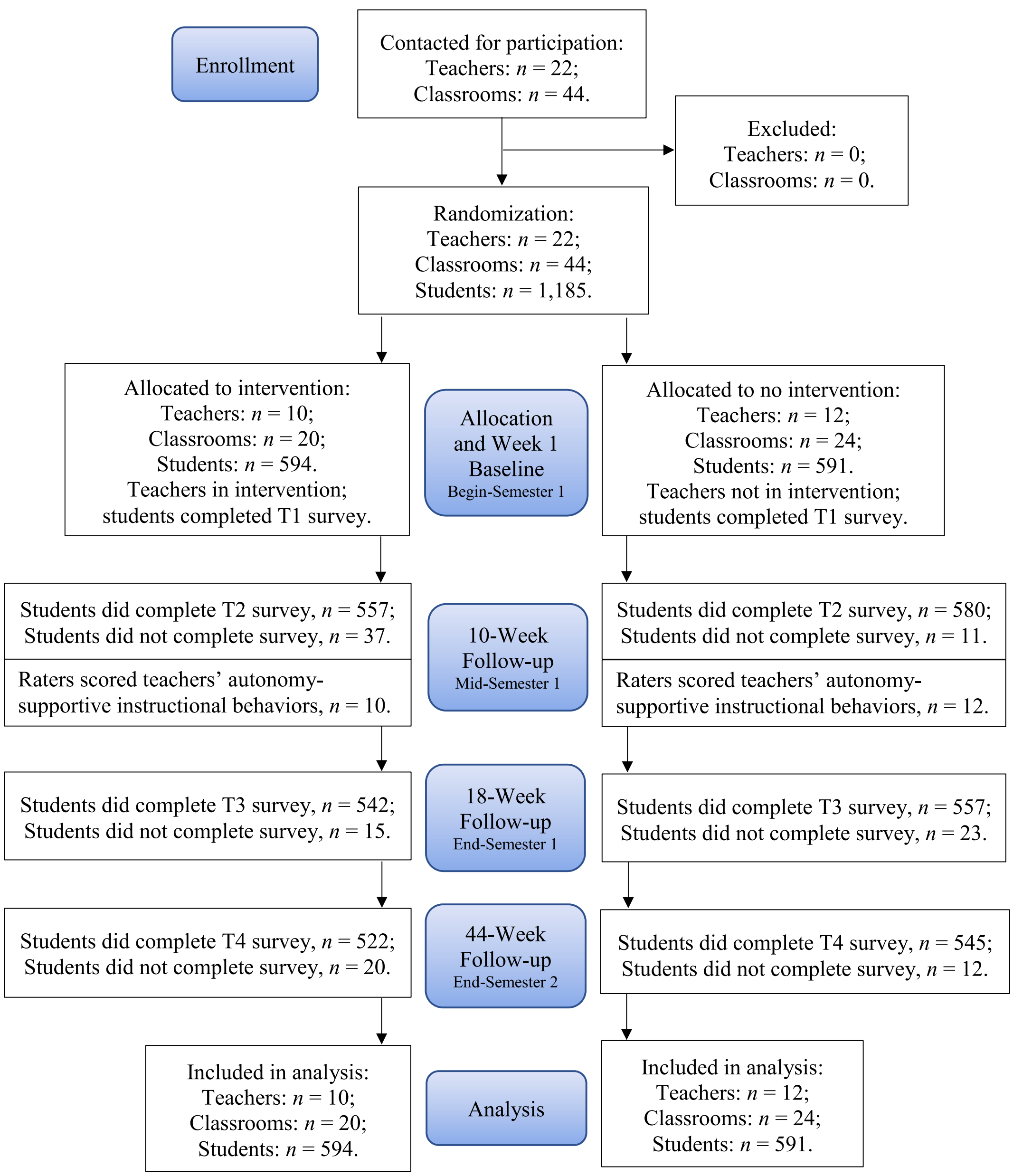

Fig. 1. Intervention and data collection flowchart (CONSORT).

(intervention; $n = 10$ teachers, 20 classrooms) or the control (no intervention; $n = 12$ teachers, 24 classrooms) condition. We collected 4 waves of data in which students completed the same 3-page questionnaire at the beginning (T1; week 1), in the middle (T2; week 10), and at the end (T3; week 18) of the Spring (first) semester and, again, at the end of the Fall (second) semester (T4, week 44). On each occasion, the questionnaire began with a consent form. Students completed the questionnaire specifically about that particular class. We assured students that their responses would be used only for the research study. In addition, classroom raters visited each teacher's class during the first semester to rate the usage of in-class autonomy-supportive instructional behaviors (see Week 10, Fig. 1). As for the teacher workshop, the delivery of the 3-part, 8-h autonomy-supportive teaching (AST) workshop followed the contents, activities, and step-by-step procedures of previously published workshops (e.g., Cheon, Reeve, Lee, et al., 2019; Reeve et al., 2022; see description on the OSF project site).

