



Lying to friends: Examining lie-telling, friendship quality, and depressive symptoms over time during late childhood and adolescence

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ABSTRACT

Introduction: Lie-telling appears to peak during adolescence; however, previous research has not yet examined lie-telling frequency in adolescents' friendships. Increased lie-telling may be problematic given that honesty is crucial for trust within positive relationships, and more positive relationships lead to more positive well-being. The present study examined adolescents' lies to friends and longitudinal associations between lying, friendship quality, and depressive symptoms. **Methods:** Canadian adolescents (Time 1: $N = 1313$, $M_{\text{age}} = 11.65$, $SD = 11.75$, 50% male) reported how often they lied to their friends about their mental health/mood, possessions, romantic relationships, school, and to avoid spending time with them. Participants also completed measures of friendship quality and depressive symptoms. Participants completed these measures at two time points one year apart. **Results:** Poorer friendship quality predicted more frequent lie-telling over time. Greater depressive symptoms predicted more frequent lie-telling over time, and more frequent lie-telling predicted greater depressive symptoms over time. Lies about mental health in particular were bidirectionally associated with both friendship quality and depressive symptoms over time. **Conclusions:** These findings highlight the developmental importance of lie-telling during adolescence. More negative friendships lead to greater lie-telling over time. Additionally, increased lie-telling predicted and is predicted by depressive symptoms, suggesting that lie-telling may be an important indicator of poor mental health.

Building positive friendships is an important aspect of adolescence, a task for which building trust is vital. One of the key features of trust is honesty (Rotenberg, 1994), such that dishonesty can violate trust while honesty can strengthen trust. Yet, adolescents report telling lies more frequently than any other age group (Debey, De Schryver, Logan, Suchotzki, & Verschuere, 2015; Levine, Serota, Carey, & Messer, 2013). Given that lie-telling violates the expectation of honesty in interpersonal relationships, increased lie-telling during adolescence may be detrimental to the development of positive friendships. Additionally, if adolescents engage in behaviors that disrupt their friendships, such as lie-telling, they may prevent their friendships from becoming forms of support that protect against negative experiences like depression. Thus, the present study examined the associations between lie-telling frequency, relationship quality, and depressive symptoms over time during late childhood and adolescence.

Lie-telling, the act of stating information one believes to be false but intends for another to believe to be true, emerges in the

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preschool years and increases in sophistication throughout childhood and adolescence (Evans & Lee, 2011, 2013a; Talwar & Lee, 2002, 2008; Talwar, Gordon, & Lee, 2007). Self-report research suggests that lie-telling frequency increases during late childhood and peaks during the adolescent years (Debey et al., 2015; Levine et al., 2013). Given this developmental trend, the current study examined whether age and lie-telling were positively associated with one another. While adolescence has been found to be a time of heightened lie-telling, it is important to note that there is variability in the number of lies individuals report. Specifically, when adult participants report how many lies they have told in the previous 24 hours there is a sizeable portion that report telling no lies. In addition, there is a small minority (about 5–10%) of “prolific liars” that are responsible for the majority of lies reported by the sample (Serota, Levine, & Boster, 2010). Thus, it is also appropriate to examine how individual differences in lie-telling might be associated with developmental outcomes. Given that lie-telling is most frequent during adolescence compared to other age groups, its impact on developmental outcomes is especially important to consider. The current study focused on associations between lie-telling, friendship quality, and depressive symptoms over time in late childhood and adolescence.

Social domain theory provides a framework for understanding the complicated and potentially impactful nature of lie-telling during adolescence. According to social domain theory (Smetana, 1995, 1997), there are three domains of knowledge (Turiel, 2002): moral, social conventional, and psychological. The moral domain involves behaviors that lead to intrinsic consequences, such as issues relating to justice, welfare, and rights (e.g., acts that harm others, deemed unacceptable regardless of context). The social conventional domain involves rules about behavior dictated by governing bodies, traditions, and social norms. The psychological domain is divided into personal and prudential issues. Personal issues impact only the actor, not other individuals, and involve private issues such as personal identity and preferences regarding appearance. Prudential issues include health, safety, and comfort concerns. Some of these issues are controlled by governing bodies which create rules for safety (e.g., speed limit, public safety rules), and other issues are parents’ rules for safety and comfort. During adolescence, some issues controlled by parents become under adolescent control. Finally, there are multifaceted acts that can be categorized into more than one domain. Lie-telling is a complex behavior to evaluate due to its competing facets; it violates the norm of honesty, which is a moral behavior, but may also accomplish other goals such as protecting someone’s feelings or maintaining confidentiality within a relationship.

Research on domain differentiated reasoning during adolescence has revealed interesting patterns and motivations regarding adolescents’ increased lie-telling (and dishonesty more broadly) within the parent-child context. This research shows a struggle that parents and adolescents face in renegotiating the boundaries of adolescents’ control (Collins & Laursen, 2004a). Parents and adolescents agree that the moral and social conventional domains remain under parental control, but prudential, personal, and multifaceted issues become a source of conflict (Cumsille, Darling, Flaherty, & Martinez, 2006; Gingo, Roded, & Turiel, 2017; Smetana, Metzger, Gettman, & Campione-Barr, 2006). Early adolescents recognize that parents should be involved in prudential issues, but expect control over the personal domain. With age, adolescents consider more prudential and multifaceted issues to be personal, and therefore expect greater control over those issues (Rote & Smetana, 2015; Smetana, Metzger, Gettman, & Campione-Barr, 2006). As they re-negotiate control, adolescents attempt to gain or maintain independence through various strategies, including lying or omitting information about a given behavior or issue (e.g., saying they are going to a friend’s house without revealing that there is a party; Jensen, Arnett, Feldman, & Cauffman, 2004; Tasopoulos-Chan, Smetana, & Yau, 2009). Adolescents report also using lying as a strategy to avoid disappointment from or conflict with parents (Darling, Cumsille, Caldwell, & Dowdy, 2006; Marshall, Tilton-Weaver, & Bosdet, 2005; Smetana, Villalobos; Tasopoulos-Chan, Gettman, & Campione-Barr, 2009).

Development during adolescence is also characterized by transitions in other relationships, and thus far the literature has largely ignored the role of lie-telling outside the parent-child context. Adolescents’ social networks become increasingly diverse and complex as they build new connections and form close relationships outside the family (Furman & Buhrmester, 1992). This increased complexity of social networks coincides with the rise in lie-telling (Debey et al., 2015; Levine et al., 2013). Despite the co-occurring changes in relationships and lie-telling, research has failed to examine lie-telling frequency within the context of other relationships during adolescence. In particular, friendships are different from the parent-child relationship given that they are chosen relationships, egalitarian, and increase in intimacy and support with age. With these changes adolescents develop additional goals and desires that may compete with the moral expectation of honesty and result in greater lying within friendships.

