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ORIGINAL ARTICLE

Values in adolescent friendship networks

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Abstract

Values—the motivational goals that define what is important to us—guide our decisions and actions every day. Their importance is established in a long line of research investigating their universality across countries and their evolution from childhood to adulthood. In adolescence, value structures are subject to substantial change, as life becomes increasingly social. Value change has thus far been understood to operate independently within each person. However, being embedded in various social systems, adolescents are constantly subject to social influence from peers. Thus, we introduce a framework investigating the emergence and evolution of value priorities in the dynamic context of friendship networks. Drawing on stochastic actor-oriented network models, we analyze 73 friendship networks of adolescents. Regarding the evolution of values, we find that adolescents' value systems evolve in a continuous cycle of internal validation through the selection and enactment of goals—thereby experiencing both congruence and conflicts—and external validation through social comparison among their friends. Regarding the evolution of friendship networks, we find that demographics are more salient for the initiation of new friendships, whereas values are more relevant for the maintenance of existing friendships.

Keywords: value change, friendship network evolution, stochastic actor-oriented network models, adolescent networks

1. Introduction

What is the motivation behind our actions and the decisions we make every day? What can explain the choices we have made in the past and what determines the paths we choose for our future? Essentially, values—or the motivational goals that define what is important to us—embody the potential to answer all of these questions. Values guide us throughout all the stages of our lives (Schwartz, 1992). Similar to the way we learn our native language, our values are formed to a large extent through learning and observing what is important to our parents (Larson, 1972). Throughout the early stages of our lives, we set and adjust priorities in our value structure until they are part of our self-identity (Meeus et al., 2002), just like the unique ways in which we learn

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to express ourselves in our native language. Similar to the manner in which communication with different native languages harbors the potential for misconceptions or misunderstandings, the expression of different values can incite disagreements or even conflicts. Every society on the planet fosters specific sets of value priorities through the different ways, in which the actions or decisions of their members are sanctioned (Schwartz, 1999). Thus, values are like a common language, through which we are bound to each other in our societies. Irrespective of whether we migrate in pursuit of better opportunities or seek refuge in other countries, we all carry our own value priorities with us (Schwartz, 2013, 2006; Bardi et al., 2014). Conflicts emerge if there are substantial gaps in how specific values such as family structures, hierarchies, traditions, conformity, freedom of speech, gender equality, social justice, or the protection of the natural environment are prioritized. Thus far, the literature on values has investigated a variety of mechanisms linking values to sociologically relevant dimensions, all of which assume that these processes take place within persons, who act independently of each other.

However, starting in adolescence, life becomes increasingly social. At this stage in our lives, we are embedded in various social systems (McPherson et al., 2001) and thus constantly exposed to social influence from the corresponding peers. Within each sphere of our lives, we can form social networks—and through the corresponding ties—access knowledge to better understand specific aspects of our reality and obtain feedback to validate our beliefs, preferences, attitudes, intentions, or behaviors (Festinger, 1954). Moreover, these social networks have a unique nature that is both dynamic and endogenous. First, according to McPherson et al. (2001), there are many criteria based on which social networks among adolescents can be formed. These salient criteria are not only limited to demographic attributes such as race and ethnicity (Marsden, 1987; Shrum et al., 1988), gender (Marsden, 1987), age (Fischer, 1982; Feld, 1982; Marsden, 1987), religion (Verbrugge, 1977), education (Marsden, 1987), occupation (Kalmijn, 1995), but also include behaviors (Steglich et al., 2010; Knecht et al., 2010; Ellwardt et al., 2012; Haye et al., 2013; Solish et al., 2010; Friemel, 2012), and values (Kandel, 1978; Lazarsfeld et al., 1954; Newcomb, 1961). Second, these criteria can be more or less salient for adolescents, depending on the stage in the evolution of these social networks. They can serve as inclusion or exclusion criteria for the formation of new ties, if social networks are at an early stage, where a majority of affiliations have not yet been formed, or for the maintenance of existing ties, if social networks have reached a more mature stage (Hallinan & Williams, 1989).