4.4. Observers' ratings of autonomy-supportive teaching

Four members of the research team received training and practice with the Behavior Rating Scale (BRS; Cheon et al., 2018). During either week 10 or 11, working in pairs, two raters made a one-time, 50-min visit to each teacher's classroom to rate the extent to which each teacher delivered instruction in an autonomy-supportive way. The two raters were blind to the teacher's assigned condition, made independent ratings, and used a unipolar scale (1 = *not at all*, 7 = *very much*). The BRS's autonomy-supportive teaching rating sheet listed the following six instructional behaviors that the two classroom observers rated in a consistent way: takes the students' perspective $r(22) = 0.75$; supports students' interests and intrinsic motivation, $r = 0.69$; provides explanatory rationales, $r = 0.74$; relies on invitational language, $r = 0.67$; acknowledges and accepts students' negative feelings, $r = 0.68$; and displays patience, $r = 83$. For each individual behavior, we averaged the two ratings into a single score and then averaged those 6 scores into a single overall "rater-scored autonomy-supportive instructional behaviors" score ($\alpha = 0.87$).

4.5. Student-reported dependent measures

All questionnaires were in the Korean language, though we provide the full English translated version on the OSF project site. Each measure was originally developed in English, but we had a previously utilized Korean-translated version available (Cheon et al., 2018). Each measure used the same 7-point bipolar response scale (1 = *strongly disagree*, 7 = *strongly agree*). For each measure, we report the inter-item (α) and inter-rater (*ICC1*) reliability statistics across all four waves of data.

4.5.1. Perceived autonomy support

To assess perceived autonomy support, we used three versions of the same 6-item Learning Climate Questionnaire (LCQ; Black & Deci, 2000)—a teacher version, a mother version, and a father version. The Perceived Autonomy-Supportive Teacher questionnaire used "My teacher" as its referent (e.g., "My PE teacher listens to how I would like to do things."); the mother questionnaire used "My mother" as its referent; and the father questionnaire used "My father" as its referent. For teacher autonomy support, students' scores showed high internally consistency (αs at T1, T2, T3, and T4 were 0.88, 0.93, 0.94 and 0.94, respectively) and high within-class consensus (*ICC1s* = 0.185, 0.229, 0.187, and 0.197, respectively). For mother autonomy support, students' reports were also internally consistent (αs = 0.93, 0.94, 0.94, and 0.94) but students' ratings were non-consensual (*ICC1s* = 0.012, 0.017, 0.010, and 0.039). For father autonomy support, students' reports were similarly internally consistent (αs = 0.95, 0.96, 0.96, and 0.96) but also similarly non-consensual (*ICC1s* = 0.016, 0.008, 0.001, and 0.004). The high *ICC1* statistics for the teacher questionnaire reflect that all the students in the class rated the same teacher, while the low *ICC1* statistics for the mother and father questionnaires reflect that all the students rated different parents.

4.5.2. Need satisfaction

We used three separate scales to assess need satisfaction. For autonomy satisfaction, we used the 5-item Perceived Autonomy scale (Standage et al., 2006; "In this PE class, I can decide which activities I want to do."; αs = 0.84, 0.90, 0.91, and 0.91; *ICC1s* = 0.106, 0.162, 0.134, and 0.130). For competence satisfaction, we used the 4-item Perceived Competence scale from the Intrinsic Motivation Inventory (Ryan et al., 1983; "After working with PE activities, I feel pretty competent."; αs = 0.88, 0.91, 0.92, and 0.92; *ICC1s* = 0.065, 0.094, 0.110, and 0.119). For relatedness satisfaction, we used the 5-item Basic Need Satisfaction in Sport Scale (Ng et al., 2011; "In this PE class, I feel close to my teacher."; αs = 0.86, 0.94, 0.94, and 0.95; *ICC1s* = 0.155, 0.159, 0.135, and 0.155).

4.5.3. Prosocial behavior

To assess students' prosocial behavior, we used the two prosocial scales from the Prosocial and Antisocial Behaviors in Sport scale (Kavussanu & Boardley, 2009), including the 4-item prosocial teammate scale (e.g., "In this PE class, I encouraged a classmate.") and the 3-item prosocial opponent scale (e.g., "In this PE class, I helped a classmate off the floor."). Students' reports on both prosocial scales showed high internally consistency with a moderate level of within-class consensus: prosocial teammate (αs = 0.84, 0.82, 0.82, and 0.86; *ICC1s* = 0.051, 0.081, 0.093, and 0.093); and prosocial opponent (αs = 0.82, 0.87, 0.83, and 0.87; *ICC1s* = 0.055, 0.061, 0.078, and 0.086).

4.6. Teachers' ratings of students' prosocial behavior

At the end of semester 1 (T3), we gave each teacher a class roster to score each individual student in their class on their in-class prosocial behavior, using a bipolar scale (1 = *strongly disagree*, 7 = *strongly agree*). In its heading, the rating scale listed four prototypical behaviors (e.g., "encouraged classmates") and asked teachers to make a single overall "prosocial behavior" rating for each student, $M = 5.56$, $SD = 0.71$, $ICC1 = 0.09$.

4.7. Data analyses

We conducted three sets of analyses. In the first, we conducted a pair of manipulation check analyses. The tests were whether the experimental condition predicted student-reported perceived autonomy-supportive teaching (manipulation check #1) and rater-scored autonomy-supportive teaching (manipulation check #2). In the second, we tested the overall hypothesized model. The tests were for the fit of the measurement model, the fit of the hypothesized model, and the significance of the paths corresponding to H1-H3. In the third, we conducted explanatory mechanism analyses. The tests were whether T3 prosocial behavior was a significant mediator in the hypothesized model, whether experimental condition predicted teacher-rated T3 prosocial behavior, and whether teacher-rated T3 prosocial behavior scores agreed with student-reported T3 prosocial behavior scores.