While adolescents’ self-reported lie-telling frequency within friendships has not been examined, previous research has shown that children and adolescents recognize that (1) honesty is a moral virtue that is violated by lie-telling (Bussey, 1999) and (2) honesty is integral for trust in interpersonal relationships, including friendships (Betts, Rotenberg, & Trueman, 2013; Debnam, Howard, & Garza, 2014; Rotenberg, 1994; Rotenberg & Boulton, 2013; Sakai, Sugawara, Maeshiro, Sugawara, & Kitamura, 2002). With age, competing concerns both within and outside the moral domain become more salient, and lying is considered more acceptable in some circumstances. Perkins and Turiel (2007) showed increasingly complex reasoning about lie-telling in 12–17 year olds’ evaluations of the acceptability of lying to friends. They were presented with hypothetical scenarios in which the protagonist engaged in a moral (e.g., physically harming a bully), personal (e.g., relationship and leisure choices), or prudential (personal well-being; e.g., riding a motorcycle) behavior that the friend did not approve of and then lied about having done so. For example, in a moral scenario a friend encouraged the protagonist to physically harm a peer who had teased them; the protagonist considered this physical violence to be wrong, and lied to their friend about having committed this act (i.e., they did not do it but said they did). About half of participants considered lies in the moral domain to be acceptable, because they prevented injustice or preserved the welfare of another; the other half considered the moral violation of lying to be unacceptable regardless of the reason (moral concern of honesty outweighed competing concerns). On the other hand, lies in the personal and prudential domains were more acceptable for older (15–17 years) compared to younger (12–14 years) participants. Furthermore, those who considered lies in these domains to be unacceptable stated that lying violated trust in the friendship. In contrast, those who considered lying acceptable in these domains justified lying by personal choice (right to have privacy and control over decision-making) and maintaining harmony (e.g., lied to avoid conflict).

Perkins and Turiel's (2007) findings highlight the complexity of balancing the expectations of different domains, and how adolescents' changing relationships and goals (e.g., social acceptance) may make this more challenging. In particular, adolescents may experience competing goals that result in greater lie-telling within their friendships. Adolescents' acceptance of lies to preserve relationships in Perkins and Turiel's study may reflect a tendency to tell lies that allow them to avoid conflict and maintain harmony with friends. They may also be more approving of lies that lead to social acceptance, which adolescents often strive for. It is important to note, however, that evaluations of lies and actual lie-telling rates are often found to be uncorrelated, particularly when lying is antisocial in nature (e.g., participants acknowledge that lying is wrong but they do so anyway; Evans & Lee, 2013b). Thus, going beyond evaluations of lie-telling to explore actual lie-telling frequency is important for understanding increased lie-telling during adolescence and its implications.

Friendships are an important context to examine lie-telling because of the immense changes that occur within dyadic friendships from childhood to adolescence. During childhood, friends are typically same-sex peers that engage in similar activities, have similar interests, or are in close proximity (e.g., same school, same neighbourhood). Beginning in late childhood, friendships expand beyond this and begin to fulfill attachment-related needs, such as proximity seeking and emotional support (Bokhorst, Sumter, & Westenberg, 2010; Furman & Buhrmester, 1992). With gains in cognitive development children are able to apply more intimate aspects of the parent-child relationship to their friendships and understand that friends can be a source of support and intimacy as well. For example, children become increasingly able to take and remember others' perspectives and maintain them as separate from their own (Berndt, 1989), allowing for an increased level of understanding and support between friends. By mid-adolescence, friends are often considered more important than parents for emotional support (Bokhorst et al., 2010; Furman & Buhrmester, 1992). In early adolescence friendships also become an important space for intimate disclosure or secret-keeping, particularly within female friendships. This intimate disclosure allows for the formation of trust and the provision of emotional support within the friendship. There is an expectation of reciprocity, where both members of this dyadic relationship disclose and keep the other's disclosures confidential (Armsden & Greenberg, 1987; Bauminger; Finzi-Dottan; Chason, & Har-Even, 2008; Parker & Asher, 1993). Additionally, when adolescents experience various conflicts or problems they are increasingly likely to seek the support and advice of friends, as compared to seeking these from parents during childhood. Adolescent friendships often involve disclosing issues, discussing reasons for those issues, and trying to reach a possible solution (Rose, 2002).

Trust is foundational to these various levels of intimacy. Rotenberg's (1994) interpersonal trust theory highlights the importance of trust in interpersonal relationships. A foundational aspect of trust is honesty, which is the expectation that members of the relationship will be truthful and refrain from manipulative behaviors; thus, honesty is integral to building positive friendships. Trust has been examined during adolescence in terms of keeping and sharing secrets, and those who are unable to do so are considered less trustworthy by their peers and unable to form close, reciprocal friendships (Berndt, 2002). Given the importance of forming positive friendships for psychosocial, academic, and behavioral outcomes (Jones, Audley-Piotrowski, & Kiefer, 2012; Kreager; Rulison, & Moody, 2011; La Greca & Harrison, 2005), it is important to understand the types of behaviors that might prevent the development of positive friendships. Increased lie-telling may be one behavior that adolescents engage in that threatens their ability to form and maintain friendships as it violates the key expectations of positive friendships: honesty and trust.

Lying to friends in adolescence may be motivated by or influence other outcomes as well, such as depression. Adolescents can be particularly vulnerable to experiencing depressive symptoms because they are less capable than adults of using positive coping strategies in effective ways to manage negative emotions or experiences (Garnefski, Legerstee, Kraaij, Van den Kommer, & Teerds, 2002; Green, McGinnity, Meltzer, Ford, & Goodman, 2005). Depressive symptoms increase from childhood to adolescence and experiencing depressive symptoms in adolescence is a precursor to developing a major depressive disorder during adulthood (Aalto-Setälä, Marttunen, Tuulio-Henriksson, Poikolainen, & Lönnqvist, 2002). Adolescents experience depressive symptoms quite frequently without necessarily meeting the threshold for a clinical diagnosis (Saluja et al., 2004). By understanding various behaviors adolescents engage in that might contribute to or result from depressive symptoms, practitioners can better understand what behaviors to address to prevent or help manage adolescents' depression.

Relationships provide an important form of social support, which is a protective factor for developing depressive symptoms following negative experiences or emotions (La Greca & Harrison, 2005; Stice, Ragan, & Randall, 2004). Lie-telling may not only impact relationships themselves, but also limit friends' ability to provide support for coping with negative emotions or experiences. In fact, children who experience low trust in their friendships, and peer networks more broadly, are more likely to experience internalizing problems like depression (Herman-Stahl & Peterson, 1996). While research has not yet examined lie-telling and depression in the context of friendships, evidence has demonstrated a positive correlation between lying to parents and depressive symptoms, where greater lie-telling is associated with greater symptoms (Engels Finkenauer, & Van Kooten, 2006; Rote & Smetana, 2014; Warr, 2007). Thus, a similar pattern may be found within adolescents' friendships.