Surprisingly, values have not yet been investigated in such a dynamic context of evolving social systems. Thus, the goal of this paper is to provide insights into how value systems emerge in childhood and how their multi-dimensional structure evolves in the dynamic contexts of social networks in school classes during adolescence.

Therefore, in the current study, we will investigate how value priorities evolve and interact with priorities assigned to other values in multi-dimensional value systems, how the change in adolescents' value priorities is affected by the value priorities of peers in their social networks, and how the salience of demographic attributes and values as inclusion or exclusion criteria changes at different stages in the evolution of social networks. This paper is structured as follows: We begin with our theoretical framework and hypotheses, followed by a description of our data and the variables considered in our model specifications. Next, we present the results and complete the paper with concluding remarks.

2. Theoretical framework and hypotheses

In their transition to adulthood, adolescents explore different pathways in their quest to find their preferred forms of relationships as well as their worldviews and principles, which will guide their actions and decisions in the future (Shanahan, 2000). This article investigates changes in social network structures (Mercken et al., 2010) and basic human values (Schwartz et al., 2012; Cieciuch et al., 2013). According to our theoretical framework, both are conceptualized as

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dynamic processes, which have an endogenous nature, as captured by the theory of structuration (Giddens, 1991), where social network structures are built and maintained on the basis of adolescents' demographic attributes and values, which in turn are formed and adapted in the dynamic context of adolescents' social network structures.

2.1 Emergence and evolution of values

In our theoretical framework, the dynamic nature of basic human values is conceptualized according to the perspectives of dialectical theory and teleological theory (Van de Ven & Poole, 1995). According to dialectical theory (Neale & Northcraft, 1991), adolescents are seen as pluralistic entities hosting a system of goals that are either maintained as a current status quo of harmonious goals or negotiated with the priorities assigned to conflicting goals to form a new status quo. According to our theoretical framework, the goals underlying adolescents' value systems are structured as specified by the theory of basic human values (Schwartz et al., 2012), which can be interpreted as alternative identities competing for their host's priority. If specific identities can mobilize a sufficient amount of focus, they can drive the thoughts and actions of their corresponding hosts.

What are basic human values? In a review on value theories and value research, Rohan (2000) identified considerable inconsistency in how values are defined. Theorists define values as motivational guides (Lewin, 1951), conceptions (Kluckhohn, 1965), properties of entities (Heider, 1958), and beliefs about the desirability or preferability of modes of conduct and states of existence (Morris, 1956; Feather, 1996; Rokeach, 1973). There is general agreement that value systems contain a finite number of universally relevant value types, to which people assign relative importance, and that value systems need to have an underlying structure based on the motivational goals embodied by each value type.

Therefore, this study uses the framework of higher order values from the theory of basic human values. This theory defines values as trans-situational goals, which vary in importance and serve as guiding principles for groups or in an individual's life (Schwartz, 1992; Bardi & Schwartz, 2003; Skimina et al., 2018). The term "value structure" is used with reference to the classification of values according to the congruence or conflict experienced when contemporaneously enacting these values, while the term "value priorities" describes the relative importance assigned to different values. According to the theory of basic human values, value systems are structured according to two motivational dimensions, which are cast in terms of conflicts and fundamental human problems that need to be solved (Schwartz et al., 2012).

2.2 Structure of value systems

The first dimension highlights the conflict between conservation and openness to change. Conservation is defined as the motivation to "preserve the status quo and the certainty it provides in relationships with close others, institutions, and traditions" (p. 43) and encompasses the values "security," "conformity," and "tradition." Openness to change is defined as the motivation to "follow one's own intellectual and emotional interests, in unpredictable and uncertain directions" (p. 43) and is composed of "self-direction" and "stimulation" values.

