EMPIRICAL ARTICLE

Variability and change in adolescents' prosocial behavior across multiple time scales

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Abstract
We examined variability and change in adolescents' prosocial behaviors directed to peers and friends across four time scales: two-years, one-year, two-monthly, and daily. Data from three longitudinal datasets with a total of 569 adolescents (55.7% girl, M_{age} = 15.23, SD = 3.90) were included. The overall time-related stability of prosocial behavior across time scales was moderate to excellent. Variability did not differ between early (age 10–15) and late (age 16–21) adolescence, but late adolescence was associated with higher mean levels of prosociality. Finally, results indicated that prosocial behaviors measured over longer periods (i.e., two-years and one-year) were positively associated with cognitive processes (perspective taking), whereas prosocial behaviors measured over shorter periods (i.e., two-monthly) were positively associated with affective processes (empathy).

KEYWORDS
adolescence, emotional support, giving, prosocial behavior, sharing

INTRODUCTION

Adolescence is a developmental period that is characterized by rapid changes in social contexts and a fundamental need to contribute to society (Crone & Fuligni, 2020; Fuligni, 2019). Adolescents spend more time outside the family context, and interactions with peers become more important over time (Crone & Dahl, 2012). Prosocial interactions form the basis of positive interpersonal relationships with family, peers, and intimate others (Carlo & Padilla-Walker, 2020). Moreover, opportunities to display prosocial behaviors (i.e., voluntary behaviors that are intended to benefit the recipient) are consistently linked with desirable developmental outcomes, such as psychosocial well-being (Hui et al., 2020).

Over the past decades, methodological and technological advances have enabled researchers to include multiple time scales in their studies of prosocial development. This is consistent with dynamic system theories, which state that developmental changes span across multiple time scales; from seconds to minutes, from hours to days and from months to years (Smith & Thelen, 2003). Time scale decision are, however, often based on methodological (e.g., power) or practical

(e.g., feasibility), rather than theoretical (e.g., hypotheses) arguments (Hopwood et al., 2022). To date, little is known about the variability of prosocial behavior across different time scales. Therefore, the main aim of this study is to examine variability and change in adolescent's prosocial behavior across multiple time scales, specifically two-years, one-year, two-monthly, and daily.

Change in prosocial behavior

Prosocial behavior is generally defined as a combination of different voluntary behaviors that are intended to benefit others, such as helping, sharing, comforting, and cooperating (Luengo Kanacri et al., 2014; Nantel-Vivier et al., 2009; van der Graaff et al., 2018). Assessment methods of general prosociality include self-report questionnaires, such as the Prosocialness Scale (Caprara et al., 2005), and parent- or teacher-report questionnaires, such as the Social Behavior Questionnaire (Tremblay et al., 1991). Longitudinal measurements are a powerful method to examine mean-level changes in general prosocial behavior.

A longitudinal self-report study across the adolescent period (age 13–18) found that general levels of prosocial behavior *increased* in early and mid-adolescence (van der Graaff et al., 2018). These linear mean-level changes are also reported during the transition period from late adolescence to emerging adulthood (Crocetti et al., 2016). In contrast, a cohort-sequential longitudinal study spanning over 4 years (including grade 7–12) found an overall *decrease* in self-reported prosocial behavior from early to middle adolescence (Carlo et al., 2007). Another cohort-sequential self-report study (age 13–21) found that general prosociality decreased until age 17 with a subsequent rebound until age 21 (Luengo Kanacri et al., 2014). Taken together, prior research on the development of general prosocial behavior shows mixed results, possibly due to the multidimensional nature of prosocial behavior (Carlo & Padilla-Walker, 2020).

The strength of the association between age and prosocial behavior may thus vary as a function of methodological factors, such as the type and recipient of prosocial behavior (Eisenberg & Fabes, 1998; Fabes et al., 1999). A 6-year longitudinal study among 6–12 year-olds found a linear decrease in *helping* as reported by parents, whereas *sharing* behavior did not change across time (Malti et al., 2016). Moreover, various studies have observed increases or peaks in prosocial behaviors directed toward friends, as compared to strangers (Brandner et al., 2020; Fu et al., 2017; Padilla-Walker et al., 2018; Sweijen et al., 2022; van de Groep et al., 2020). Thus, different developmental patterns have been observed for prosocial behaviors across adolescence, which can be partially explained by differences in assessed types and targets. This study therefore focuses on different types of prosocial behavior (i.e., giving/sharing, altruistic helping and emotional support) to familiar others, by the inclusion of the Opportunities for Prosocial Actions questionnaire (Blankenstein et al., 2020; van de Groep et al., 2020). Specifically, we measure prosocial behaviors directed to peers/friends, because relationships with peers and friends become increasingly important during adolescence (Schreuders et al., 2021). Moreover, these specific prosocial actions are found to facilitate reciprocal social connections (Padilla-Walker et al., 2015).

Variability of prosocial behavior

An overlooked but important determinant of prosocial development may be day-to-day dynamics in prosocial behavior. Earlier research has mainly examined mean-level changes, without explicitly taking the *variability and stability* of prosocial behavior into account. In related research fields (i.e., mood variability and value orientation), shifts from mean level change to examination of variability across time and context have pictured a more nuanced view of adolescent development (Daniel & Benish-Weisman, 2019; Döring et al., 2016; Larson & Lampman-Petraitis, 1989; Maciejewski et al., 2019). A longitudinal study on mood variability with daily measurements showed that for most (>80%)

adolescents, the frequency of mood swings declines over the course of adolescence, even after controlling for mean-level changes (Maciejewski et al., 2019). Moreover, a longitudinal study on personal value orientation (e.g., beliefs concerning desirable goals that serve as guiding principles in the individual's life) with three-monthly measurements has shown that only a small proportion (<5%) of adolescents experiences a change in their personal value hierarchy (Vecchione et al., 2020). Overall, these studies suggest that examining variability may help to paint a more complete picture of (prosocial) behavior change across adolescent development.

Up until now, there is little evidence on how the variability of prosocial behavior develops across adolescence, although in line with general trends toward intensive longitudinal data sampling (Podsakoff et al., 2019), there have been some studies that include daily or weekly assessments of prosocial behavior. A 10-week study (i.e., two reports per week) with university students showed that the between-day variability in empathic concern represented 54% of the total variance in empathy, which is an important precursor to prosocial behaviors (Nezlek et al., 2001). In a 14-day diary study among university students (mean age 19.9), participants reported on 85% of the days at least one prosocial helping act to a stranger or acquaintance, but variability across time was not reported (Morelli et al., 2014). A daily diary study on adolescents' (mean age 16.56) prosocial behavior during the COVID-19 pandemic showed that the variability of prosocial behavior did not change over the course of three weeks (van de Groep et al., 2020). Another daily diary study during the COVID-19 pandemic found that adolescents (mean age 15.31) displayed higher levels of daily prosocial support toward friends compared to family (Sweijen et al., 2022).

Variability and change across multiple time scales

To summarize, evidence on mean-level changes in prosocial behavior across adolescence is inconsistent, and relatively little is known about the potential impact of measurement timing on variability and change in prosocial behavior across adolescence and early adulthood. Therefore, the first goal of this study was to examine the impact of *measurement timing* on variability and change in prosocial behavior. Specifically, two larger (i.e., two-years and one-year) and two smaller (i.e., two-monthly, and daily) time scales were taken into account. We hypothesized that measurement timing influenced both variability and change in prosocial behavior across time, with higher variability (i.e., lower stability) on the daily and two-monthly levels compared to the two- and one-year levels, and higher mean-level change on the two- and one-year levels compared to the daily and two-monthly levels. This hypothesis was based on theoretical notions indicating that on shorter time scales, participants may base their answers on a more recent set of experiences and social interactions, which may on the one hand result in larger between-person variability in the assessed constructs, and on the other hand

TABLE 1 Overview of demographic information and measurement spacings for included datasets

	Two-year sample	One-year sample	Two-monthly sample	Daily sample
	[Braintime]	[Brainlinks]	[Brainlinks]	[Leiden self-concept]
Demographic information	$N = 267$ 9–21 years-old $M_{age} = 15.22$, SD = 2.83 52.8% girls	$N = 142^a$ 9–18 years-old $M_{age} = 14.46$, SD = 2.76 63.4% girls	$N = 134^a$ 9–18 years-old $M_{age} = 14.51$, SD = 2.70 64.2% girls	$N = 160$ 11–21 years-old $M_{age} = 15.92$, SD = 2.97 53.8% girls
Measurement spacings	2 timepoints T1–T2; 2 years	2 timepoints T1–T2; 1 year	5 time points M1–M5; 2 months	5 time points D1–D5; 1 day

[a]Same participants.

on lower between-person stability in comparison to larger time scales (Podsakoff et al., 2019).

A second, related goal was to examine the impact of *developmental differences* on variability and change in prosocial behavior across time scales. Specifically, we examined potential developmental differences from both a gradual-change perspective (i.e., continuous age-related differences) and a phase-related perspective (i.e., differences in early vs. late adolescence). It was expected that both variability and change in prosocial behavior would be larger in early adolescence (10–15) as compared to late adolescence (16–21). This hypothesis was based on theoretical notions indicating that the developmental phase of early adolescence is particularly characterized as a sensitive window for prosocial development (Dahl et al., 2018; Fabes et al., 1999), and empirical findings indicating that the variability in related constructs (i.e., mood) decreases with age during adolescence (Maciejewski et al., 2019).