4.7.1. Manipulation check analyses

Rater-scored Autonomy-Supportive Instructional Behaviors. To test for the effect of experimental condition on rater-scored autonomy-supportive instructional behaviors, the unit-of-analysis was the teacher ($N = 22$). The statistical test was a 2-group independent *t*-test. To provide effect size information, we used Cohen's *d* (Cohen, 1988).

Students' Perceived Autonomy-Supportive Teaching. To test for the effect of experimental condition on students' perceived autonomy-supportive teaching, we conducted a T1-to-T4 growth model within the framework of a multilevel structural equation modeling analysis. Using the 6 indicators from the teacher version of the LCQ to create the perceived autonomy-supportive teaching latent variable, we regressed that latent variable on the slope of the T1, T2, T3 and T4 scores (weighted as 0, 1, 2, 3). The independent variable was experimental condition (control = 0, experimental = 1), the three statistical controls were gender (male = 0, female = 1), grade level (middle = 0, high = 1), and class size ($M = 28.0$ students/class, $SD = 4.8$). We used the Complex command in Mplus to recognize that students' data were nested within classrooms. In this analysis, we tested for a significant effect of experimental condition on the T1-to-T4 linear growth (longitudinal change) on perceived autonomy-supportive teaching. This is essentially a test for a condition × time interaction effect in which T1-to-T4 growth occurred more for students in the experimental condition than it did for students in the control condition.

Supplemental Growth Analyses. We conducted three similar, supplemental growth model analyses for the other three student-reported dependent measures, including need satisfaction, prosocial behavior, and perceived autonomy-supportive parenting. For the need satisfaction latent variable, the three indicators were autonomy, competence, and relatedness satisfaction scores; for the prosocial behavior latent variable, the two indicators were prosocial teammate and prosocial opponent scores; and for the perceived autonomy-supportive parenting latent variable, the two indicators were the mother and father LCQ scores. As was the case for the perceived autonomy-supportive teaching analysis, the independent variable was experimental condition, the three statistical controls were gender, grade level, and class size, we used the Complex command to account for the data's multilevel structure, and the critical test was for a significant condition × time interaction.

4.7.2. Hypothesized model analysis

The data had a two-level longitudinal structure with repeated measures (4 waves) nested within students (Level 1, $N = 1185$) nested within classrooms (Level 2, $k = 44$) and nested further within teachers (a cross-classified Level 2, $k = 22$). Given this data structure, we used a multilevel structural equation modeling analysis to test the measurement and hypothesized models. We used Mplus 8.7 (Muthén and Muthén, 2019) with the maximum likelihood-robust estimator (MLR) and full information maximum likelihood (FIML) estimation procedures for handling missing data. To evaluate model fit, we used the following goodness-of-fit statistics: Root-mean-square error of approximation (*RMSEA*), standardized root-mean-square residual (*SRMR*), comparative fit index (*CFI*), and Tucker-Lewis index (*TLI*).

We first tested for the fit of the 14-item, 6-latent variables measurement model. The three indicators for the T1 and T2 need satisfaction latent variables were autonomy, competence, and relatedness satisfaction. The two indicators for the T1 and T3 prosocial behavior latent variables were prosocial teammates and prosocial opponents. The two indicators for the T1 and T4 parental autonomy support latent variables were mother's and father's autonomy support. In evaluating the measurement model, we evaluated the fit of both the constrained and unconstrained models. We did this to test for multilevel measurement invariance (i.e., metric invariance; Morin, Blais, & Chenard-Poirier, 2022). To make this evaluation, we compared the fit of the unconstrained measurement model (the indicators were free to vary) vs. the fit of a constrained model in which the indicators were invariant across time (T1, T2, T3, T4). If the constrained measurement model shows little or no decrement in the goodness-of-fit statistics compared fit of the unconstrained measurement model, this result supports multiwave measurement invariance (Marsh et al., 2011).

We second tested the hypothesized model. To do so, we added the following predictor variables to the measurement model: experimental condition as an uncentered predictor (control = 0, experimental = 1); gender as a grand mean-centered L1 covariate (0 = male, 1 = female); and grade level (0 = middle, 1 = high) and class size ($M = 28.0$, $SD = 4.8$) as two grand mean-centered L2 covariates. We also added paths to represent H1-H3. The Mplus syntax for the test of the measurement, measurement-invariant, and hypothesized models can be found on the OSF project site.

4.7.3. Explanatory mechanism analyses

Mediation Analysis. The hypothesized model proposes a mediation effect, so we performed a pair of follow-up mediation analyses. To do so, we used both the "model indirect" command in Mplus as well as Preacher and Selig's (2012) bootstrapping procedure to construct 95% confidence intervals (*CI*) for the indirect effect (20,000 values). If the 95% *CI* does not include 0, then the mediation effect is significant.

Teacher-scored Prosocial Behavior Analyses. We also tested to confirm that the experimental condition had a significant effect on both student-reported T3 prosocial behavior and teacher-rated T3 prosocial behavior. Because these ratings were nested within teachers, we used a multilevel analysis for both tests. In addition, we were interested in the convergence between these two indices of T3 prosocial behavior. To test for this informant agreement, we used a multilevel analysis to test for a positive, significant association between teacher-rated T3 prosocial behavior and student-reported T3 prosocial behavior.