Lie-telling more broadly may be associated with greater depressive symptoms as telling lies isolates the lie-teller from others. There may also be specific types of lies that are more strongly associated with depressive symptoms. For example, adolescents may lie more often to their friends about their mental health to avoid negative stigma that can often accompany disclosures of mental health problems. In fact, children and adolescents who hold negative stigmas about those with mental health issues are significantly less likely to seek help for their own symptoms compared to those who have more positive attitudes towards mental health (Perry, Pescosolido, Martin, McLeod, & Jensen, 2007; Sirey, Bruce, Alexopoulos, Perlick, Friedman, & Meyers, 2001). Depressive symptoms may also predict more lie-telling over time. Those who experience symptoms may be more likely to lie because depressed individuals have a more negative perception of themselves, therefore they feel the need to present a more positive persona to others (Lewinsohn, Mischel, Chaplin, & Barton, 1980). This may be particularly relevant to adolescents as they attempt to gain friends and social acceptance.

1. The present study

The present study aimed to address current gaps in our understanding of adolescent development by examining children and adolescents' self-reported lying to friends in relation to relationship quality and depressive symptoms. These associations were examined over time to understand the direction of effects. Participants reported on how frequently they lied to friends across a variety of topics, as well as their relationship quality with friends and depressive symptoms at two time points one year apart.

Based on previous self-report findings, it was predicted that the frequency of adolescents' lying to friends would be positively associated with age (Debey et al., 2015). Additionally, it was predicted that friendship quality and lie-telling would be negatively associated with one another, given that lying violates the expectation of honesty for trust in relationships (Rotenberg, 1994). Finally, it was expected that depressive symptoms would be positively associated with lie-telling, as lying to parents is positively associated with depressive symptoms (Warr, 2007).

Given that previous research has not yet examined relations between lie-telling frequency, friendship quality, and depressive symptoms over time, bidirectional associations were examined between all variables. Additionally, a second model was analyzed examining each type of lie separately in relation to friendship quality and depressive symptoms. Given the lack of previous research examining specific lie types and these outcomes, these analyses were exploratory.

2. Method

2.1. Participants

The present sample was drawn from a larger 3-year longitudinal study examining risk behaviors. As the lying questions used were included only in the second and third years of the larger study, only the latter two waves were included in the present study (labelled as T1 and T2 for ease of comprehension). Participants consisted of 1313 children and adolescents. At T1, participants were 8–15 years old ($N = 1313$, $M_{\text{age}} = 11.65$, $SD = 11.75$, 50% male); at T2 participants were 9–16 years old ($N = 939$, $M_{\text{age}} = 12.43$, $SD = 1.72$, 50% male). Participants were recruited from elementary schools in a mid-sized city in Canada. Parent report indicated that 83.6% of the children and adolescents were White, 2.7% were Hispanic, 2.2% were Asian, 1.9% were Black, 1.8% were Indigenous, 6.8% were Mixed, and 1% preferred not to answer (consistent with the broader regional population, Statistics Canada, 2016a). Mean levels of parental education (reported by parents and used as a proxy for socioeconomic status) fell between “some college or university (no degree/diploma)” and “completed an associate, college, or technical program/diploma.” Parental education level in the present sample was representative of the greater population of the province (Statistics Canada, 2016b).

2.2. Primary measures

Lie-telling. Lying to friends at each time point was measured using five questions assessing lies about a variety of topic areas over the previous two weeks. Participants were asked how often they lied about school, how they were feeling, their experience in romantic relationships, things they have, and to avoid spending time with friends. For example, participants were asked “*In the last two weeks, how often did you lie to your friends about school?*” Participants responded on a 1 to 5 scale ranging from 1 (never lied) to 5 (lied 10 or more times). Responses across each type of lie were averaged for an overall measure of lie-telling ($\alpha = 0.72$ and 0.76 at T1 and T2).

Friendship Quality. Friendship quality at each time point was measured using the Inventory of Peer Attachment (Armsden & Greenberg, 1987). Participants responded to 10 questions asking about participants' experiences in their relationships with their friends (e.g., *My friends are concerned about my well-being*). Participants responded to these questions based on how often they experienced each item in the context of that relationship on a 1 (never) to 4 (almost always) scale ($\alpha = 0.81$ and 0.84 for T1 and T2). Responses were averaged across items to create a composite measure of friendship quality.

Depressive Symptoms. Depressive symptoms at each time point were assessed using the 20 item Center for Epidemiological Studies Depression (CES-D) Scale for adolescents (Radloff, 1977; Weissman; Orvaschel, & Padian, 1980). Due to the large age range, with younger participants being in late childhood, all participants responded to a subset of seven questions. Participants were asked to

Table 1
Descriptive Statistics.

	Time 1 M(SD)		Time 2 M(SD)	
Lying to Friends (composite)	1.38	(.55)	2.33	(.49)
Lying: Mental health	1.76	(1.12)	2.64	(.91)
Lying: Romantic relationships	1.29	(.79)	2.20	(.55)
Lying: School	1.29	(.70)	2.25	(.61)
Lying: To avoid	1.37	(.77)	2.30	(.60)
Lying: Possessions	1.22	(.64)	2.21	(.57)
Friendship Quality	3.15	(.56)	3.13	(.57)
Depressive Symptoms	1.75	(.66)	1.78	(.67)
Age (years)	11.65	(1.75)	12.43	(1.72)
Sex (% males)	50%		50%	
Parental Education	4.12	(.85)	–	

rate how often they had experienced each symptom in the previous week (e.g., During the past week, I felt lonely, like I didn't have any friends) on a 4 point scale ranging from 1 (not at all) to 4 (a lot of the time). To create a composite score for depressive symptoms, participants' responses were averaged across the seven items ($\alpha = 0.83$ and 0.84 for T1 and T2, respectively).

2.3. Covariates

Adolescents provided their age and sex at each time point. To control for socioeconomic status (SES), one parent in the home reported on each parent's highest level of education. Responses were provided at the first wave of data collection and averaged across parent 1 and parent 2 (see Table 1 for descriptives).

2.4. Procedure

Participants were invited to participate in the study during visits to schools. Each year, the survey was completed in two separate parts, both occurring within a 4-month period (January–April). Trained researchers and volunteers administered the surveys to participants in their classrooms during school hours. Participants were compensated with small gifts (e.g., backpacks, pencils). All participants who completed the survey at the first wave of data collection were invited to complete it again at subsequent time points. Parents provided informed consent at the first wave; adolescents provided assent at each time point. Parents reported on demographic variables at the first wave in a survey that was completed at home and submitted with the parents' consent form. All procedures were approved by a university ethics research board prior to commencing the study.