Socio-cognitive and affective determinants of prosocial behavior: Empathy and perspective taking

An important determinant of the development of prosocial behavior are socio-cognitive and affective underlying processes, such as perspective taking and empathic concern (Eisenberg et al., 2005). A systematic review shows that perspective taking gradually increases during adolescence (i.e., across the ages of 13–18 years), and that this development is associated with prosocial attitudes (Hall et al., 2021). Empathy is also found to increase during the adolescent period (i.e., age 12–16; Allemand et al., 2015), and changes in empathic concern are found to be related to changes in prosocial behavior (van der Graaff et al., 2018). Although the relevance of these socio-cognitive and affective processes for the development of prosocial behavior have clearly been established in the literature, there remains debate about the relative importance of "understanding" (socio-cognitive) and "feeling" (affective) processes (van der Graaff et al., 2018). Moreover, the association between perspective taking/empathy and prosocial behavior measured at different time scales, has not been examined. The third aim of this study was therefore to examine the associations between baseline levels of perspective taking and empathy, and prosocial

behavior measured across time scales. It was expected that higher levels of empathy and perspective taking were related to higher levels of prosocial behavior on all four time scales (Eisenberg et al., 2005; van der Graaff et al., 2018).

Current study

The overall goal of this study was to examine variability and change in adolescents' prosocial behaviors across four time scales: two-years, one-year, two-monthly, and daily. This is important, because a better understanding of developmental differences in variability and change across time scales might have implications for our developmental understanding of and methodological approach to prosocial development. If across the adolescent period, the relative stability of year-to-year versus day-to-day changes in prosocial behavior shifts, this might indicate, for example, that the development of prosocial behavior is characterized by a process of daily prosocial exploration in early adolescence (i.e., relatively high day-to-day variability) toward prosocial commitment in late adolescence (i.e., relatively high year-to-year stability), mimicking identity processes (Klimstra et al., 2010). This knowledge can also inform us on aspects of prosociality that are particularly sensitive to environmental influences (i.e., interventions). Moreover, if the variability of prosocial behavior differs across time scales, this might inform future study design choices and questionnaire development (Hopwood et al., 2022).

METHOD

Design

The current study combined data from three longitudinal samples in the Netherlands: Braintime, Brainlinks, and Leiden Self-Concept (see Table 1). This enabled us to include four time scales, as the Brainlinks study includes both yearly and two-monthly measurement occasions of the same constructs. The Braintime study is a longitudinal study with three biannual measurement waves (i.e., Blankenstein et al., 2020). In the current study, data from the second (2013) and third (2015) timepoint were included, as these where the timepoints in which our measure of prosocial behavior was

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available. The Brainlinks study (https://osf.io/56t9m/) is an ongoing longitudinal study with yearly measurement waves (i.e., van de Groep et al., 2020). In the current study, data from the first (2018) and second (2019–2020) timepoint were included. Moreover, between the first and second timepoint, 5 questionnaires were included (spaced 2 months apart). The Leiden Self-Concept study is a longitudinal study with three yearly measurement waves (van der Cruijsen et al., 2019). In the current study, data from the first (2016) timepoint were used, as this timepoint included five daily diary assessments of prosocial behavior. The start day of the daily diary assessment differed per participant (e.g., 39% started on a Thursday, 20% on a Tuesday, 16% on a Saturday). For 91% of the participants, at least one weekend-day was included. The studies were approved by the Medical Ethics Committee (CME) of the Leiden University Medical Centre (LUMC). See Table 1 for the spacing of measures per sample.

Participants and procedure

In total, 569 participants (55.7% girl) between 9 and 21 years-old participated in this study (M_{age} = 15.23, SD = 3.90). Demographic statistics per sample are displayed in Table 1. The majority of Braintime participants was from a European Background (i.e., 81.2%; Blankenstein et al., 2020). Most Brainlinks participants were born in the Netherlands (97.8%), with 16.4% of participants having at least one parent born in another country than the Netherlands. Likewise, the majority of Leiden Self-Concept participants was born in the Netherlands (i.e., 95.3%; van der Cruijsen et al., 2019). Participants were divided into two age groups: early adolescence (9–15) and late adolescence (16–21). This division resulted in a good balance between developmental groups and sample size per group and is in accordance with earlier research (e.g., Masselink et al., 2018). At the first time point, 58.9% of the total sample could be classified as belonging to the early adolescence group. Adolescents aged above 21 were excluded (*n* = 25 in the 2-year sample). All questionnaires were answered by participants individually using online software systems (e.g., Qualtrics), and participants received an incentive for participation in the full study, which for all samples also included MRI scans. More details regarding demographics and study procedures (e.g., settings, recruitment) per datasets are reported elsewhere (Blankenstein et al., 2020; van de Groep et al., 2020; van der Cruijsen et al., 2019).

Missing data ranged across measurements from 6.3% to 12.7% for the two-year sample (Little's MCAR; χ^2/df = 0.75, *p* = .560) from 0.0% to 25.8% for the one-year sample (Little's MCAR; χ^2/df = 0.81, *p* = .626), from 6.7% to 26.9% for the two-monthly sample (Little's MCAR; χ^2/df = 1.19, *p* = .089), and from 0.0% to 26.9% for the daily sample (Little's MCAR; χ^2/df = 0.80, *p* = .722). In total, 71.8% of the participants completed at least 4 out of 5 two-monthly measurements and 83.7% of the participants completed at least 4 out of 5 daily measurements.

Measures

Opportunities for prosocial actions

The frequency of prosocial actions toward friends and/or peers was measured with the Opportunities for Prosocial Actions scale (OPA; Blankenstein et al., 2020; van de Groep et al., 2020). The questionnaire includes 25 items that cover a broad range of prosocial actions (i.e., altruistic prosocial actions, emotional support, and giving/sharing) across three subscales. All questions are asked for peers and friends combined. The total scale includes all 25 items. The altruism subscale includes 10 items (e.g., "Sacrificed your own goals to help a friend/peer with theirs"). The emotional support subscale includes 8 items (e.g., "Comforted a friend/peer when he/she was upset"). The giving/sharing subscale includes 7 items (e.g., "Gave money to a friend/peer because they really needed it"). For the two-year, one-year, and two-monthly prosocial behavior (see Table 1), participants were asked to indicate how often they displayed these behaviors "in the last (few) month(s)" on a 6-point scale from 1 (*not something I do*) to 6 (*very often*). For daily prosocial behavior (see Table 1), participants were asked to indicate whether they displayed these behaviors "that day" on a 2-point scale (*yes/no*). The items are provided in Table S1 and Cronbach's alphas are displayed in Table S2. Mean scores were constructed, with a higher score indicating that participants reported more prosocial behavior toward friends and peers.

Perspective taking and empathic concern

Perspective taking and empathic concern were measured with the Interpersonal Reactivity Index (IRI; Davis, 1980). The perspective taking subscale includes 6 items measuring the inclination to spontaneously adopt the psychological viewpoint of others. An example item from this scale is "I sometimes try to understand my friends better by imagining how things look from their perspective". The empathic concern subscale includes 6 items, measuring the tendency to experience feelings of warmth, compassion, and concern for other people. An example item from this scale is "I often have tender, concerned feelings for people less fortunate than me". Items are rated using a 5-point Likert scale from 0 (*does not at all apply to me*) to 4 (*completely applies to me*). Cronbach's alpha ranged from .68 to .72 across samples for the perspective taking scale and from .71 to .75 for the empathic concern scale.

Analyses

Variability in prosocial behavior

To examine the variability in prosocial behavior across time scales and between age groups, ICC estimates were calculated using SPSS statistical package version 24 (SPSS

Inc) based on a mean-rating, absolute agreement, two-way mixed-effects model (Koo & Li, 2016). ICC values <0.5 are interpreted as poor stability (i.e., high variability), values between 0.5 and 0.75 as moderate stability, values between 0.75 and 0.90 as good stability (i.e., low variability), and values >0.90 as excellent stability (Koo & Li, 2016). Differences in between-person stability were examined by checking overlap in 95% confidence intervals.

Change in prosocial behavior

To examine change in prosocial behavior across time scales and between age groups, we used two-way repeated measure ANOVAs, in which time (T1–T2) was included as within-person variable, age group (early adolescence vs. late adolescence) as between-person variable, and gender (0 = girl, 1 = boy) as between-person covariate. Gender was included as covariate, because prior research shows that the development of prosocial behavior differs for adolescent boys and girls, with girls displaying higher mean levels and steeper increases (van der Graaff et al., 2018).

Associations between perspective taking, empathy, and prosocial behavior

To examine the association between perspective taking, empathy, and prosocial behavior across time scales, a two-step approach was used. First, we examined the association in the two-year and one-year sample using SEM regression analyses (Mplus 8.0, MLM estimator). To examine the average association, perspective taking/empathy (T1) were simultaneously regressed on the average level of prosocial behavior (mean score T1–T2). Subsequently, to capture the longitudinal association, perspective taking/empathy (T1) and initial levels of prosocial behavior (T1) were simultaneously regressed on prosocial behavior measured at T2. Second, we examined the association in the two-monthly and daily sample, using LGM analyses (Mplus 8.0, MLM estimator). Specifically, perspective taking/empathy (T1) were simultaneously regressed on the intercept and slope of prosocial behavior.

RESULTS

Descriptive statistics and correlations among study variables are provided in Table 2.