5. Results

We present the results in three parts. First, we test for the intervention effect on the two manipulation checks. Second, we test the hypothesized model (and its underlying measurement model) to evaluate the overall model fit and Hypotheses 1–3. Third, we test for mediation within the hypothesize model, the intervention effect on student-reported and teacher-rated T3 prosocial behavior, and whether teacher ratings corresponded to students' self-reports.

5.1. Manipulation checks

5.1.1. Rater-scored autonomy-supportive teaching

Raters scored the in-class instructional behaviors of teachers in the experimental group as significantly more autonomy supportive than the instructional behaviors of teachers in the control group (*Ms* = 5.33 vs. 4.41), $t(20) = 6.96$, $p < 0.001$, $d = 3.03$.

5.1.2. Students' perceived autonomy-supportive teaching

Fig. 2 (panel A) shows students' perceived autonomy-supportive teaching broken down by experimental condition and time of assessment. The multilevel structural equation modeling analysis fit the data reasonably well, $X^2(351) = 1020.50$, $p < 0.001$, $RMSEA = 0.043$, $SRMR = 0.058$, $CFI = 0.954$, and $TLI = 0.950$. Perceived autonomy-supportive teaching increased significantly more from T1 to T4 for students in the experimental condition (M Δ T1-T4 = +1.01) than it did for students in the control condition (M Δ T1-T4 = +0.29), $B = 0.60$, $SE = 0.14$, $t = 4.30$, $p < 0.001$.

5.1.3. Additional growth curve analyses

Fig. 2 (panel B) shows students' need satisfaction broken down by experimental condition and time of assessment. The multilevel structural equation modeling analysis fit the data reasonably well, $X^2(79) = 333.95$, $p < 0.001$, $RMSEA = 0.052$, $SRMR = 0.052$, $CFI = 0.968$, and $TLI = 0.953$. Need satisfaction increased significantly more from T1 to T4 for students in the experimental condition (M Δ T1-T4 = +0.86) than it did for students in the control condition (M Δ T1-T4 = +0.20), $B = 0.19$, $SE = 0.04$, $t = 5.01$, $p < 0.001$.

Fig. 2 (panel C) shows students' prosocial behavior broken down by experimental condition and time of assessment. The multilevel structural equation modeling analysis fit the data reasonably well, $X^2(32) = 121.16$, $p < 0.001$, $RMSEA = 0.048$, $SRMR = 0.032$, $CFI = 0.976$, and $TLI = 0.956$. Prosocial behavior increased significantly more from T1 to T4 for students in the experimental condition (M Δ T1-T4 = +0.61) than it did for students in the control condition (M Δ T1-T4 = +0.21), $B = 0.15$, $SE = 0.04$, $t = 3.38$, $p = 0.001$.