2.5. Missing data

Missing data occurred because some students did not complete all the questions in the surveys (average missing data was 8.83% at Year 1, and 3.8% at Year 2), and because some students did not complete each part of the survey in Year 1 and Year 2 (as mentioned in the procedure, the survey each year was split into two parts that were completed at different time periods; missing data was due to absenteeism but also occasionally to time conflicts, students declining to participate in one part of the survey, and students moving to another school district with no contact information). For the first part of the survey (containing the friendship quality measure), in Year 1 18% of students missed the survey and in Year 2 28% missed the survey. For the second part of the survey (containing the lying and depression measures), in Year 1 19% of students missed the survey, and in Year 2 33.6% missed the survey. Missing data, however, was not related to the variables used in the current analyses (i.e., participants who participated at both time points were not different from those who did not participate at T2; $ps > .05$). Thus, missing data were estimated using the full information maximum likelihood (FIML) estimation method. FIML retains cases that are missing survey waves, thus avoiding the biased parameter estimates that can occur with pairwise or listwise deletion (Schafer & Graham, 2002).

3. Results

Analyses were carried out using autoregressive cross-lagged path analysis in Mplus 8. T1 variables included lying, friendship quality, depressive symptoms, and three covariates (age, sex, SES; see Table 1 for means and standard deviations). Correlations among T1 variables were estimated; however, correlations among covariates (age, sex, and SES) were not expected to be significant and were not estimated (Willoughby, Heffer, & Hamza, 2015). T2 variables included lying, friendship quality, and depressive symptoms (see Table 1 for means and standard deviations). All autoregressive and cross-lag paths were estimated for lying, friendship quality, and depression from T1 to T2, as well as unidirectional paths between covariates and T2 variables. Any significant cross-lagged paths accounted for previous scores (autoregressive path), covariate scores, and associations between variables at each time point. As such, significant cross-lagged paths represent unique associations between T1 and T2 variables in the model. Two separate models were analyzed. In Model 1, overall lie-telling scores were entered. In Model 2, each type of lie was entered as an individual predictor to

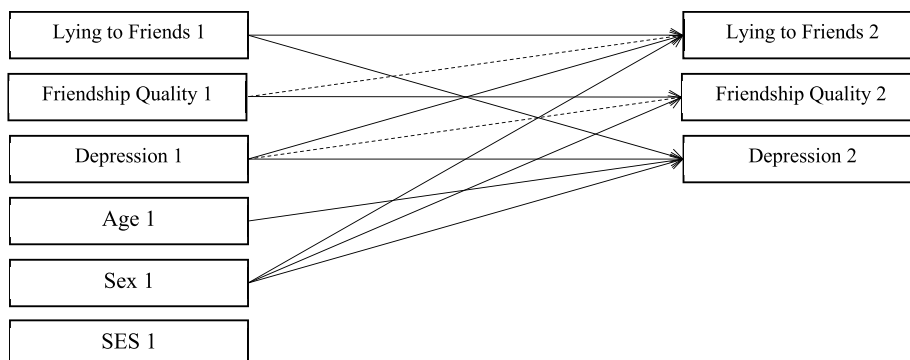


Fig. 1. Significant autoregressive and cross-lagged paths for Model 1.

explore whether specific types of lies would have unique associations with the other variables in the model.

3.1. Overall lie-telling: model 1

Model fit was well-specified, $\chi^2(3) = 5.175, p = .159$, CFI = 0.997, and RMSEA = 0.023, 90% CI [0.00, 0.057]. Being older was associated with greater depressive symptoms at T2 ($B = 0.038, SE = 0.013, \beta = 0.099$, 95% CI [0.034, 0.163], $p = .003$). Being female was associated with greater friendship quality ($B = 0.073, SE = 0.033, \beta = 0.064$, 95% CI [0.007, 0.120], $p = .027$), greater lie-telling ($B = 0.073, SE = 0.032, \beta = 0.075$, 95% CI [0.010, 0.140], $p = .023$), and greater depressive symptoms ($B = 0.151, SE = 0.043, \beta = 0.112$, 95% CI [0.050, 0.174], $p < .001$) at T2. Given the difference between males and females on all outcome variables, multilevel modelling was performed to assess whether the models would be different for males and females. The models were not significantly different; therefore, results are presented collapsed across males and females, $\chi^2(6) = 6.62, p > .05$. Additionally, given that there may be developmental differences in late childhood (8–11, $n = 632$) and early adolescence (12–15, $n = 676$) on friendship quality, we examined the model separately for these two age groups. The models were not significantly different for late childhood and early adolescence ($\chi^2(6) = 4.46, p > .05$). See Fig. 1 for all significant pathways and Table 2 for full model results.

Lie-telling and friendship quality. The hypothesis that lying and friendship quality would be negatively related was supported. Specifically, poorer friendship quality at T1 was associated with greater lie-telling at T2 ($p = .023$). However, lie-telling did not predict friendship quality over time, $p > .05$.

Lie-telling and depressive symptoms. The hypothesis that lying and depressive symptoms would be positively associated was supported. Specifically, greater lie-telling at T1 was associated with greater depressive symptoms at T2 ($p = .004$). Additionally, greater depressive symptoms at T1 predicted greater lie-telling at T2 ($p = .020$).

3.2. Types of lies: model 2

Despite the single-items measuring the specific topics (school, mood, romantic relationships, possessions, to avoid spending time with friends), we felt that this additional analysis would provide an opportunity to explore the types of lies that may be more problematic, as well as make inferences regarding adolescents' motivations lie-telling. Thus, we conducted an additional cross-lagged autoregressive analysis with each type of lie entered separate predictors and outcomes.

Model fit was well-specified, $\chi^2(3) = 5.271, p = .153$, CFI = 0.999, and RMSEA = 0.024, 90% CI [0.00, 0.057]. Being older was associated with lying more often to avoid spending time with friends ($B = 0.028, SE = 0.013, \beta = 0.081$, 95% CI [0.008, 0.154], $p = .029$) and greater depressive symptoms ($B = 0.036, SE = 0.013, \beta = 0.094$, 95% CI [0.027, 0.1610.038, 0.150], $p = .006$). Higher SES was associated with greater friendship quality ($B = 0.045, SE = 0.023, \beta = 0.067$, 95% CI [0.001, 0.133], $p = .046$). Being female was associated with greater friendship quality ($B = 0.083, SE = 0.033, \beta = 0.073$, 95% CI [0.016, 0.130], $p = .012$), lying more often to avoid spending time with friends ($B = 0.114, SE = 0.042, \beta = 0.096$, 95% CI [0.027, 0.164], $p = .035$), lying more often about mental health ($B = 0.342, SE = 0.060, \beta = 0.187$, 95% CI [0.123, 0.251], $p < .001$), and greater depressive symptoms ($B = 0.133, SE = 0.043, \beta = 0.099$, 95% CI [0.036, 0.162], $p = .002$). Given the difference between males and females on all outcome variables, multilevel modelling was performed to assess whether the models would be different for males and females. The models were not significantly different; therefore, results are presented across males and females, $\chi^2(42) = 56.838, p < .05$. See Fig. 2 for all significant pathways and Table 3 for full model results.