Measurement timing differences in variability and change in prosocial behavior across time scales

Variability

First, the between-person variability in prosocial behavior was examined, with ICC estimates (see Table 3 and Figure 1).

For the two- and one-year measurements, stability of all (sub)scales of prosocial behavior can be classified as 'moderate', whereas for the two-monthly measurements, stability ranged between 'good' (i.e., altruism and giving/sharing) and 'excellent' (i.e., total prosocial actions and emotional support). For the daily intervals, stability also ranged between 'good' (i.e., altruism, emotional support and giving/sharing) and 'excellent' (i.e., total prosocial actions).

Change over a two-year period

In the next analysis, performed on the Braintime sample ($N = 267$), we addressed the question whether prosocial behavior changed across a two-year period. Results of a two-way Age Group × Time repeated measure ANOVA showed that the total level of prosocial actions did not change over the two-year period, $F(1, 212) = 0.35$, $p = .742$, $\eta^2 = .01$. The analysis was repeated for each subscale separately. For the altruism subscale, $F(1, 212) = 0.36$, $p = .547$, $\eta^2 = .01$, and the giving and sharing subscale, $F(1, 212) = 0.55$, $p = .457$, $\eta^2 = .01$, the total levels did not change over the two-year period. For the emotional support subscale, there was, however, a significant main effect of time, $F(1, 212) = 5.47$, $p = .020$, $\eta^2 = .03$, indicating that emotional support toward friends decreased over the two-year period. This effect was no longer statistically significant ($p = .055$), when the covariates age group and gender were removed from the model. Thus, across the two-year time period, only emotional support changed significantly.

Change over a one-year period

Next, we addressed change over a one-year period using the Brainlinks sample ($N = 142$). Results of a two-way repeated measure ANOVA showed a main effect of time for the total level of prosocial actions, with a decrease over the one-year period $F(1, 112) = 7.35$, $p = .008$, $\eta^2 = .06$. The main effect of time was also significant for the altruism subscale $F(1, 112) = 10.45$, $p = .002$, $\eta^2 = .09$, and the giving and sharing subscale, $F(1, 112) = 5.85$, $p = .017$, $\eta^2 = .05$, indicating that the frequency of altruistic actions and giving to and sharing with peers/friends decreased over the one-year period. For the emotional support subscale, the main effect of time was not significant, $F(1, 112) = 1.37$, $p = .244$, $\eta^2 = .01$. The within-subject effects of time on total prosocial actions ($p < .001$), altruism ($p < .001$), and giving/sharing ($p < .001$) remained significant after the covariates age group and gender were removed from the model. Thus, across the one-year time period, the total level of prosocial actions, altruism, and giving/sharing decreased significantly.

Change over five two-month periods

Next, we addressed change over five two-month periods using the Brainlinks sample ($N = 134$). Results of a two-way

TABLE 2   Descriptives and correlations with age, perspective taking, and empathic concern

	M	*SD*	1.	2.	3.
1. Age (T1)	15.23	2.90	–		
2. Perspective taking (T1)	2.33	0.78	.29**	–	
3. Empathic concern (T1)	2.39	0.60	−.06	.38**	–
Total prosocial actions					
4. Two-years (T1–T2)	3.86	0.78	.19**	.37**	.22**
5. One-year (T1–T2)	3.45	0.84	.09	.28**	.32**
6. Two-monthly (M1–M5)	3.60	0.76	.15	.08	.27**
7. Daily (D1–D5)	0.34	0.11	−.01	.19*	.07
Altruism					
8. Two-years (T1–T2)	3.73	0.90	.10	.30**	.18**
9. One-year (T1–T2)	3.13	0.95	−.08	.24**	.29**
10. Two-monthly (M1–M5)	3.20	0.87	−.02	.15	.17
11. Daily (D1–D5)	0.46	0.08	−.18*	.14	.03
Emotional support					
12. Two-years (T1–T2)	4.22	0.91	.15*	.37**	.27**
13. One-year (T1–T2)	4.06	0.96	.17*	.28**	.36**
14. Two-monthly (M1–M5)	4.06	0.86	.17	.10	.28**
15. Daily (D1–D5)	0.36	0.18	.07	.18*	.07
Giving and sharing					
16. Two-years (T1–T2)	3.65	0.78	.32**	.34**	.12
17. One-year (T1–T2)	3.22	0.92	.21*	.24**	.18*
18. Two-monthly (M1–M5)	3.25	0.86	.19*	.01	.21*
19. Daily (D1–D5)	0.16	0.16	.03	.16	.06

* indicates p < .05, ** indicates p < .01.

repeated measure ANOVA showed that the total level of prosocial actions did not change over the two-month periods $F(4, 73) = 0.29$, $p = .878$, $\eta^2 = .02$. The main effect of time was also not significant for the altruism subscale $F(4, 58) = 0.72$, $p = .581$, $\eta^2 = .05$, the emotional support subscale, $F(4, 72) = 0.25$, $p = .908$, $\eta^2 = .01$, and the giving and sharing subscale, $F(4, 61) = 0.98$, $p = .425$, $\eta^2 = .06$. Thus, across the two-month periods, prosocial behavior did not change.

Change over five one-day periods

Next, we addressed change over five days using the Leiden Self-Concept sample ($N = 160$). Results of a two-way repeated measure ANOVA showed that the total level of prosocial actions did not change over the 5 days, $F(4, 111) = 2.11$, $p = .084$, $\eta^2 = .07$. For the altruism subscale $F(4, 111) = 1.65$, $p = .168$, $\eta^2 = .06$, and the emotional support subscale, $(4, 111) = 0.95$, $p = .440$, $\eta^2 = .03$, the main effect of time was also not significant. For the giving and sharing subscale, the main effect of time, $F(4, 111) = 2.79$, $p = .030$, $\eta^2 = .09$, was, however, significant. Specifically, there was a decrease in giving and sharing over the five days. The within-subject effects of time on giving/sharing ($p < .001$) remained significant after the

covariates age and gender were removed from the model. Thus, across days, only giving/sharing decreased.

Developmental differences in variability and change in prosocial behavior across time scales

Variability

To examine whether the between-person variability of prosocial behavior differed depending on developmental phase, we repeated the between-person variability analysis for the two age groups separately. The between-person stability in prosocial behavior for the early (9–15) adolescence and late (16–21) adolescence sample is reported in Table 3. Confidence intervals overlapped for all constructs. Thus, the average between-person stability was comparable between the two age groups (Figure 1).

Associations between age and prosocial behavior

Next, we examined whether the associations between age and mean levels of prosocial behavior were comparable

across the four time scales. This association is plotted in Figure 3, and descriptives are included in Table 2. Because the daily measure used a different scale (i.e., yes/no, see the method section), the average daily scores are lower, and age trends cannot be directly compared. Visual inspection showed that the 95% confidence intervals for the two-year, one-year, and two-monthly intervals show overlap (Figure 3). This indicates that there are similarities in developmental patterns.

Developmental phase differences in change over a two-year period

Results of a two-way Age Group × Time repeated measure ANOVA showed that there was a significant main effect of age group, $F(1, 212) = 10.59$, $p = .001$, $\eta^2 = .05$, and a significant interaction between change over time and age group, $F(1, 212) = 11.82$, $p = .001$, $\eta^2 = .05$ for the total level of prosocial actions in the two-year Braintime sample ($N = 267$). Adolescents in the late adolescence group reported significantly more prosocial actions than adolescents in the early adolescence group, and the two-year increase in prosocial actions was larger in the late adolescence group than in the early adolescence group (see Figure 2, panel a). The analysis was repeated for each subscale separately. For the altruism subscale, we also found a significant main effect of age group, $F(1, 212) = 4.69$, $p = .032$, $\eta^2 = .02$, and a significant interaction between change over time and age group, $F(1, 212) = 32.81$, $p < .001$, $\eta^2 = .13$. Similar as observed for total prosocial actions, adolescents in the late adolescence group reported significantly more altruism and a larger two-year increase than adolescents in the early adolescence group (see Figure 2, panel b). For the emotional support subscale, there was a significant main effect of age group, $F(1, 212) = 3.25$, $p = .012$, $\eta^2 = .03$. Adolescents in the late adolescence group reported higher levels of emotional support, but the decrease over time did not significantly differ between the early and late adolescence sample $F(1, 212) = 1.08$, $p = .299$, $\eta^2 = .01$ (see Figure 2, panel c). For the giving and sharing subscale, we also found a significant main effect of age group, $F(1, 212) = 19.71$, $p < .001$, $\eta^2 = .09$, and a significant