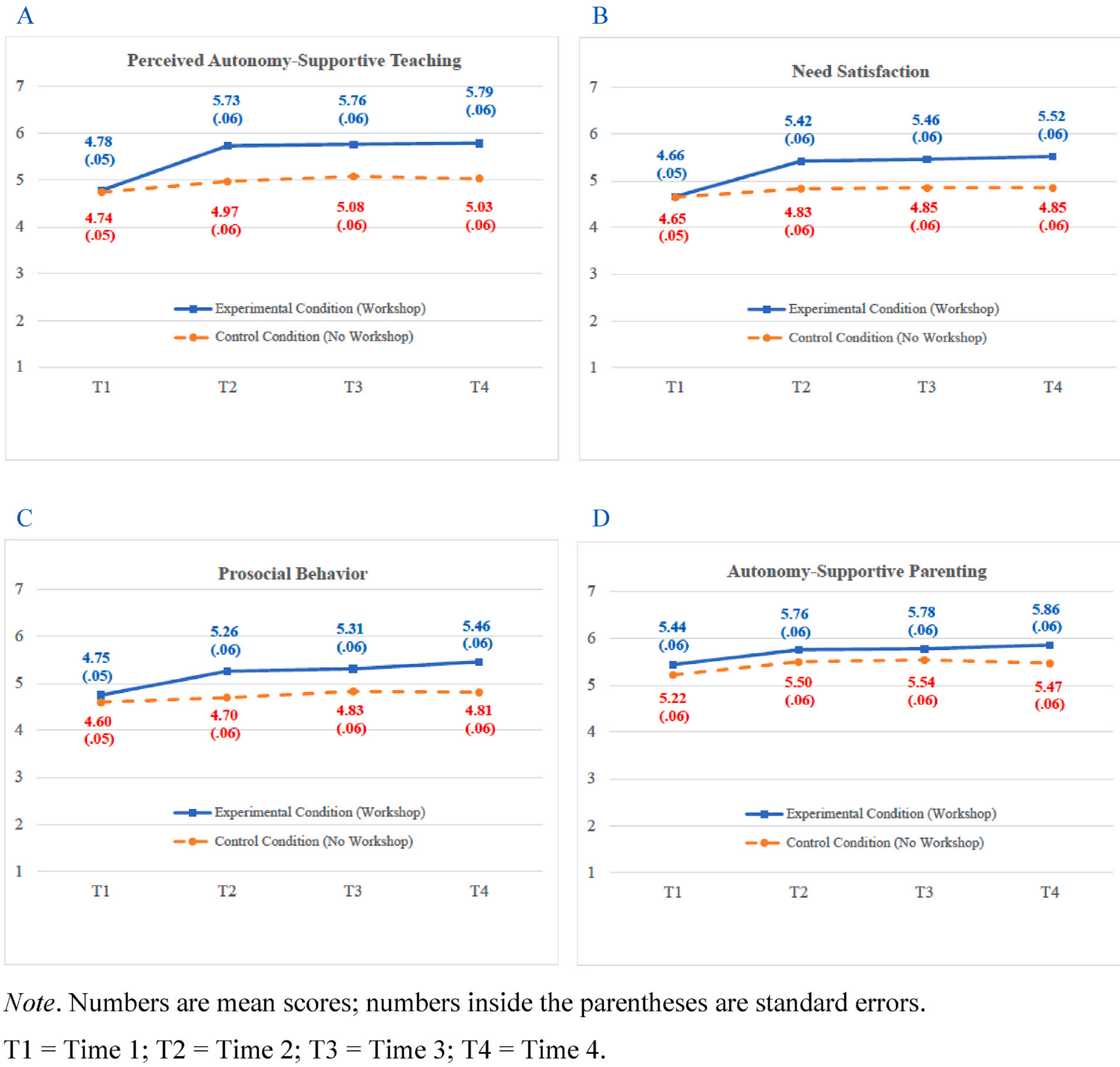

Fig. 2. Student-Reported Dependent Measures Broken Down by Experimental Condition and Time of Assessment
Note. Numbers are mean scores; numbers inside the parentheses are standard errors.
T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4.

Fig. 2 (panel D) shows students' perceived autonomy-supportive parenting broken down by experimental condition and time of assessment. The multilevel structural equation modeling analysis fit the data reasonably well, $X^2(32) = 92.17$, $p < 0.001$, $RMSEA = 0.040$, $SRMR = 0.029$, $CFI = 0.980$, and $TLI = 0.963$. However, perceived autonomy-supportive parenting did not increase significantly more from T1 to T4 for students in the experimental condition (M Δ T1-T4 = +0.42) than for students in the control condition (M Δ T1-T4 = +0.25), $B = 0.06$, $SE = 0.04$, $t = 1.62$, $p = 0.104$. Perceived autonomy-supportive parenting was higher in the experimental than in the control condition only at T4, $B = 0.43$, $SE = 0.14$, $\beta = 0.17$, $t = 3.10$, $p = 0.002$ (but not at T1, T2, or T3).

5.2. Hypothesized model

The 14-item, 6-latent variable unconstrained measurement model fit the data well, $X^2(55) = 131.50$, $p < 0.001$, $RMSEA = 0.034$, $SRMR = 0.034$, $CFI = 0.988$, and $TLI = 0.980$. To test for measurement invariance, we further tested the measurement model that constrained the indicators to be invariant across time (T1, T2, T3, T4). The constrained measurement model fit the data well, $X^2(59) = 131.90$, $p < 0.001$, $RMSEA = 0.032$, $SRMR = 0.035$, $CFI = 0.989$, $TLI = 0.982$, and it did so with no decrement in the chi-square or fit indices. These analyses establish measurement invariance across time for the measurement model.

We next tested the hypothesized model. It too fit the data well, $X^2(102) = 239.69$, $p < 0.001$, $RMSEA = 0.034$, $SRMR = 0.044$, $CFI = 0.979$, and $TLI = 0.969$. The correlations among all latent variables and statistical controls in the hypothesized model appear in Table 1. Fig. 3 reports the standardized beta weights for the three hypothesized paths.

Consistent with H1, experimental condition increased T2 need satisfaction ($B = 0.64$, $SE = 0.09$, $\beta = 0.28$, $t = 6.88$, $p < 0.001$), controlling for T1 need satisfaction ($\beta = 0.65$, $p < 0.001$), gender ($\beta = 0.09$, $p = 0.001$), grade level ($\beta = 0.01$, $p = 0.840$), and class size ($\beta = -0.01$, $p = 0.714$). This result confirms H1.

Consistent with H2, the more T2 need satisfaction students experienced during class, the greater was their T3 prosocial behavior ($B = 0.26$, $SE = 0.06$, $\beta = 0.28$, $t = 4.48$, $p < 0.001$), controlling for T1 prosocial behavior ($\beta = 0.54$, $p < 0.001$), T1 need satisfaction ($\beta =$

Table 1
Intercorrelations and descriptive statistics for experimental condition, latent variables, and statistical controls in the hypothesized model.

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Experimental Condition	–	−0.03	0.03	0.04	0.25	0.08	0.12	−0.14	−0.51	0.44
Time 1 Baseline										
2. Need Satisfaction		–	0.57	0.46	0.65	0.39	0.30	0.16	0.01	−0.09
3. Prosocial Behavior			–	0.58	0.37	0.59	0.37	−0.05	−0.04	−0.03
4. Parental Autonomy Support				–	0.30	0.35	0.56	−0.04	−0.05	−0.02
Time 2										
5. Need Satisfaction					–	0.42	0.35	0.05	−0.12	0.11
Time 3										
6. Prosocial Behavior						–	0.51	0.03	0.07	0.05
Time 4										
7. Parental Autonomy Support							–	0.03	−0.04	0.02
Statistical Controls										
8. Gender								–	0.17	0.02
9. Grade Level									–	0.08
10. Class Size	–									
Descriptive Statistics										
Mean	0.50	4.64	4.66	5.30	5.11	5.04	5.65	0.46	0.46	28.0
Standard Deviation	0.50	0.88	1.01	1.09	1.09	1.14	1.18	0.50	0.50	4.8

$N = 1185$ students. Any $r > 0.06$, $p < 0.05$; any $r > 0.08$, $p < 0.01$; and any $r > 0.10$, $p < 0.001$.