Lies about mood/Mental health. Lying about mental health was bidirectionally associated with friendship quality and depressive symptoms over time. Lying more often about mental health at T1 was significantly associated with poorer friendship quality ($p = .007$) and depressive symptoms ($p = .004$) at T2. Poorer friendship quality ($p = .034$) and greater depressive symptoms ($p = .001$) at T1 also predicted more frequent lies about mental health.

Lies about school. Greater depressive symptoms at T1 predicted greater lies about school at T2 ($p = .001$). Lies about school were not associated with friendship quality over time ($ps > .05$).

Table 2

Model 1 Autoregressive cross-lagged model results.

	B		SE	β	95% CI
Cross-Lagged Paths					
Lying to Friends 1 → Friendship Quality 2	-0.074		0.038	-0.072	[-0.144, 0.001]
Lying to Friends 1 → Depression 2	0.140	**	0.049	0.114	[0.037, 0.192]
Friendship Quality 1 → Lying to Friends 2	-0.074	*	0.033	-0.085	[-0.159, -0.012]
Friendship Quality 1 → Depression 2	-0.055		0.044	-0.046	[-0.117, 0.025]
Depression 1 → Lying to Friends 2	0.070	*	0.030	0.094	[0.015, 0.173]
Depression 1 → Friendship Quality 2	-0.077	*	0.032	-0.089	[-0.161, -0.017]
Autoregressive Paths					
Lying to Friends 1 → Lying to Friends 2	0.297	***	0.037	0.337	[0.258, 0.415]
Friendship Quality 1 → Friendship Quality 2	0.453	***	0.033	0.448	[0.390, 0.507]
Depression 1 → Depression 2	0.370	***	0.040	0.359	[0.287, 0.432]

Note: * $p < .05$, ** $p < .01$, *** $p < .001$.

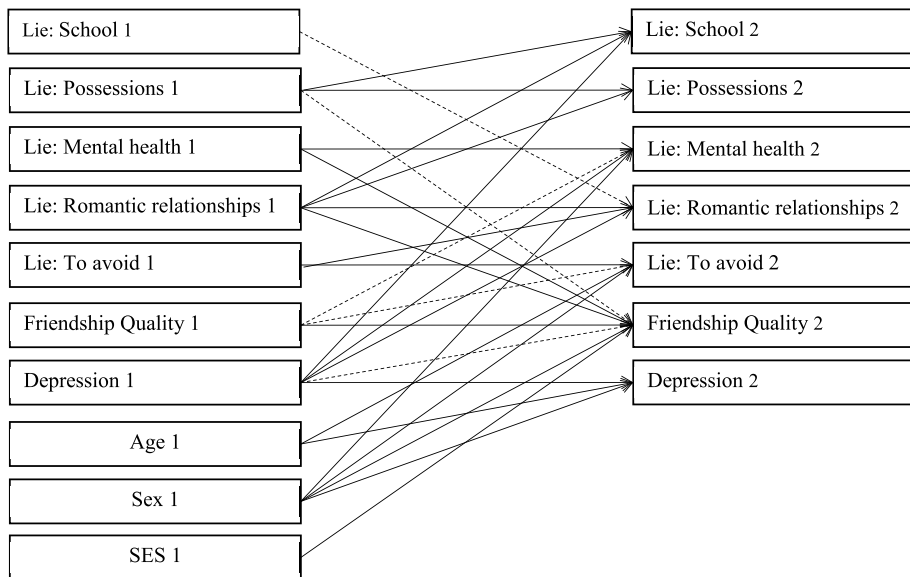


Fig. 2. Significant autoregressive and cross-lagged paths for Model 2.

Lies about romantic relationships. Lying more often about romantic relationships at T1 was associated with greater friendship quality at T2 ($p = .003$); friendship quality at T1 did not predict lies about romantic relationships ($p < .05$). Additionally, greater depressive symptoms at T1 was associated with greater lies about romantic relationships ($p = .023$); lying about romantic relationships at T1 was not associated with depressive symptoms over time ($p < .05$).

Lies about possessions. Lying more often about possessions at T1 was associated with friendship quality at T2 ($p = .011$). Friendship quality did not predict lies about possessions and lies about possessions were not associated with depressive symptoms over time ($ps > .05$).

Lies to avoid spending time with friends. Poorer friendship quality at T1 was associated with lying more often to avoid spending time with friends at T2 ($p = .005$). Lies to avoid spending time with friends did not predict friendship quality over time and lies to avoid spending time with friends was not associated with depressive symptoms over time ($ps > .05$).

4. Discussion

Increased lie-telling from late childhood through adolescence may prevent adolescents from forming positive relationships and developing positive social support networks. Given the potential negative implications of lie-telling, the current study aimed to examine the associations between adolescent lie-telling, friendship quality, and depressive symptoms over time. The findings revealed that lying to avoid spending time with friends was positively associated with age. Both friendship quality and depressive symptoms predicted lie-telling over time and lie-telling predicted depressive symptoms over time. Additionally, we found unique relationships for specific types of lies with both friendship quality and depressive symptoms.

Previous lie-telling research guided by social domain theory has focused on the parent-child relationship and found that adolescents lie to their parents to increase autonomy, to avoid conflict or punishment, and to avoid disappointing parents (e.g., Jensen et al., 2004; Smetana, Villalobos, Tasopoulos-Chan, Gettman, & Campione-Barr, 2009). The current research extends beyond the parent-child context to adolescents' friendships, a crucial component of adolescent social networks, and in doing so explores additional explanations or motivations for adolescents' lies. As previously discussed, friends are not responsible for monitoring or controlling their friends' behaviors, therefore lies in this context should be driven by other motivations. The types of lies adolescents were asked to report on in the current study provides additional insight into the reasons for increased lie-telling with age, particularly regarding adolescents' attempts to manage relationships, avoid conflict, and conceal negative experiences such as depressive symptoms. Throughout the discussion of the findings, possible explanations for adolescents' use of lie-telling in this context will be proposed.