TABLE 3 Average between-person stability (ICC[a]) in prosocial behavior across time scales

|	Total	Age: 9–15	Age: 16–21
Total prosocial actions			
Two-years (T1–T2)	.71 [.62, .78]	.67 [.54, .76]	.77 [.60, .86]
One-year (T1–T2)	.67 [.45, .80]	.66 [.44, .80]	.69 [.26, .85]
Two-monthly (M1–M5)	.93 [.90, .95]	.91 [.86, .95]	.94 [.90, .97]
Daily (D1–D5)	.85 [.80, .89]	.83 [.75, .89]	.87 [.80, .92]
Altruism			
Two-years (T1–T2)	.62 [.50, .71]	.59 [.43, .71]	.70 [.36, .84]
One-year (T1–T2)	.60 [.26, .77]	.61 [.29, .78]	.60 [.07, .81]
Two-monthly (M1–M5)	.89 [.84, .93]	.83 [.72, .90]	.94 [.90, .97]
Daily (D1–D5)	.75 [.66, .81]	.73 [.61, .82]	.74 [.61, .83]
Emotional support			
Two-years (T1–T2)	.71 [.62, .78]	.73 [.62, .81]	.65 [.45, .78]
One-year (T1–T2)	.73 [.60, .81]	.71 [.54, .82]	.71 [.47, .84]
Two-monthly (M1–M5)	.92 [.88, .94]	.91 [.87, .95]	.92 [.87, .96]
Daily (D1–D5)	.81 [.75, .86]	.79 [.70, .67]	.82 [.74, .89]
Giving and sharing			
Two-years (T1–T2)	.64 [.53, .73]	.65 [.52, .75]	.57 [.24, .74]
One-year (T1–T2)	.67 [.50, .78]	.63 [.40, .77]	.72 [.45, .85]
Two-monthly (M1–M5)	.87 [.81, .91]	.87 [.79, .93]	.86 [.77, .93]
Daily (D1–D5)	.79 [.73, .85]	.79 [.69, .86]	.80 [.71, .87]

[a]95% CI in square brackets.
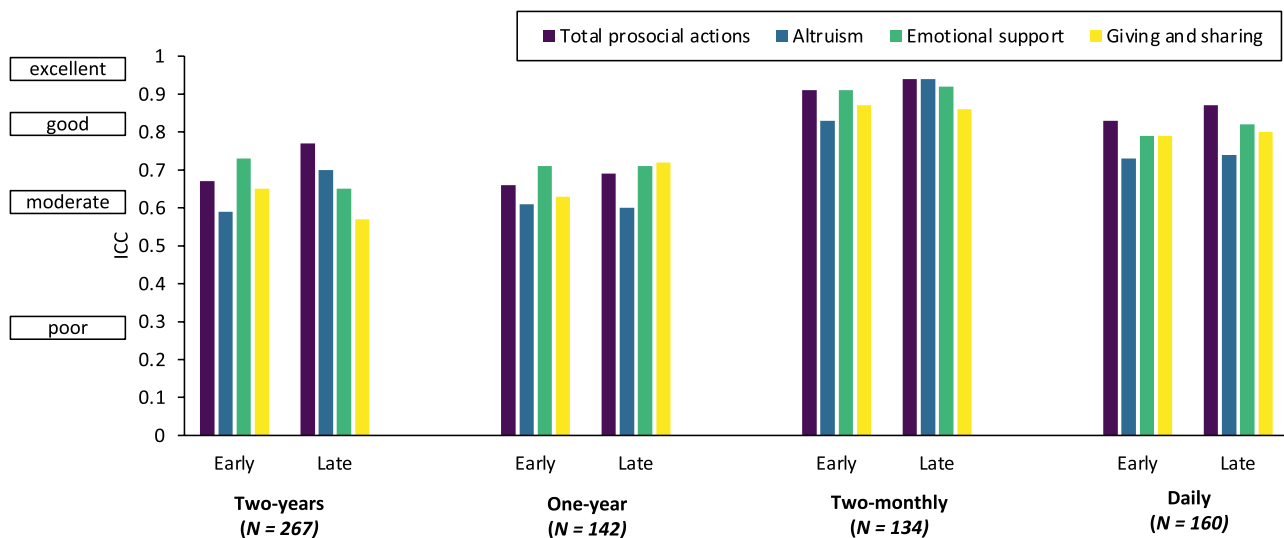
FIGURE 1 Between-person stability (ICCs) in total prosocial actions, altruism, emotional support, and giving/sharing in early (age 10–15) and late (age 16–21) adolescence across four samples
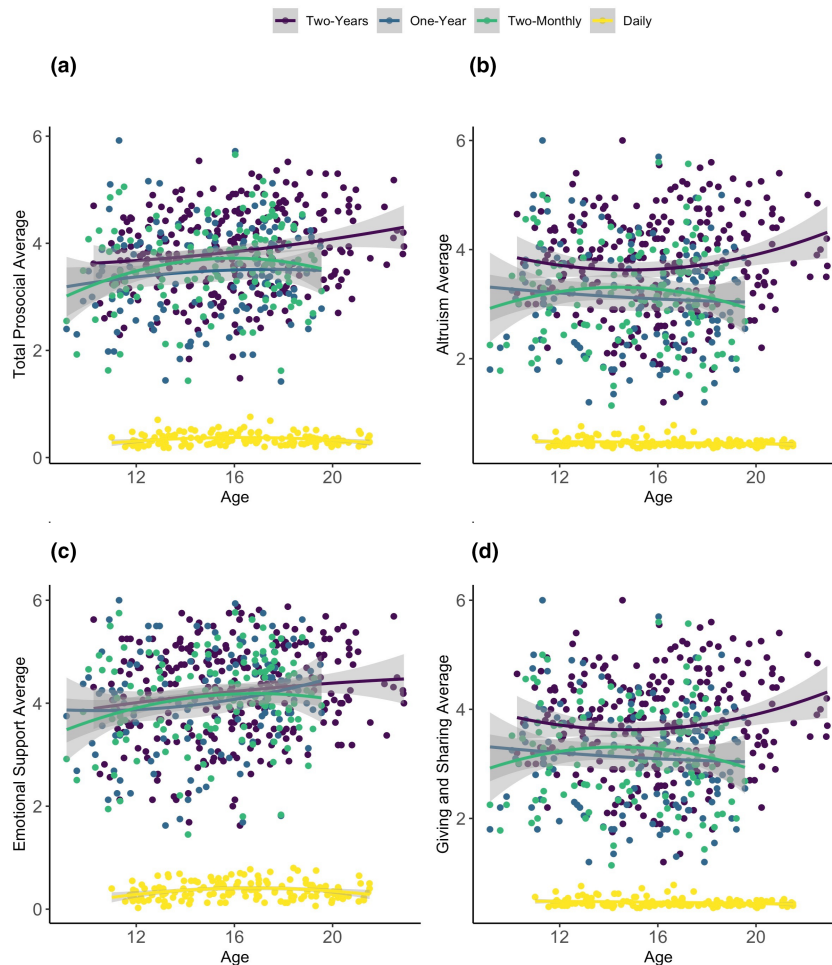
FIGURE 2 Association between age (averaged across time points) and average prosocial behavior (mean across time points) in total prosocial behavior (panel a), altruism (panel b), emotional support (panel c), and giving/sharing (panel d). *Note*: The shaded area represents the 95% confidence interval.

interaction between change over time and age group, $F(1, 212) = 8.26$, $p = .004$, $\eta^2 = .04$. Adolescents in the late adolescence group reported significantly more giving/sharing and a larger two-year increase than adolescents in the early adolescence group (see Figure 2, panel d). Thus, the late adolescence group reported higher levels of all prosocial actions than the early adolescence group, and for total prosocial actions, altruism, and giving/sharing, two-year increases were larger in the late adolescence group.

Developmental phase differences in change over a one-year period

Results of a two-way Age Group × Time repeated measure ANOVA showed that the main effect of age group on the total level of prosocial behaviors in the one-year Brainlinks sample ($N = 142$) was not significant, $F(1, 112) = 1.16$, $p = .283$, $\eta^2 = .01$. Moreover, the decrease over time did not significantly differ between the early and late adolescence sample, $F(1, 112) = 0.24$, $p = .629$, $\eta^2 = .01$. For the altruism

subscale, the main effect of age group, $F(1, 112) = 0.21$, $p = .646$, $\eta^2 = .01$, and the interaction between time and age group were, also not significant, $F(1, 112) = 0.39$, $p = .535$, $\eta^2 = .01$. Thus, the frequency of altruistic actions toward friends decreased for both the early and late adolescence sample. For the emotional support subscale, the main effect of age group was significant, $F(1, 112) = 5.84$, $p = .017$, $\eta^2 = .05$, but the interaction between time and age group, $F(1, 112) = 0.01$, $p = .950$, $\eta^2 = .01$, was not significant. Thus, adolescents in the late adolescence group reported significantly more emotional support to peers and friends than adolescents in the early adolescence group over the one-year period, but the change over time did not differ between the early and late adolescence sample. For the giving and sharing subscale, the main effect of age group, $F(1, 112) = 1.95$, $p = .165$, $\eta^2 = .02$, and the interaction between time and age group were, however, not significant, $F(1, 112) = 0.30$, $p = .585$, $\eta^2 = .01$, indicating that the frequency of giving to and sharing with friends decreased for both the early and late adolescence sample. Thus, the late adolescence group reported higher levels of emotional support
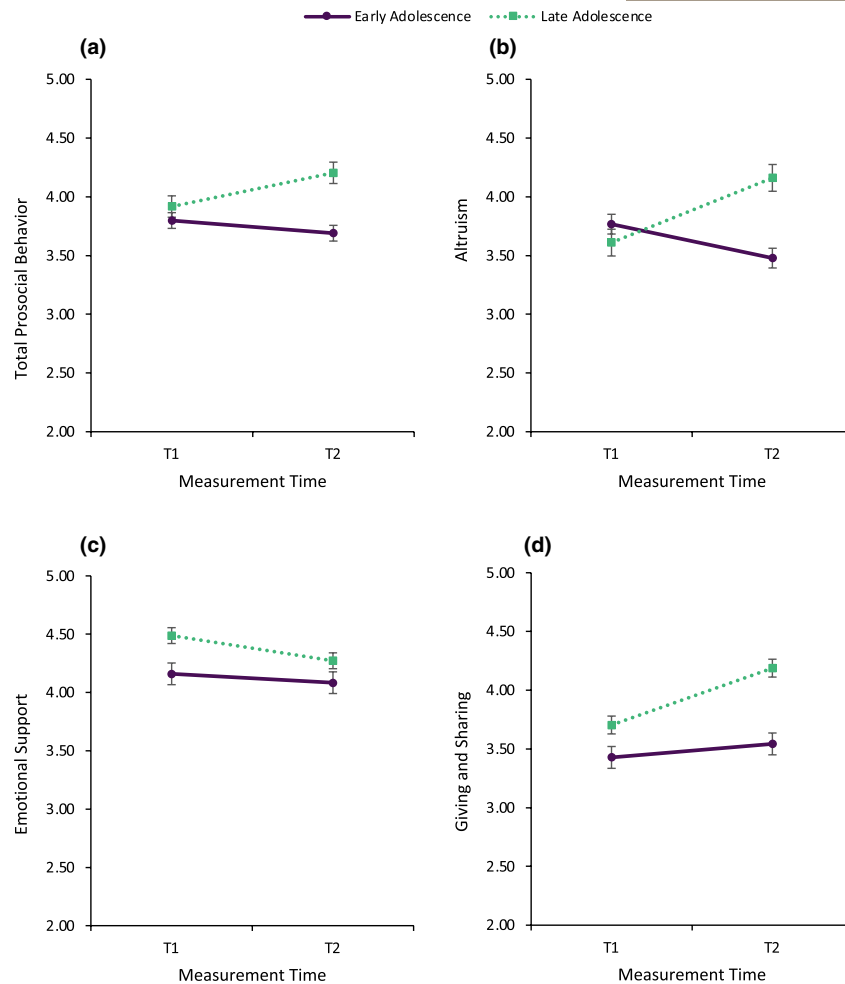
FIGURE 3 Two-year change in total prosocial actions (panel a), altruism (panel b), emotional support (panel c), and giving/sharing (panel d) in early (age 10–15) and late (age 16–21) adolescents (two-year sample; $N = 267$). *Note*: The error bar represents one standard error around the mean.