−0.10, $p = 0.116$), experimental condition ($\beta = 0.10$, $p = 0.054$), gender ($\beta = 0.00$, $p = 0.871$), grade level ($\beta = 0.17$, $p < 0.001$), and class size ($\beta = -0.03$, $p = 0.491$). This result confirms H2.

Consistent with H3, the more T3 prosocial behavior students experienced during class, the more T4 perceived autonomy-supportive parenting they reported at home ($B = 0.41$, $SE = 0.06$, $\beta = 0.41$, $t = 7.05$, $p < 0.001$), controlling for T1 autonomy-supportive parenting ($\beta = 0.52$, $p < 0.001$), T1 prosocial behavior ($\beta = -0.19$, $p < 0.001$), T1 need satisfaction ($\beta = -0.09$, $p = 0.102$), T2 need satisfaction ($\beta = 0.14$, $p = 0.003$), experimental condition ($\beta = 0.00$, $p = 0.941$), gender ($\beta = 0.02$, $p = 0.577$), grade level ($\beta = -0.06$, $p = 0.140$), and class size ($\beta = -0.01$, $p = 0.788$).

5.3. Explanatory mechanism

H3 proposed a mediation effect with the overall hypothesized model (experimental condition → T3 prosocial behavior → T4 perceived autonomy-supportive parenting). According to the Mplus analysis, the indirect effect of T3 prosocial behavior was significant, $B = 0.17$, $SE = 0.06$, $\beta = 0.08$, $t = 2.82$, $p = 0.005$. According to the bootstrapping procedure, the 95% confidence interval for the T3 prosocial behavior mediator did not contain 0 (95% $CI = +0.042, +0.143$). Collectively, these results establish mediation for H3.

In the test for the effect of experimental condition on student-reported T3 prosocial behavior and teacher-reported T3 prosocial behavior, scores in the experimental condition were significantly higher than scores in the control condition: student-reported T3 prosocial behavior (Ms, 5.31 vs. 4.83), $B = 0.41$, $SE = 0.12$, $\beta = 0.22$, $t = 3.39$, $p = 0.001$; and teacher-rated T3 prosocial behavior ($Ms = 5.67$ vs. 5.48), $B = 0.22$, $SE = 0.10$, $\beta = 0.14$, $t = 2.15$, $p = 0.031$. Importantly, teacher ratings agreed (correlated) significantly with students' T3 self-reported prosocial behavior, $B = 0.15$, $SE = 0.04$, $\beta = 0.21$, $t = 3.98$, $p < 0.001$.

6. Discussion

The present investigation produced two primary findings: (1) students of teachers in the experimental condition reported greater prosocial behavior (fueled by greater need satisfaction) than did students in the control condition and (2) these teacher-supported gains in prosocial behavior then enabled and encouraged greater perceived autonomy-supportive parenting ($\beta = 0.41$, $p < 0.001$; see Fig. 3). An additional finding was that teachers' mid-year ratings of students' prosocial behavior correlated significantly with students' self-reported mid-year prosocial behavior, which means that the underlying explanatory process behind the "the rich get richer" relationship spillover effect was a readily observable behavioral change (i.e., changes in T3 prosocial behavior). When taken as a whole, these findings provide initial, preliminary evidence for the hypothesized relationship spillover effect in which receiving autonomy support in one relationship (from one's teacher) makes it more likely that, over time, one will similarly receive greater autonomy support in a second, different relationship (from one's parents).

6.1. Two relationship spillover effects

The first discovered relationship spillover effect was that receiving autonomy support in one relationship led to more of its giving in another relationship—a "pay it forward" effect (Van der Kaap-Deeder, 2021; van der Kaap-Deeder et al., 2015). According to van der Kaap-Deeder and her colleagues, the mechanism underlying this "pay it forward" effect is an experience of need satisfaction. That is, receiving autonomy support generates need satisfaction (e.g., Aelterman et al., 2019), which then empowers the recipient to pay forward the greater autonomy support to others.

We identified a second relationship spillover effect—a "spreading" or a "the rich get richer" effect. Like the "pay it forward" effect, this spreading spillover effect begins with receiving high autonomy support. However, with the spreading effect, receiving autonomy support in one relationship makes it more likely that one will also receive autonomy support in another relationship. According to our findings, the mechanism underlying this "the rich get richer" effect is elevated social competence and improved peer interactions (i.e., greater prosocial behavior). That is, receiving autonomy support strengthens prosocial behavior, and this more constructive way of relating to others then enables and encourages greater autonomy support from others.

Other researchers have demonstrated a similar "the rich get richer" finding. Students' classroom functioning (e.g., high vs. low engagement) shapes the kinds of supports teachers and parents provide to students (Jang et al., 2024; Nurmi & Kiuru, 2015; Rickert & Skinner, 2024). This classroom functioning effect occurs both in student-teacher interactions at school (Skinner & Belmont, 1993) as well as in student-parent interactions at home (e.g., during homework sessions; Dumont et al., 2014).