Previous self-report findings suggest that lie-telling is most frequent during adolescence (Debey et al., 2015; Levine et al., 2013); however, only lies to avoid spending time with friends were significantly positively related to age. This suggests that the types of lies that are greater in adolescence compared to childhood may specifically be those told in an attempt to manage or avoid conflicts within their relationships. Rather than being honest and telling friends they do not want to spend time with them, they likely are providing alternative reasons (e.g., being busy with family or having another prior commitment). By telling this lie, they avoid hurting a friend's feelings and potentially damaging a friendship. These competing motivations highlight how adolescents' decision-making is influenced by competing concerns within and across domains. Across these contexts, these findings suggest that adolescents may be attempting to manage their relationships using less productive or positive methods, such as telling lies. Future research could ask adolescents not only about the types of lies they tell, but also their motivation for telling these lies to further understand whether

Table 3
Model 2 Autoregressive cross-lagged model results.

	B	SE	β	95% CI
Cross-Lagged Paths				
Lying: Mental health 1 → Lying: Romantic relationships 2	0.011	0.023	0.023	[-0.070, 0.116]
Lying: Mental health 1 → Lying: School 2	-0.003	0.027	-0.006	[-0.101, 0.089]
Lying: Mental health 1 → Lying: To avoid 2	0.026	0.026	0.048	[-0.046, 0.142]
Lying: Mental health 1 → Lying: Possessions 2	-0.008	0.025	-0.015	[-0.109, 0.079]
Lying: Mental health 1 → Friendship Quality 2	-0.057	** 0.021	-0.111	[-0.193, -0.030]
Lying: Mental health 1 → Depression 2	0.076	** 0.026	0.126	[0.041, 0.211]
Lying: Romantic relationships 1 → Lying: Mental health 2	-0.026	0.057	-0.019	[-0.101, 0.063]
Lying: Romantic relationships 1 → Lying: School 2	0.113	** 0.041	0.123	[0.037, 0.209]
Lying: Romantic relationships 1 → Lying: To avoid 2	-0.008	0.039	-0.009	[-0.094, 0.076]
Lying: Romantic relationships 1 → Lying: Possessions 2	0.111	** 0.037	0.130	[0.045, 0.214]
Lying: Romantic relationships 1 → Friendship Quality 2	0.090	** 0.031	0.105	[0.035, 0.176]
Lying: Romantic relationships 1 → Depression 2	-0.047	0.040	-0.046	[-0.124, 0.032]
Lying: School 1 → Lying: Mental health 2	0.027	0.059	0.021	[-0.068, 0.110]
Lying: School 1 → Lying: Romantic relationships 2	-0.075	* 0.036	-0.096	[-0.187, -0.005]
Lying: School 1 → Lying: To avoid 2	-0.027	0.040	-0.032	[-0.124, 0.060]
Lying: School 1 → Lying: Possessions 2	0.044	0.039	0.054	[-0.038, 0.147]
Lying: School 1 → Friendship Quality 2	-0.007	0.033	-0.008	[-0.088, 0.071]
Lying: School 1 → Depression 2	0.062	0.042	0.065	[-0.020, 0.149]
Lying: To avoid 1 → Lying: Mental health 2	0.074	0.049	0.062	[-0.018, 0.143]
Lying: To avoid 1 → Lying: Romantic relationships 2	0.068	* 0.030	0.095	[0.011, 0.179]
Lying: To avoid 1 → Lying: School 2	0.009	0.035	0.012	[-0.074, 0.098]
Lying: To avoid 1 → Lying: Possessions 2	0.049	0.033	0.066	[-0.019, 0.151]
Lying: To avoid 1 → Friendship Quality 2	0.019	0.027	0.025	[-0.045, 0.096]
Lying: To avoid 1 → Depression 2	-0.012	0.034	-0.014	[-0.089, 0.061]
Lying: Possessions 1 → Lying: Mental health 2	0.031	0.059	0.022	[-0.060, 0.104]
Lying: Possessions 1 → Lying: Romantic relationships 2	0.055	0.036	0.065	[-0.019, 0.149]
Lying: Possessions 1 → Lying: School 2	0.135	** 0.041	0.143	[0.057, 0.228]
Lying: Possessions 1 → Lying: To avoid 2	0.066	0.041	0.072	[-0.015, 0.158]
Lying: Possessions 1 → Friendship Quality 2	-0.083	* 0.033	-0.094	[-0.167, -0.021]
Lying: Possessions 1 → Depression 2	0.021	0.041	0.021	[-0.057, 0.098]
Friendship Quality 1 → Lying: Mental health 2	-0.129	* 0.061	-0.079	[-0.153, -0.006]
Friendship Quality 1 → Lying: Romantic relationships 2	-0.048	0.038	-0.049	[-0.125, 0.026]
Friendship Quality 1 → Lying: School 2	-0.063	0.043	-0.057	[-0.134, 0.019]
Friendship Quality 1 → Lying: To avoid 2	-0.118	** 0.042	-0.111	[-0.189, -0.033]
Friendship Quality 1 → Lying: Possessions 2	-0.026	0.040	-0.025	[-0.102, 0.052]
Friendship Quality 1 → Depression 2	-0.051	0.043	-0.043	[-0.113, 0.028]
Depression 1 → Lying: Mental health 2	0.185	** 0.057	0.133	[0.053, 0.213]
Depression 1 → Lying: Romantic relationships 2	0.080	* 0.035	0.096	[0.013, 0.179]
Depression 1 → Lying: School 2	0.111	** 0.040	0.118	[0.034, 0.202]
Depression 1 → Lying: To avoid 2	-0.006	0.039	-0.007	[-0.090, 0.077]
Depression 1 → Lying: Possessions 2	-0.003	0.037	-0.004	[-0.087, 0.080]
Depression 1 → Friendship Quality 2	-0.063	* 0.032	-0.073	[-0.146, 0.000]
Autoregressive Paths				
Lying: Mental health 1 → Lying: Mental health 2	0.201	*** 0.037	0.246	[0.158, 0.335]
Lying: Romantic relationships 1 → Lying: Romantic relationships 2	0.162	*** 0.035	0.197	[0.115, 0.280]
Lying: School 1 → Lying: School 2	0.076	0.042	0.086	[-0.008, 0.181]
Lying: To Avoid 1 → Lying: To void 2	0.176	** 0.033	0.225	[0.143, 0.308]
Lying: Possessions 1 → Lying: Possessions 2	0.241	*** 0.038	0.272	[0.190, 0.354]
Friendship Quality 1 → Friendship Quality 2	0.451	*** 0.033	0.446	[0.388, 0.504]
Depression 1 → Depression 2	0.357	*** 0.040	0.346	[0.273, 0.420]

Note: *p < .05, **p < .01, ***p < .001.

increased lie-telling may be due to a desire to avoid conflict. Additionally, it may be useful to gain a greater understanding of these types of lies to encourage adolescents to manage conflict and relationships in more positive ways.