toward peers and friends than the early adolescence group, but one-year increases in prosocial actions did not differ between the two groups.

Developmental phase differences in change over five two-month periods

Next, we addressed developmental phase differences in the change over five two-month periods using the two-months Brainlinks sample ($N = 134$). Results of a two-way repeated measure ANOVA showed that the main effect of age group was not significant, $F(1, 76) = 0.81$, $p = .372$, $\eta^2 = .01$. The decrease over time did also not significantly differ between the early and late adolescence sample, $F(4, 73) = 0.89$, $p = .476$, $\eta^2 = .05$. For the altruism subscale, the main effect of age group, $F(1, 61) = 0.01$, $p = .935$, $\eta^2 = .00$, and the interaction between time and age group, $F(4, 58) = 0.91$, $p = .464$, $\eta^2 = .06$, were also not significant. For the emotional support subscale, the main effect of age group, $F(1, 75) = 0.67$, $p = .235$, $\eta^2 = .02$, and the interaction between time and age group, $F(4, 72) = 0.60$, $p = .661$, $\eta^2 = .03$, were also not significant. For the giving and sharing subscale, the main effect of

age group, $F(1, 64) = 0.25$, $p = .617$, $\eta^2 = .00$, and the interaction between time and age group, $F(4, 61) = 0.81$, $p = .521$, $\eta^2 = .05$, were not significant. Thus, over the five two-month periods, we did not find any developmental phase differences in prosocial behavior.

Developmental phase differences in change over five one-day periods

Next, we addressed developmental phase differences in the change over five one-day periods using the Leiden Self-Concept sample ($N = 160$). Results of a two-way repeated measure ANOVA showed that the main effect of age group was not significant, $F(1, 114) = 1.09$, $p = .299$, $\eta^2 = .01$. Moreover, the decrease over time did not significantly differ between the early and late adolescence sample, $F(4, 111) = 0.46$, $p = .762$, $\eta^2 = .02$. For the altruism subscale, the interaction between time and age group, $F(1, 61) = 0.01$, $p = .935$, $\eta^2 = .00$ was also not significant. There was, however, a main effect of age group, $F(1, 114) = 6.65$, $p = .011$, $\eta^2 = .06$, with the younger age group reporting higher daily mean levels of altruism. For the emotional support subscale, the main

TABLE 4 Parameter estimates for the association between socio-cognitive and affective determinants (T1) and average (mean T1–T2) or longitudinal (T2, accounting for differences at T1) prosocial behavior in the two- and one-year samples

	Average				Longitudinal			
	B	SE	β	p	B	SE	β	p
Two-years total prosocial actions								
Perspective taking	0.34	0.08	0.30	<.001	0.03	0.09	0.02	.747
Empathic concern	0.14	0.09	0.12	.100	0.10	0.08	0.07	.226
Two-years altruism								
Perspective taking	0.31	0.09	0.24	.001	0.17	0.11	0.11	.131
Empathic concern	0.14	0.11	0.10	.202	0.10	0.12	0.06	.344
Two-years emotional support								
Perspective taking	0.31	0.09	0.24	.001	−0.16	0.10	−0.11	.106
Empathic concern	0.27	0.10	0.19	.005	0.22	0.11	0.14	.046
Two-years giving and sharing								
Perspective taking	0.40	0.07	0.35	<.001	0.12	0.10	0.10	.209
Empathic concern	−0.01	0.07	−0.01	.992	−0.03	0.08	−0.02	.715
One-year total prosocial actions								
Perspective taking	0.27	0.14	0.19	.044	0.07	0.14	0.04	.626
Empathic concern	0.38	0.15	0.25	.012	0.08	0.16	0.05	.624
One-year altruism								
Perspective taking	0.24	0.15	0.15	.102	−0.05	0.15	−0.03	.726
Empathic concern	0.40	0.18	0.23	.028	0.10	0.19	0.05	.610
One-year emotional support								
Perspective taking	0.27	0.15	0.16	.079	0.18	0.15	0.10	.234
Empathic concern	0.51	0.15	0.30	.001	0.16	0.19	0.08	.396
One-year giving and sharing								
Perspective taking	0.33	0.15	0.20	.029	0.13	0.16	0.08	.424
Empathic concern	0.19	0.17	0.11	.277	−0.01	0.17	−0.01	.972

effect of age group, $F(1, 114) = 0.01$, $p = .934$, $\eta^2 = .00$, and the interaction between time and age group, $F(4, 11) = 0.27$, $p = .897$, $\eta^2 = .01$, were not significant. Thus, over the days, emotional support toward friends did not change. For the giving and sharing subscale, the main effect of age group, $F(1, 114) = 0.43$, $p = .515$, $\eta^2 = .00$, and the interaction between time and age group, $F(4, 111) = 1.49$, $p = .209$, $\eta^2 = .05$, were not significant. Thus, although the younger age group reported higher daily mean levels of altruism, no developmental phase differences in daily prosocial behavior were found.

Associations between prosocial behavior, perspective taking, and empathy

Two-year sample

Results of SEM regression analyses are reported in Table 4. Perspective taking was significantly associated with all two-year average levels of prosocial behavior (i.e., total prosocial actions, altruism, emotional support, giving/sharing). Thus, adolescents who reported higher levels of perspective taking reported higher two-year average levels of prosocial behavior. No significant two-year longitudinal associations between perspective taking and prosocial behavior were found. Thus, adolescents with higher levels of perspective taking did not change more over a two-year period in prosocial behavior. Empathic concern was significantly associated with two-year average and longitudinal levels of emotional support, but not with total prosocial actions, emotional support, and giving/sharing. This indicates that adolescents who reported higher levels of empathic concern at the first measurement moment also reported higher levels of emotional support toward peers and friends two years later, even when taking initial levels of emotional support into account.

One-year sample

Results of SEM regression analyses showed that perspective taking was significantly associated with the one-year average levels of total prosocial actions and giving/sharing, but not with altruism and emotional support (Table 4). Thus, adolescents who reported higher levels of perspective taking reported higher one-year average levels of total prosocial actions and emotional support toward peers and friends. Empathic concern at the first measurement moment was

significantly associated with one-year average levels of total prosocial actions, altruism, and emotional support, but not with giving/sharing. No associations with one-year changes in prosocial behavior were found.

Two-monthly sample

Results of LGM analyses with perspective taking and empathic concern as predictors of the intercepts and slopes of two-monthly prosocial behavior are reported in Table 5, and the univariate growth models are reported in Tables S3 and S4. Perspective taking was not associated with the intercepts of two-monthly measured prosocial behavior. Thus, adolescents who reported higher levels of perspective taking did not report higher initial levels of prosocial behavior in the two-monthly sample. Empathic concern was positively associated with the intercept of total prosocial actions and emotional support, but not with altruism, giving/sharing and two-monthly changes in prosocial behavior. Thus, adolescents who reported higher levels of empathic concern, also reported higher initial levels of prosocial actions and emotional support toward peers and friends, but empathic concern was unrelated to changes in prosocial behavior in the two-monthly sample. No associations with two-monthly changes in prosocial behavior were found.

Daily sample

Results of LGM analyses with perspective taking and empathic concern as predictors of the intercepts and slopes of daily prosocial behavior are reported in Table 5, and the univariate growth models are reported in Tables S3 and S4. Perspective taking and empathic concern were not significantly associated with the intercepts or slopes of daily measured prosocial behavior (Table 5). Thus, adolescents who reported higher levels of perspective taking and empathic concern did not report higher initial levels of—or steeper changes in—prosocial behavior in the daily sample.