The second dimension relates to the conflict between self-enhancement and self-transcendence. Self-enhancement is defined as the motivation to "enhance one's own personal interests, (even at the expense of others)" (p. 44) and entails the importance assigned to "achievement" and "power" values. Self-transcendence is defined as the motivation to "transcend selfish concerns and promote the welfare of others, close and distant, and of nature" (p. 44) and is composed of "benevolence" and "universalism" values. For a detailed description of these values, we refer to Tables 1 and 2 of the Online Supplementary Information.

People are assumed to have a capacity for meta-cognition, which means that they are not only capable of talking about their value priorities but are also able to use value language to make arguments supporting their decisions or behaviors (Rohan, 2000; Schwartz, 1996).

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2.3 Internal validation of value systems

According to our framework, adolescents assign different priorities to their alternative identities and thus place some of them in the spotlight—a position from which they are in charge of forming desirable goals and choosing effective actions to reach those goals (Neale & Northcraft, 1991). A status quo is achieved if the enactment of the corresponding goals does not create any conflicts (Schwartz et al., 2012). Spending time and financial resources on activities or products are ways for the alternative identities in the spotlight to tell a story about themselves. Spending time and effort to initiate new friendships and spending money on new brands or products with new features are valid means to satisfy the need for novelty underlying openness to change values. Moreover, exploring new relationships or features of new brands also allows teenagers to increase their capacity to provide social support as advisors and thus enhance their social status in social networks. However, spending money on products without an established brand reputation cannot provide the security or express the conformity required for the pursuit of conservation values. Moreover, spending time in pursuit of openness to change values through the initiation of new friendships reduces the time available for the maintenance of existing friendships that is needed for the pursuit of conservation values.

Conflicts such as these are experienced not only in terms of time and financial resources but also in terms of cognitive dissonance (Festinger, 1962). If teenagers envision activities that are in conflict with the goals underlying their prioritized values, the corresponding cognitive dissonance urges teenagers to shift priorities toward values, which can establish consonance with the envisioned activities or to seek out other activities through which they expect to achieve consonance. In our framework, the process of avoiding conflicts, reducing cognitive dissonance, and thus striving for consonance to form a status quo is referred to as internal validation.

Hypothesis 1a (H1a)**.** *We expect that teenagers experience conflict when enacting*
(1) self-transcendence alongside self-enhancement values and
(2) openness to change alongside conservation values.

If teenagers envision activities through which they can achieve a state of consonance in the pursuit of goals underlying multiple alternative identities, then all of them can be in the spotlight. As a result, we expect that the simultaneous pursuit of each corresponding higher order value reinforces the emphasis placed on the other higher order values.

Hypothesis 1b (H1b)**.** *We expect that teenagers experience congruence when enacting*
(1) self-transcendence alongside conservation or openness to change values,
(2) openness to change alongside self-transcendence or self-enhancement values,
(3) self-enhancement alongside openness to change or conservation values, or
(4) conservation alongside self-enhancement or self-transcendence values.

2.4 External validation of value systems

However, teenagers do not form values in isolation. They can come into contact with peers in a variety of contexts. Moreover, these contexts can change as teenagers self-select into different contexts, either based on their own initiative or when forced through changing circumstances (Bardi et al., 2014). Thus, they are constantly exposed to information about how their peers behave, how peers solve problems, and how peers are affiliated with each other. According to social comparison theory (Festinger, 1954), external validation provides teenagers with the necessary information for decisions regarding the complex trade-offs associated with changes in their value systems. It also enables teenagers to derive social meaning for the goals underlying their values. The status quo in their value systems can be challenged if the enactment of a harmonious set of values cannot be externally validated in their social networks or if the adoption of desirable activities that are observed among their peers creates dissonance, given the way the corresponding values are

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currently prioritized. We expect that teenagers adapt the values of their peers, as they assume that the peers with whom they spend most of their time are very similar to themselves and that the average extent to which those peers emphasize values in their value systems is very close to their ideal. Thus, they regard those peers as reliable sources of social information and the latter's corresponding collective wisdom to be trustworthy (Lorenz et al., 2011).