6.2. Practical implications and future research

Both relationship spillover effects (i.e., "pay it forward", "the rich get richer") and both relationship partners (i.e., teachers, parents) are meaningfully important in terms of practical application and real-world implications. The spreading of autonomy support among one's

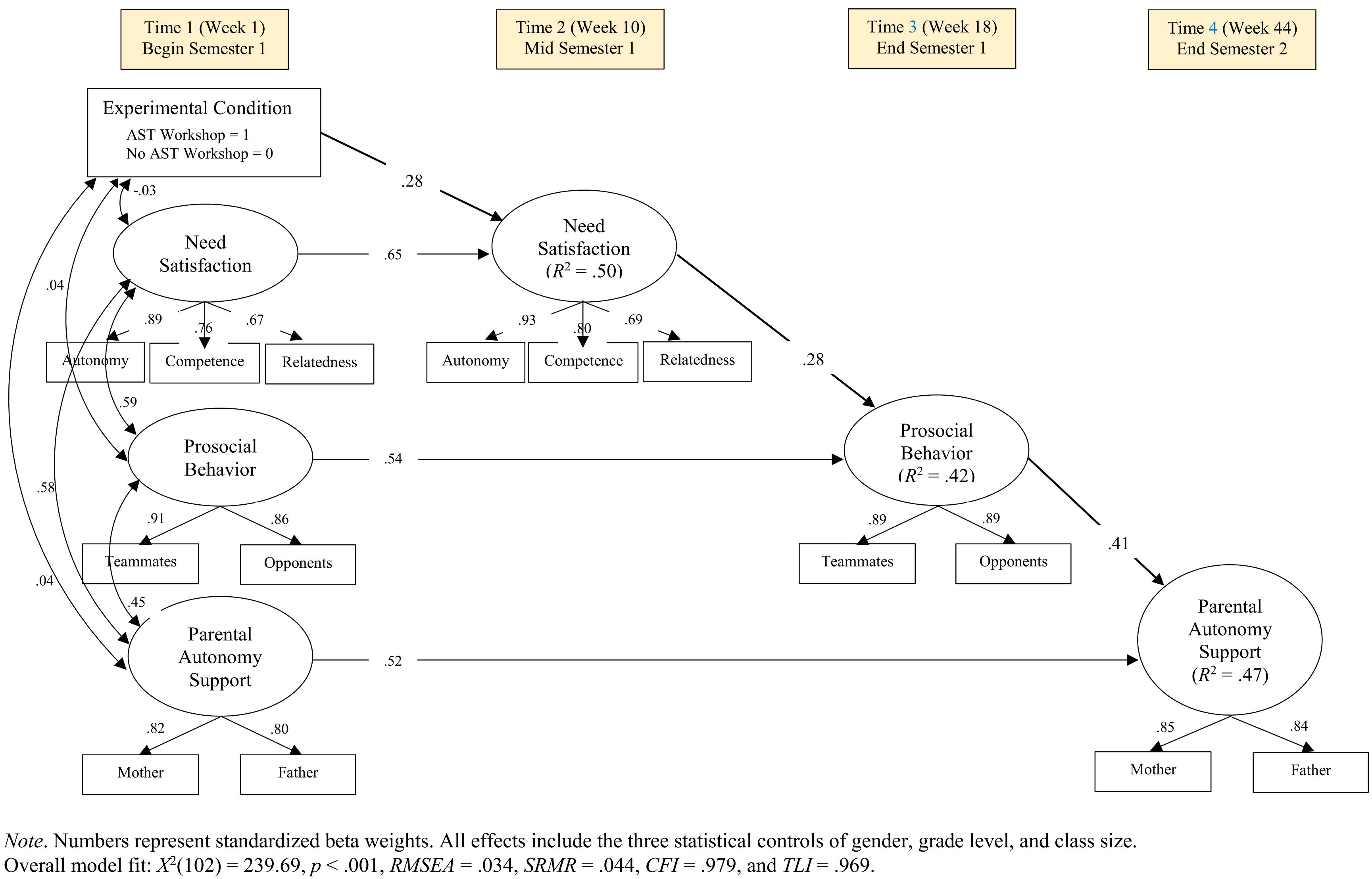

Fig. 3. Test of Hypothesized Model
Note. Numbers represent standardized beta weights. All effects include the three statistical controls of gender, grade level, and class size.
Overall model fit: $X^2(102) = 239.69$, $p < 0.001$, $RMSEA = 0.034$, $SRMR = 0.044$, $CFI = 0.979$, and $TLI = 0.969$.

relationship partners is a very important asset in any adolescent's life, because receiving autonomy support catalyzes all of the following manifestations of adaptive adjustment: engagement; agency and initiative; learning; skill development; positive self-concept; achievement; prosocial behavior; and positive emotions and well-being (Reeve et al., 2022; Rickert & Skinner, 2024; Ryan & Deci, 2017). Our interpretation as to why "the rich get richer" spillover effect occurred is that students who receive autonomy-supportive teaching first experience highly adaptive, teacher-supported changes in their motivation, engagement, learning, behavior, and well-being. We suspect that some of these adaptive changes are easier to observe for teachers, parents, and others (e.g., engagement, prosocial behavior) than are other less public and more privately-experienced changes (e.g., student motivation).