DISCUSSION

The main aim of the current study was to examine variability and change in adolescents' prosocial behavior directed to peers and friends across four time scales: two-years, one-year, two-monthly, and daily, using the Opportunities for Prosocial Actions questionnaire (Blankenstein et al., 2020; van de Groep et al., 2020). Results indicated that the overall time-related stability of prosocial behavior across time scales was moderate to excellent during both early (age 10–15) and late (age 16–21) adolescence, showing that prosocial behavior can be assessed reliably on all time scales. Mean levels of prosocial behavior were higher during late adolescence, in comparison to early adolescence. With regard to change over

time, the results indicated that two-year increases of altruism and giving/sharing were larger in the late adolescence group compared to the early adolescence group, but this pattern was not found on shorter time scales. Finally, an analysis of associations with socio-cognitive and affective factors perspective taking and empathic concern, revealed relations mostly with longer term assessment. Specifically, perspective taking was positively associated with giving/sharing (average two-years and one-year), altruism (average one-year), and emotional support (average one-year). Empathic concern was only positively associated with emotional support (average/longitudinal two-years, average one-year, average two-monthly) and altruism (average one-year).

Methodological implications

The current study has several implications for future research on prosocial development in adolescence. First, this study shows that prosocial behavior can be reliably measured on both longer (i.e., year-to-year) and shorter (i.e., day-to-day) time intervals. The overall time-related stability of prosocial behavior could be classified as moderate to excellent across all four time scales (two-years, one-year, two-monthly, daily). It should be noted, however, that we were not able to directly test differences in stability scores between time scales. Stability differences between time scales may be an artifact of the study design, in which the longer time intervals (two-years, one-year) consisted of two time points, and the shorter time intervals (two-monthly, daily) of five time points. As such, it cannot be ruled out that stability estimates were influenced by the number of time points included. For future research, it is recommended to measure the same participants over both longer and shorter time-points.

Second, this study shows that in order to examine change in prosocial behavior over time, longer time scales are recommended. Specifically, this study showed that although age-related developmental patterns were comparable across time scales, mean-level changes were most profound on the two-year time scale. This indicates that developmental processes underlying prosocial development, can best be captured on a macro time scale. Moreover, it is recommended that future research includes at least three measurement points, as this broadens the statistical methods that can be used (Curran et al., 2010). In the current study, the two- and one-year time scales only consisted of two available measurement points, which made it difficult to use more advanced statistical methods, such as accelerated latent growth models (Duncan et al., 1996) and latent class growth (mixture) analysis (Jung & Wickrama, 2008). Studies have shown that the developmental trajectories of prosocial behavior in adolescence can be clustered into different groups (Flynn et al., 2015; Nantel-Vivier et al., 2009). For example, in a study that included yearly assessments, three prosocial trajectory groups were found (i.e., low, medium, and high mean-levels of prosocial behaviors), but within these groups, prosocial behavior remained relatively stable from middle

TABLE 5 Parameter estimates for the association between socio-cognitive and affective determinants (T1) and initial (intercept) or longitudinal (linear slope) prosocial behavior in the two-monthly and daily samples

	Intercept				Linear slope			
	B	SE	β	p	B	SE	β	p
Two-monthly total prosocial actions								
Perspective taking	0.03	0.13	0.03	.792	−0.05	−0.29	−1.04	.128
Empathic concern	0.33	0.14	0.26	.016	0.04	0.20	0.89	.299
Two-monthly altruism								
Perspective taking	0.22	0.15	0.19	.150	−0.06	0.04	−0.32	.187
Empathic concern	0.16	0.17	0.13	.362	0.05	0.04	0.26	.238
Two-monthly emotional support								
Perspective taking	−0.06	0.15	−0.04	.677	0.01	0.04	0.08	.715
Empathic concern	0.49	0.15	0.33	.001	−0.02	0.04	−0.10	.668
Two-monthly giving and sharing								
Perspective taking	0.01	0.17	0.00	.997	−0.07	0.06	−0.24	.227
Empathic concern	0.23	0.19	0.15	.214	0.09	0.06	0.30	.133
Daily total prosocial actions								
Perspective taking	0.03	0.02	0.20	.050	0.00	0.01	−0.07	.971
Empathic concern	0.01	0.02	0.05	.608	−0.01	0.00	−0.98	.506
Daily altruism								
Perspective taking	0.02	0.01	0.17	.151	0.00	0.01	0.11	.917
Empathic concern	0.01	0.02	0.10	.411	−0.01	0.01	0.13	.111
Daily emotional support								
Perspective taking	0.05	0.03	0.21	.077	−0.01	0.01	−0.92	.822
Empathic concern	0.00	0.03	0.01	.995	0.01	0.01	0.76	.822
Daily giving and sharing								
Perspective taking	0.04	0.02	0.19	.095	−0.01	0.01	−0.34	.862
Empathic concern	0.01	0.03	0.05	.583	−0.01	0.01	−0.84	.583

childhood to late adolescence (Flynn et al., 2015). Thus, inclusion of mixture modeling with different time scales may be an interesting direction for future research.

Third, the current study's findings highlight the multidimensional nature of prosocial behavior (Carlo & Padilla-Walker, 2020). Consistent with theory and empirical evidence, change trajectories of the three measured aspects of prosocial behavior (e.g., altruism, emotional support, giving/sharing) and associations with socio-cognitive and affective factors differed, which highlights that prosocial behavior takes on many different forms in the daily life of adolescents (Eisenberg & Spinrad, 2014). It is therefore recommended that future research uses behavior-specific scale scores of prosocial behavior, such as the three types of prosocial actions directed to peers and friends that were included in the current study, rather than overall levels of prosocial behavior, especially when different time scales are included.

Developmental implications

This study also provided the possibility to examine developmental differences in variability and change in prosocial behavior across time scales. Consistent with some prior studies (e.g., Blankenstein et al., 2020; Carlo et al., 2015), higher mean levels of prosocial actions toward peers and friends were reported during late adolescence, as compared to early adolescence. When measured across a larger time scale (i.e., two-years), prosocial behavior increased in late adolescence, but was relatively stable in early adolescence. An analysis examining subscales in more detail revealed that specifically altruism and giving/sharing increased in late adolescence, whereas no developmental effect was observed for emotional support. Notably, the same analysis over a one-year interval did not confirm the developmental pattern of increases in prosocial behavior. In contrast, altruism and giving/sharing decreased in both early and late adolescence during the one-year interval. This is in contrast to empirical studies that found increases in specific aspects of prosocial behavior during early adolescence, such as a longitudinal study that examined one-year changes over the course of five years (age 11–14) in which prosocial behavior toward friends increased (Fu et al., 2017).

Taken together, the current study shows that even though general levels of prosocial behavior may increase over time (i.e., two-years), this is not necessarily associated with similar patterns of mean-level changes at shorter time scales. Prior research suggested that prosocial behavior directed to peers and friends is non-linear, with decreases during early adolescence, and subsequently increases again toward middle/late adolescence into early adulthood (Carlo et al., 2015). A cohort-sequential longitudinal study also found that the overall level prosociality declined until approximately age 17 with a slight rebound until age 21 (Luengo Kanacri et al., 2014). If increases in prosocial behavior only become apparent in late adolescence/early adulthood, this may explain why the current study mainly found increases in late adolescence on the two-year interval, which included participants who were at the first timepoint between 9 and 21-years-old.

A potential explanation for our findings is that changes in prosocial behavior are a consequence of increased opportunities to act prosocial during late adolescence. The various contexts that adolescents engage in, such as their family context, school context, and community context, shape their prosocial motivations (Sweijen et al., 2022). Transitions in context, may however also influence the opportunities that adolescents have to behave prosocial. During the developmental period of late adolescence, adolescents for example enter the job market and have more financial means, which might also increase their possibilities to act prosocially (i.e., more opportunities to donate money to charity or to give money to peers or friends). Future research should examine the potential interaction between changes in prosocial opportunities and changes in prosocial motivation.

It should also be noted that the three aspects of prosocial behavior that were examined in the current study (i.e., altruism, emotional support, giving/sharing), differed in change patterns. Specifically, emotional support to friends and peers did not change over the two-year, one-year, two-month, and daily measurement intervals, which may suggest that this is a unique aspect of prosociality that is relatively stable over time. Recent empirical work also indicates that emotional support may be a unique aspect of helping behavior. A daily diary study among university students showed, for example, that the effects of helping on well-being varied by the type of support provided, with differences between emotional and instrumental support (Armstrong-Carter et al., 2020).

The current study also showed that perspective taking and empathic concern were differentially associated with prosocial behavior, depending on the time scale. Specifically, perspective taking was mainly associated with one- and two-year measures of prosocial behavior, whereas two-month measures were only associated with empathic concern. This finding is in line with the theoretical idea that on shorter time scales, participants base their responses on a more recent set of emotional experiences and interactions (Podsakoff et al., 2019). Thus, between-person differences in prosocial behavior over shorter periods (i.e., two-months or one-day intervals) may be driven by affective processes such as empathy and mood, whereas differences over longer time periods (i.e., two-years and one-year) may be driven by more cognitive (i.e., reflective) processes, such as perspective taking.