Poorer friendship quality predicted more frequent lie-telling over time. Poor friendships are characterized by low trust and self-disclosure, disengagement, and a lack of instrumental and social support (Bauminger, Finzi-Dottan, Chason, & Har-Even, 2008; Berndt & Perry, 1990; Furman & Buhrmester, 1992; Nickerson & Nagle, 2005). Adolescents with less positive friendships may lie more often in an attempt to improve their relationships. Adolescents with poorer friendships may be more willing to lie because they do not feel comfortable disclosing their true feelings or experiences due to the nature of that friendship. For example, a friendship characterized by low trust and infrequent self-disclosure would likely foster greater lie-telling because the lie-teller does not feel secure in being able to truthfully discuss their experiences or feelings. Alternatively, adolescents who experience poorer friendships may not possess the social skills or ability to improve their relationships in meaningful and effective ways. Rather than adjusting their behavior and attempting to build trust through disclosure, they may be more likely to lie to their friends to avoid conflict or to establish common

interests or experiences (Mayeux & Kraft, 2017; Olthof & Goossens, 2008). It may also be that the link between friendship and lie-telling is less direct. For example, Sullivan's interpersonal theory suggests that children learn and practice social skills through their early friendships (Sullivan, 1953). Throughout development friendships serve as a space to learn behaviors that foster intimacy, including honesty and trust. Adolescents who failed to form these closer friendships during childhood lack the space to practice and develop the necessary social skills to continue to form positive friendships. Thus, those who enter adolescence with poorer friendships may engage in greater lie-telling because they lack opportunities to develop social behaviors that foster trust and intimacy, including honesty.

Additionally, friendship quality predicted several specific types of lies over time. Poorer friendship quality predicted more frequent lies to avoid spending time with friends. Adolescents likely would want to devote less time to poorer relationships; thus, they avoid conflict by lying to avoid spending time. It was also found that poorer friendships predicted more frequent lies about mental health, which is an important and interesting finding in the context of depressive symptoms. Less positive relationships are characterized by low feelings of trust and support (Bauminger et al., 2008; Berndt & Perry, 1990; Furman & Buhrmester, 1992; Nickerson & Nagle, 2005). These are important aspects of relationships that promote well-being (Spithoven et al., 2017). If the relationship is not supportive, then adolescents would likely feel hesitant to disclose any negative emotions or experiences. This is problematic, as adolescents' friendships can provide important support for these negative symptoms and prevent them from progressing to more serious problems, such as major depressive disorder.

The results indicate that friendship quality predicts lie-telling over time; however, the opposite direction was not supported. Overall lie-telling did not predict friendship quality over time. It was found, however, that specific types of lies were significantly associated with friendship quality. These different patterns suggest that as motivations for lies vary, their influence on relationships does as well. First, lying more often about mental health predicted poorer friendship quality over time. As previously discussed, friendships are an important source of social support (Bauminger et al., 2008; Berndt & Perry, 1990), therefore if children and adolescents feel hesitant to discuss their true emotions and feelings within a friendship, they likely have a more negative perception of that relationship. Second, lying more often about possessions predicted poorer friendship quality over time. Lies about possessions may be told to impress friends, but may also create unrealistic perceptions of the self that are difficult to maintain, requiring continued dishonesty that prevents trust from being formed. Finally, lying more often about romantic relationships predicted *more* positive friendship quality over time. This finding was unexpected, and it is unclear whether participants were lying to conceal their experiences or lying about relationships that did not occur as we did not ask about one or the other specifically. Regardless of the specific content of this lie, the direction of this association may be because adolescents tell lies about romantic relationships to remain consistent with their friends' experiences (whether it be being involved in romantic relationships or not), and this commonality improves feelings of closeness in their friendships. Future research could ask specifically about adolescents' relationship experiences, and their lie-telling regarding various aspects of romantic relationships to gain a clearer understanding of why lying about romantic relationships is positively associated with friendship quality.

Across these types of lies, it appears that adolescents may be lying to manage their friends' perceptions of them, perhaps in an attempt to increase the likelihood of acceptance and shared interests or experiences. It would be interesting to continue to examine this in the context of dyadic friendships to assess various aspects of these lies. For example, knowing whether friends are aware of the various lies told in their relationship would provide insight into why the different lies are associated with better or worse friendship quality, or not related to friendship quality. Additionally, it would be interesting to gain further information about adolescent relationships to understand why they may be telling certain types of lies. For example, is there a power or status difference between friends that leads to greater lie-telling from the lower-status friend? This additional information would be informative for understanding why lie-telling has these associations with friendship quality. Further, the varying directions of the associations between lying and relationship quality suggest that lies are not generally having a negative impact on friendships. Rather, these findings suggest that the relationship is much more complex and requires further information on the motivations behind these lies to really understand the relationships found in the current study.

Lies are told for many different reasons and are typically discussed in terms of being told for the benefit of the self (antisocial lies) or others (prosocial lies). During adolescence, motivations for lies may be more complex due to the increased complexity of their social environments and relationships, the continued development of their sense of self, and their desire for acceptance and approval from others (Collins & Laursen, 2004b; Kroger, 2004). Due to these changes, adolescents' reasons for telling lies may be different than adults'. Examining lie-telling overall may be too simplistic to gain a true understanding of how lie-telling influences relationships, as our results have suggested regarding the different associations between types of lies and relationship quality. Future research should continue to examine this by asking adolescents about a wide variety of lies, but also asking *why* adolescents tell various lies to gain a greater understanding of how lie-telling influences relationship quality.

Another possible explanation for the pattern of findings between lie-telling and friendship over time is that there is a specific group of adolescents that tend to tell lies more often than others. Self-report lie-telling research has shown that there is typically a group of "prolific liars" within samples that lie much more frequently than the rest of the sample (Serota et al., 2010). In our results lie-telling was stable over time, suggesting that those who lied more often than other participants at T1 also lied more often compared to others at T2. These individuals may have a greater tendency to tell lies, and due to this may not possess the social skills required to form positive friendships. Those who are considered to be dishonest by their peers will likely be unable to form close friendships with more desirable individuals, as honesty is a valued characteristic within relationships (Rotenberg, 1994). Because they lack the ability to form these positive friendships and may make friends with less desirable peers, their friendship quality would likely be lower than those who are honest more often.