While our investigation focused on the adaptive change in students' prosocial behavior, we acknowledge that teacher-provided autonomy support tends to enhance multiple adaptive changes in students' classroom functioning (e.g., see Panels A–D in Fig. 2). This observation leads to two important conclusions. First, future research could explore and test for additional explanatory mechanisms beyond longitudinal gains in prosocial behavior. Second, while our explanatory mechanism was a longitudinal gain in prosocial behavior, the practical catalyst that launched the relationship spillover effect in the first place was greater autonomy-supportive teaching. From a practical point of view, it makes as much sense to focus on the relationship spillover effect's initial catalyst (greater autonomy-supportive teaching) as it does to focus on the downstream explanatory mechanism (greater prosocial behavior).

The most reliable way to help someone develop a more autonomy-supportive motivating style is to encourage that person to participate in a carefully-designed AST workshop (Reeve et al., 2022). However, in the present study, greater perceived autonomy-supportive parenting emerged as a naturally-occurring response. As students became more prosocial, parents tended to become more autonomy supportive. This means that a second avenue to learn how to become more autonomy supportive toward others is to listen to and be responsive to students' initiatives and cues for greater autonomy support.

Additional relationship spillover effects might also occur. Because greater autonomy-supportive teaching enhanced students T3 prosocial behavior, this means that students in the experimental condition were surrounded by relatively prosocial classmates. Perhaps an additional relationship spillover effect occurs from classmate-to-classmate. If so, this effect would be very similar to Kaap-Deeder et al.'s pay it forward effect among siblings. Recent experimental-intervention work shows that greater autonomy-supportive teaching promotes a more supportive peer-to-peer classroom climate (Cheon et al., 2022, Cheon, Reeve, Marsh, & Jang, 2023). Such autonomy-support can encourage a "pay it forward" effect, and such more positive classroom functioning can encourage a "rich get richer" effect. The autonomy-supportive teaching helps students in that class volitionally internalize prosocial values and behaviors (e.g., "be considerate of others", "use respectful language"), and it may also allow one's peers to see constructive gains in their classmates' adaptive functioning to bring out greater peer-provided autonomy support. This classmate-to-classmate relationship spillover effect seems like a promising area for future research to pursue.

A second future research study might investigate the reciprocal (or bi-directional) effects of autonomy-supportive teaching and autonomy-supportive parenting, as by using a random intercept cross-lagged panel model research design and analysis (Hamaker et al., 2015). Such an investigation would go a long way in helping educators better understand the complex social ecologies (school, home) that affect students' motivation and functioning (Skinner et al., 2022).

6.3. Limitations

We acknowledge that four methodological decisions may limit our conclusions. First, we assessed students' prosocial behavior in only one class, which was the PE course. Each student attended multiple classes at school, so the PE course and the PE teacher were only one class and one teacher in the student's school experience. It is possible that students' enhanced prosocial behavior spread or spilled over to their other (non-PE) courses and other social interactions and relationships, but our study did not assess this. How important a single class and a single teacher is to the relationship spillover effect and how generalizable the current findings from the PE course are need to be treated as merely initial, preliminary evidence for "the rich get richer" relationship spillover effect.

Second, classroom observers made only a single visit to observe and score each teacher's provision of autonomy-supportive teaching. It is possible that multiple classroom observations would produce a more reliable rating. However, we used a single classroom observation to represent teachers' provision of autonomy-supportive teaching following Wubbels et al.'s (2006) finding that a single classroom observation does serve to provide a reliable and representative sample of that teacher's motivating style.

Third, our study could be made methodologically stronger by having parents report on their child's prosocial behavior as well as on their own autonomy-supportive parenting. That said, we did collect teacher ratings of students' prosocial behavior, and we did collect observer ratings of teachers' autonomy-supportive instructional behaviors. These objective ratings help argue against a possible common method variance critique of our findings and interpretations. Nevertheless, assessing parental reports would improve the methodological rigor of this line of research.

Fourth, we pooled parents' autonomy-supportive style into a single overall latent variable score. We acknowledge that we could analyze mothers' and fathers' autonomy-supportive parenting separately, and also that previous research has adopted this approach (Van der Kaap-Deeder, 2021). However, we preferred to use the combined score because the mothers' and fathers' scores were so highly positively correlated in our dataset (r's [1185] at T1, T2, T3, and T4 = 0.66, 0.64, 0.69, and 0.71; all p's < 0.001). Our goal in the present study was simply to provide a first test of the hypothesized relationship spillover effect. Now that we have done this, we encourage future research to investigate for possible mother-father differences.

7. Conclusion

The findings support a school-to-home (teacher-to-parent) relationship spillover effect. Adolescents receipt of a high level of autonomy-supportive teaching spread or spilled over, one year later, from school to home such that these same adolescents received greater autonomy-supportive parenting. This spreading effect is important because the downstream benefits from autonomy-supportive relationship partners are widespread and profound.

Declaration of competing interest

The authors have no conflict of interest to declare related to the manuscript. The authors declare that we did not use any AI or AI-assisted technologies in preparing the manuscript.

Data availability

The dataset and Mplus syntax files to test the hypothesized model are available on the study's Open Science Framework project site, https://osf.io/g5wn8/?view_only=c79af500b7354f59bbc4d35849e41925.

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