These findings may not only have implications for developmental theories, but also for (educational) applications. Youth growing up in our society face multiple challenges (i.e., social injustice, climate change), and opportunities for prosocial actions may empower adolescents in dealing with these challenges (e.g., when peers are bullied or cyberbullied based on their social identities; Byers & Cerulli, 2021; Mulvey et al., 2018). Our finding that fluctuations in prosocial behavior over shorter time periods are linked to affective (i.e., empathic concern) rather than cognitive (i.e., perspective taking) processes, might indicate that adolescents are more likely to act prosocial when benevolence motives are triggered (i.e., when they empathize with the wellbeing of close others). This suggestion is in line with research demonstrating the centrality of benevolence goals in adolescents' self-evaluative thinking about (prosocial) third-party bystander actions (Frey et al., 2021). Importantly, previous research also shows that prosocial bystander actions may not only benefit victims, but also the bystanders themselves as adolescents feel more proud, more helpful, and more like a good friend, after resolving a peer-victimization situation peacefully (Frey et al., 2021).

Strengths and limitations

Strengths of the current study are the inclusion of three longitudinal studies, which enabled us to examine the development of prosocial behavior across four distinct time scales.

Across these time scales, the same questionnaire of prosocial actions was included. By a focus on frequency of specific prosocial actions rather than prosocial behavior in general, these time scales could be compared. However, several limitations should be taken into account.

First, it should be noted that because the data stemmed from three longitudinal studies, changes across time scales could not be linked to one another. This offers an important direction for future research, since time scales do not operate as distinct systems, but are interrelated within individuals (Keijsers & van Roekel, 2018). Changes in day-to-day prosocial interactions may influence yearly developmental trajectories, and vice versa. Second, some findings of this study may be influenced by demographic and sampling differences. Specifically, the one-year/two-month sample included a higher percentage of girls than the two-year and one-day sample. Although we controlled for gender in some of the analyses, we cannot rule out that some between-sample differences were impacted by demographic differences. Due to measurement timing and initial recruitment differences between samples, the two-year interval also spanned over a larger period of late adolescence/early adulthood (i.e., age 16–21 to age 18–23) than the one-year interval (i.e., age 16–18 to 17–19). Moreover, the daily sample used a two-point response scale (i.e., yes/no), whereas a continuous scale was used for the longer measurement occasions. Relatedly, the relatively high between-time stability across time scales may have masked mean-level changes over time. Third, only self-reports of prosocial actions toward peers and friends were considered, which implicates that our findings mainly reflect how adolescents view their prosocial behaviors (i.e., self-presentations). We were also unable to examine prosocial behavior toward peers and friends separately, whereas previous research indicates that the recipient of the prosocial behavior influences developmental patterns (Padilla-Walker et al., 2018). Moreover, the included measure of prosocial behavior only tapped into reported frequencies of prosocial actions, without taking prosocial intentions or opportunities into account. In future research, it is recommended to differentiate between targets (i.e., peers vs. friends), and to incorporate behavioral observations, experimental paradigms (i.e., economic games), and teacher or parent-reports.

CONCLUSION

The current study examined, for the first time, variability and change in adolescents' prosocial behavior across four time scales and showed that the overall time-related stability of prosocial behavior is moderate to excellent. Changes in prosocial behavior were most profound on a two-year time scale, and no differences between early and late adolescence in stability were found. That is, there was no evidence for a specific window of opportunity for interventions targeting prosocial behavior during this age period, but this question should be addressed in future studies that also include children and young adults, as well as behavioral measures in addition to self-report (i.e., economic games; van de Groep et al., 2020). Our findings highlight the multi-dimensional nature of prosocial development in adolescence and implicate that different processes are involved in fluctuations in prosocial behavior over longer compared to shorter time periods. As such, this study contributes to a better understanding of prosocial behavior during the formative period of adolescence.

CONFLICT OF INTEREST
The authors declare no conflict of interest.

REFERENCES

Allemand, M., Steiger, A. E., & Fend, H. A. (2015). Empathy development in adolescence predicts social competencies in adulthood. *Journal of Personality*, 83(2), 229–241. https://doi.org/10.1111/jopy.12098

Armstrong-Carter, E., Moreira, J. F. G., Ivory, S. L., & Telzer, E. H. (2020). Daily links between helping behaviors and emotional well-being during late adolescence. *Journal of Research on Adolescence*, 30(4), 943–955. https://doi.org/10.1111/jora.12572

Blankenstein, N. E., Telzer, E. H., Do, K. T., van Duijvenvoorde, A. C. K., & Crone, E. A. (2020). Behavioral and neural pathways supporting the development of prosocial and risk-taking behavior across adolescence. *Child Development*, 91(3), e665–e681. https://doi.org/10.1111/cdev.13292

Brandner, P., Güroğlu, B., & Crone, E. A. (2020). I am happy for us: Neural processing of vicarious joy when winning for parents versus strangers. *Cognitive, Affective, & Behavioral Neuroscience*, 20(6), 1309–1322. https://doi.org/10.3758/s13415-020-00839-9

Byers, D. S., & Cerulli, M. (2021). Staying in their own lane: Ethical reasoning among college students witnessing cyberbullying. *Journal of Diversity in Higher Education*, 14(4), 508–518. https://doi.org/10.1037/dhe0000287

Caprara, G. V., Steca, P., Zelli, A., & Capanna, C. (2005). A new scale for measuring adults' prosocialness. *European Journal of Psychological Assessment*, 21(2), 77–89. https://doi.org/10.1027/1015-5759.21.2.77

Caprara, G. V., Kanacri, B. P. L., Gerbino, M., Zuffianò, A., Alessandri, G., Vecchio, G., Caprara, E., Pastorelli, C., & Bridglall, B. (2014). Positive effects of promoting prosocial behavior in early adolescence: Evidence from a school-based intervention. *International Journal of Behavioral Development*, 38(4), 386–396. https://doi.org/10.1177/0165025414531464

Carlo, G., Crockett, L. J., Randall, B. A., & Roesch, S. C. (2007). A latent growth curve analysis of prosocial behavior among rural adolescents. *Journal of Research on Adolescence*, 17(2), 301–324. https://doi.org/10.1111/j.1532-7795.2007.00524.x

Carlo, G., & Padilla-Walker, L. (2020). Adolescents' prosocial behaviors through a multidimensional and multicultural lens. *Child Development Perspectives*, 14(4), 265–272. https://doi.org/10.1111/cdep.12391

Carlo, G., Padilla-Walker, L., & Nielson, M. (2015). Longitudinal bidirectional relations between adolescents' sympathy and prosocial behavior. *Developmental Psychology*, 51(12), 1771–1777. https://doi.org/10.1037/dev0000056

Crocetti, E., Moscatelli, S., Van der Graaff, J., Rubini, M., Meeus, W., & Branje, S. (2016). The interplay of self–certainty and prosocial

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development in the transition from late adolescence to emerging adulthood. *European Journal of Personality*, 30(6), 594–607. https://doi.org/10.1002/per.2084

Crone, E. A., & Dahl, R. E. (2012). Understanding adolescence as a period of social–affective engagement and goal flexibility. *Nature Reviews Neuroscience*, 13(9), 636–650. https://doi.org/10.1038/nrn3313

Crone, E. A., & Fuligni, A. J. (2020). Self and others in adolescence. *Annual Review of Psychology*, 71(1), 447–469. https://doi.org/10.1146/annurev-psych-010419-050937

Curran, P. J., Obeidat, K., & Losardo, D. (2010). Twelve frequently asked questions about growth curve modeling. *Journal of Cognition and Development*, 11(2), 121–136. https://doi.org/10.1080/15248371003699969

Dahl, R. E., Allen, N. B., Wilbrecht, L., & Suleiman, A. B. (2018). Importance of investing in adolescence from a developmental science perspective. *Nature*, 554, 441–450. https://doi.org/10.1038/nature25770

Daniel, E., & Benish-Weisman, M. (2019). Value development during adolescence: Dimensions of change and stability. *Journal of Personality*, 87(3), 620–632. https://doi.org/10.1111/jopy.12420

Davis, M. H. (1980). A multidimensional approach to individual differences in empathy. *JSAS Catalog of Selected Documents in Psychology*, 10, 85–104.

Döring, A. K., Daniel, E., & Knafo-Noam, A. (2016). Introduction to the special section value development from middle childhood to early adulthood—New insights from longitudinal and genetically informed research. *Social Development*, 25(3), 471–481. https://doi.org/10.1111/sode.12177

Duncan, S. C., Duncan, T. E., & Hops, H. (1996). Analysis of longitudinal data within accelerated longitudinal designs. *Psychological Methods*, 1(3), 236–248. https://doi.org/10.1037/1082-989X.1.3.236

Eisenberg, N., Cumberland, A., Guthrie, I. K., Murphy, B. C., & Shepard, S. A. (2005). Age changes in prosocial responding and moral reasoning in adolescence and early adulthood. *Journal of Research on Adolescence*, 15(3), 235–260. https://doi.org/10.1111/j.1532-7795.2005.00095.x

Eisenberg, N., & Fabes, R. A. (1998). Prosocial development. In W. Damon (Series Ed.) & N. Eisenberg (Vol. Ed.), *Handbook of child psychology, vol. 3: Social, emotional, and personality development* (5th ed., pp. 701–778). John Wiley.