Consistent with predictions, lie-telling and depressive symptoms were significantly associated with one another over time. Greater

depressive symptoms were associated with greater lie-telling over time, and greater lie-telling was associated with greater depressive symptoms over time. Lie-telling may isolate the individual from their social support network and prevent others from aiding in coping with negative experiences or emotions. Specifically, depressive symptoms predicted more frequent lies about romantic relationships, school, and mental health. Adolescents experiencing greater symptoms of depression may hold a more negative perception of themselves and feel a greater need to lie to present a more positive or ideal version of themselves to others (Lewinsohn et al., 1980). Thus, they may lie more often about school and relationships to manage others' perceptions. Alternatively, negative cognitive style is often associated with depressive symptoms, and due to this, adolescents with depressive symptoms may be more likely to remember negative or harmful behaviors like lie-telling (Muris, Schmidt, Lambrichts, & Meesters, 2001). They may not be more likely to lie than those experiencing fewer symptoms but may instead be more likely to focus on and remember their lies. Future research could address this potential memory explanation by using a diary methodology to keep track of day-to-day lie-telling in a way that does not ask participants to remember their lies over a long period of time.

Importantly, lies about mental health and depressive symptoms were associated bidirectionally. This suggests that adolescents experiencing depressive symptoms may lie more often specifically to conceal their symptoms, perhaps out of fear of experiencing negative stigma that can be associated with disclosures of poor mental health. Yet, lies about mental health predicted depressive symptoms, suggesting that being honest and confiding in friends about these experiences may be an important factor in preventing symptoms from persisting or worsening. Importantly, this may be a behavior for clinicians to address by encouraging adolescents to confide in their friends and use them as a form of social support, which is important to prevent development of further symptoms or a clinical disorder.

Interestingly, lying to friends was associated with both depressive symptoms and friendship quality over time. It is possible that these three variables are interconnected. For example, the relation between lying and depressive symptoms may be mediated by friendship quality. Specifically, lying may have a detrimental impact on friendship quality. Due to this negative impact, greater lying would be associated with less trusting and supportive friendships. This, in turn, is associated with greater depressive symptoms because there is a lack of positive social support from those friendships. Future research with multiple waves of data could test this model to provide a greater understanding of how these three variables are associated with one another over time.

While lie-telling may be directly and causally associated with both friendship quality and depressive symptoms, it is important to note that these associations may also be explained by other variables not included in the current study. For example, attachment with parents may play a role. Poor attachment with parents predicts poor relationships with friends, and lie-telling is more likely in negative relationships (e.g., Finkenauer, Engels, & Meeus, 2002; Frijns, Finkenauer, Vermulst, & Engels, 2005). Other aspects of the home environment could also explain the link between lie-telling, friendship quality, and depressive symptoms. For example, a more punitive environment has been shown to foster more frequent and sophisticated lie-telling in childhood (Talwar & Lee, 2011). Thus harsh, discipline-focused home environments may foster greater lie-telling, contributing to its negative impact on depressive symptoms. Future research should aim to include variables not included in the present study to explore factors that could explain these associations.

It is important to note that although previous research demonstrates high rates of adolescent lie-telling [e.g., 3–4 lies per day in Debey et al.'s (2015) study], the present study found that adolescents reported moderate levels of lie-telling. Over the two-week period, the average number of lies told was 1.76 at T1 and 2.64 at T2, where a score of 1 indicates no lies, 2 indicates one lie, and 3 indicates 2–5 lies. Other studies also indicate lower levels of lying. For example, other studies using the same scale asking about lies to parents find similarly low lie-telling rates. Jensen et al. (2004) measured lying across six issues over the previous year and found similar means (1.78–2.57; see also [blind for review]). Thus, adolescents' lie-telling rates are low in these studies. There are several important factors that may explain these different lie-telling rates. First, Debey et al. (2015) asked participants about *overall* lie-telling, whereas our study asked specifically about lies to friends (others with similar low rates asked about lies to parents). Thus, we are only accounting for a portion of adolescents' lies. Additionally, the studies that find these lower rates of lying, such as the current study and Jensen et al. (2004), ask adolescents to reflect on a longer period of time (two weeks and one year respectively). Thus, it is likely that adolescents are only able to report on the more serious lies that they told, as these lies may be easier to remember over a long period of time. In contrast, studies that ask about the previous 24 h, such as Debey et al. (2015) and Levine et al. (2013), may be better able to capture all lies regardless of severity because of the shorter time frame. Future research using diary or experience sampling methodologies would help address memory issues that may be influencing the differences in reported frequencies across studies.

The current study has additional limitations to note. First, adolescents were asked about their friendships broadly rather than examining qualities of specific relationships (e.g., best friend, a few close friends). Future research could examine lie-telling in close, dyadic relationships during adolescence to greater understand how lie-telling impacts relationship quality. For example, one aspect of friendship quality that we were unable to examine is power dynamics within friendships. Adolescents may be more likely to lie to friends who are of greater social status or have greater perceived power, as approval from this type of friend is likely considered to be more important than that of a lower status peer. Future research should examine these more specific characteristics of friendships.

Future research would benefit from gaining additional information about the lies adolescents tell in multiple ways. First, participants were asked a single question regarding the frequency of lies on each topic. Future research could ask multiple questions about each topic to allow for more detail as to the types of lies adolescents are telling across these domains (e.g., Are they hiding relationships? Are they lying to hide poor school performance?). Additionally, while participants were asked about different topics of lies, they were not asked to report on their reasons for their lies. This would be an important distinction to include in future studies, where adolescents could be asked to report both the topic of their lies and why they told those lies to their friends. Knowing adolescents' motivations for their lies may provide a better understanding of how lie-telling is related to various outcomes. For example, are most of the lies adolescents tell self- or other- oriented? Adolescents who tell more other-oriented lies may experience fewer

negative outcomes compared to adolescents who tell more self-oriented lies. Finally, we did not specify in our lie-telling measure whether we were referring to lies told about the self or about others. Future research could differentiate between these two by asking separate questions for lies told about information regarding the self or regarding others' behaviors. Finally, future studies could build on this research by asking adolescents about outright lie-telling (as we measured) as well as lies of omission (i.e., keeping secrets). Previous research has found that secret-keeping is associated with relationship quality over and above lie-telling (blind for review), and secret-keeping is an important aspect of friendship (Furman & Buhrmester, 1992; McNelles & Connolly, 1999; Niobe, 2013). Thus, examining both types of dishonesty would build upon our understanding of how dishonesty impacts development.

5. Conclusion

The current study addressed the current limited understanding of lying to friends during adolescence, as well as the association between lying to friends, friendship quality, and depressive symptoms over time. The findings suggest that lie-telling is an important behavior to continue to examine and understand during adolescence. Specifically, poorer friendship quality predicted greater lie-telling over time and lie-telling and depressive symptoms were bidirectionally associated over time. These findings highlight the importance of understanding the development of lie-telling during adolescence and its potential negative implications for important developmental outcomes.

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Declaration of competing interest

The authors have no conflicts of interests to declare.

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