Eisenberg, N., & Spinrad, T. L. (2014). Multidimensionality of prosocial behavior: Rethinking the conceptualization and development of prosocial behavior. In L. M. Padilla-Walker & G. Carlo (Eds.), *Prosocial development: A multidimensional approach* (pp. 17–39). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199964772.003.0002

Fabes, R. A., Carlo, G., Kupanoff, K., & Laible, D. (1999). Early adolescence and prosocial/moral behavior I: The role of individual processes. *The Journal of Early Adolescence*, 19(1), 5–16. https://doi.org/10.1177/0272431699019001001

Flynn, E., Ehrenreich, S. E., Beron, K. J., & Underwood, M. K. (2015). Prosocial behavior: Long-term trajectories and psychosocial outcomes. *Social Development*, 24(3), 462–482. https://doi.org/10.1111/sode.12100

Frey, K. S., McDonald, K. L., Onyewuenyi, A. C., Germinaro, K., & Eagan, B. R. (2021). "I felt like a hero:" Adolescents' understanding of resolution-promoting and vengeful actions on behalf of peers. *Journal of Youth and Adolescence*, 50, 521–535. https://doi.org/10.1007/s10964-020-01346-3

Fu, X., Padilla-Walker, L. M., & Brown, M. N. (2017). Longitudinal relations between adolescents' self-esteem and prosocial behavior toward strangers, friends and family. *Journal of Adolescence*, 57, 90–98. https://doi.org/10.1016/j.adolescence.2017.04.002

Fuligni, A. J. (2019). The need to contribute during adolescence. *Perspectives on Psychological Science*, 14(3), 331–343. https://doi.org/10.1177/1745691618805437

Hall, H. K., Millear, P. M. R., Summers, M. J., & Isbel, B. (2021). Longitudinal research on perspective taking in adolescence: A systematic review. *Adolescent Research Review*, 6(2), 125–150. https://doi.org/10.1007/s40894-021-00150-9

Hopwood, C. J., Bleidorn, W., & Wright, A. G. (2022). Connecting theory to methods in longitudinal research. *Perspectives on Psychological Science*, 17(3), 884–894. https://doi.org/10.1177/1745691621100840

Hui, B. P. H., Ng, J. C. K., Berzaghi, E., Cunningham-Amos, L. A., & Kogan, A. (2020). Rewards of kindness? A meta-analysis of the link between prosociality and well-being. *Psychological Bulletin*, 146(12), 1084–1116. https://doi.org/10.1037/bul0000298

Jung, T., & Wickrama, K. A. S. (2008). An introduction to latent class growth analysis and growth mixture modeling. *Social and Personality Psychology Compass*, 2(1), 302–317. https://doi.org/10.1111/j.1751-9004.2007.00054.x

Keijsers, L., & van Roekel, E. (2018). Longitudinal methods in adolescent psychology. Where could we go from here? And should we? In L. B. Hendry & M. Kloep (Eds.), *Reframing Adolescent research.* (pp. 56–77). Routledge.

Klimstra, T. A., Luyckx, K., Hale, W. A., III, Frijns, T., Van Lier, P. A., & Meeus, W. H. (2010). Short-term fluctuations in identity: Introducing a micro-level approach to identity formation. *Journal of Personality and Social Psychology*, 99(1), 191–202. https://doi.org/10.1037/a0019584

Koo, T. K., & Li, M. Y. (2016). Longitudinal analysis of flexibility and reorganization in early adolescence: A dynamic systems study of family interactions. *Journal of Chiropractic Medicine*, 15(2), 155–163. https://doi.org/10.1016/j.jcm.2016.02.012

Larson, R., & Lampman-Petraitis, C. (1989). Daily emotional states as reported by children and adolescents. *Child Development*, 60(5), 1250–1260. https://doi.org/10.2307/1130798

Luengo Kanacri, B. P., Pastorelli, C., Eisenberg, N., Zuffianò, A., Castellani, V., & Caprara, G. V. (2014). Trajectories of prosocial behavior from adolescence to early adulthood: Associations with personality change. *Journal of Adolescence*, 37(5), 701–713. https://doi.org/10.1016/j.adolescence.2014.03.013

Maciejewski, D. F., Keijsers, L., van Lier, P. A. C., Branje, S. J. T., Meeus, W. H. J., & Koot, H. M. (2019). Most fare well—But some do not: Distinct profiles of mood variability development and their association with adjustment during adolescence. *Developmental Psychology*, 55(2), 434–448. https://doi.org/10.1037/dev0000650

Malti, T., Ongley, S. F., Peplak, J., Chaparro, M. P., Buchmann, M., Zuffianò, A., & Cui, L. (2016). Children's sympathy, guilt, and moral reasoning in helping, cooperation, and sharing: A 6-year longitudinal study. *Child Development*, 87(6), 1783–1795. https://doi.org/10.1111/cdev.12632

Masselink, M., van Roekel, E., & Oldehinkel, A. J. (2018). Self-esteem in early adolescence as predictor of depressive symptoms in late adolescence and early adulthood: The mediating role of motivational and social factors. *Journal of Youth and Adolescence*, 47(5), 932–946. https://doi.org/10.1007/s10964-017-0727-z

Morelli, S. A., Rameson, L. T., & Lieberman, M. D. (2014). The neural components of empathy: Predicting daily prosocial behavior. *Social Cognitive and Affective Neuroscience*, 9(1), 39–47. https://doi.org/10.1093/scan/nss088

Mulvey, K. L., Hoffman, A. J., Gönültaş, S., Hope, E. C., & Cooper, S. M. (2018). Understanding experiences with bullying and bias-based bullying: What matters and for whom? *Psychology of Violence*, 8(6), 702–711. https://doi.org/10.1037/vio0000206

Nantel-Vivier, A., Kokko, K., Caprara, G. V., Pastorelli, C., Gerbino, M. G., Paciello, M., Côté, S., Pihl, R. O., Vitaro, F., & Tremblay, R. E. (2009). Prosocial development from childhood to adolescence: A multi-informant perspective with Canadian and Italian longitudinal studies. *Journal of Child Psychology and Psychiatry*, 50(5), 590–598. https://doi.org/10.1111/j.1469-7610.2008.02039.x

Nezlek, J. B., Feist, G. J., Wilson, F. C., & Plesko, R. M. (2001). Day-to-day variability in empathy as a function of daily events and mood. *Journal*

of Research in Personality, *35*(4), 401–423. https://doi.org/10.1006/jrpe.2001.2332

Padilla-Walker, L. M., Carlo, G., & Memmott-Elison, M. K. (2018). Longitudinal change in adolescents' prosocial behavior toward strangers, friends, and family. *Journal of Research on Adolescence*, *28*(3), 698–710. https://doi.org/10.1111/jora.12362

Padilla-Walker, L. M., Fraser, A. M., Black, B. B., & Bean, R. A. (2015). Associations between friendship, sympathy, and prosocial behavior toward friends. *Journal of Research on Adolescence*, *25*(1), 28–35. https://doi.org/10.1111/jora.12108

Podsakoff, N. P., Spoelma, T. M., Chawla, N., & Gabriel, A. S. (2019). What predicts within-person variance in applied psychology constructs? An empirical examination. *Journal of Applied Psychology*, *104*(6), 727–754. https://doi.org/10.1037/apl0000374

Schreuders, E., Braams, B. R., Crone, E. A., & Güroğlu, B. (2021). Friendship stability in adolescence is associated with ventral striatum responses to vicarious rewards. *Nature Communications*, *12*, 313. https://doi.org/10.1038/s41467-020-20042-1

Smith, L. B., & Thelen, E. (2003). Development as a dynamic system. *Trends in Cognitive Sciences*, *7*(8), 343–348. https://doi.org/10.1016/S1364-6613(03)00156-6

Sweijen, S. W., van de Groep, S., Green, K. H., te Brinke, L. W., Buijzen, M., de Leeuw, R. N. H., & Crone, E. A. (2022). Daily prosocial actions during the COVID-19 pandemic contribute to giving behavior in adolescence. *Scientific Reports*, *12*(1), 7458. https://doi.org/10.1038/s41598-022-11421-3

Tremblay, R. E., Loeber, R., Gagnon, C., Charlebois, P., Larivée, S., & LeBlanc, M. (1991). Disruptive boys with stable and unstable high fighting behavior patterns during junior elementary school. *Journal of Abnormal Child Psychology*, *19*(3), 285–300. https://doi.org/10.1007/bf00911232

van de Groep, S., Zanolie, K., Green, K. H., Sweijen, S. W., & Crone, E. A. (2020). A daily diary study on adolescents' mood, empathy, and prosocial behavior during the COVID-19 pandemic. *PLoS One*, *15*(10), e0240349. https://doi.org/10.1371/journal.pone.0240349

van der Cruijsen, R., Peters, S., Zoetendaal, K. P. M., Pfeifer, J. H., & Crone, E. A. (2019). Direct and reflected self-concept show increasing similarity across adolescence: A functional neuroimaging study. *Neuropsychologia*, *129*, 407–417. https://doi.org/10.1016/j.neuropsychologia.2019.05.001

van der Graaff, J., Carlo, G., Crocetti, E., Koot, H. M., & Branje, S. (2018). Prosocial behavior in adolescence: Gender differences in development and links with empathy. *Journal of Youth and Adolescence*, *47*(5), 1086–1099. https://doi.org/10.1007/s10964-017-0786-1

Vecchione, M., Schwartz, S. H., Davidov, E., Cieciuch, J., Alessandri, G., & Marsicano, G. (2020). Stability and change of basic personal values in early adolescence: A 2-year longitudinal study. *Journal of Personality*, *88*(3), 447–463. https://doi.org/10.1111/jopy.12502

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