Hypothesis 2 (H2)**.** *We expect that teenagers shift their priorities toward the average expression of their friends' value priorities.*

According to teleological theory (March & Olsen, 1979; Merton & Merton, 1968; Berger & Luckmann, 1971), adolescents can be seen as purposeful and adaptive entities that are evolving toward a specific state in a cycle of goal formation, action formation, outcome evaluation, and goal adjustment based on social experiences.

2.5 Dynamics in friendship networks

Among all the different types of relationships, the concept of friendship has attracted the greatest level of attention in both theoretical and empirical research (Haynie, 2002; Lin et al., 2013; Hendrickson et al., 2011; Selfhout et al., 2010; Krackhardt & Kilduff, 1999; Mercken et al., 2010; Milardo, 1982; Hallinan, 1979). The majority of existing work measures friendship quality as the amount of time people voluntarily spend with each other (Bukowski et al., 1994). This feature makes friendship relations particularly relevant for this study, as they are contexts in which people are most likely to discuss their value priorities or observe behavioral expressions of each other's values.

In what contexts do teenagers form friendships? Feld (1981) introduces the concept of organizational foci, which are contexts in which people draw and evaluate information to validate cognitions and form relationships with their peers. Such foci are essentially pools of peers, with whom people can create and maintain friendships. They are defined as social, psychological, legal, or physical entities around which joint activities are organized. Through their impact on social interaction patterns, structural properties such as the size of these organizational foci can affect specific features of the social networks that evolve within these contexts (Hallinan, 1979).

Why does friendship emerge between acquaintances, and why does a teenager reach out to another as a friend? Social comparison theory (Festinger, 1954) suggests that people have an inherent need to validate their cognitions. Realizing that their own lifetime experiences do not yield sufficient insights, teenagers need to reach out to their peers and spend more time with them to obtain more comprehensive information.

Additionally, Wright (1984) suggests that friendships are rewarding on multiple dimensions and provides a taxonomy based on their self-referent implications. First, friends are encouraging and help to maintain an impression of one's competence. Second, friends behave in ways that facilitate the expression of one's self-concept and the recognition of important and highly valued features. Third, friends stimulate and foster an expansion or elaboration of one's knowledge and perspectives. Fourth, friends express a personalized interest and concern through their helpfulness and cooperation in meeting one's goals and thus enact behaviors that are instrumental to achieving such goals. However, the most important self referent implication—and a necessary condition for friendships to evolve—is that friends do not behave in ways that would threaten the integrity of one's self-concept. Thus, friends do not betray trust, cause embarrassment, or draw attention to points of weakness and self doubt (Kelvin, 1977).

How are friendships distinguished from other types of relationships? Do teenagers reciprocate the friendship nominations of their peers? Are they attempting to induce balance and encourage their friends to meet and spend more time together? People generally expect positive affective relationships such as friendships to be mutual, balanced in terms of social capital (Coleman, 2000), and emotionally supportive (Freeman, 1992; Laursen, 1993; Krackhardt & Kilduff, 1999;

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Vaquera & Kao, 2008). Festinger & Hutte (1954) argue that people who perceive friendships to be unbalanced experience feelings of uncertainty or instability.

Reciprocity can be a motivating force for the creation and maintenance of friendship relationships. Therefore, we expect that peers with many reciprocated ties are more likely to establish new ties and maintain existing ties than those with fewer reciprocated ties.

However, reciprocity does not exist by default in all friendships. Moreover, (Hartup, 1996) and Vaquera & Kao (2008) argue that relationships that are reciprocated are substantially different from those that are not. Reciprocated friendship relationships are significantly more likely to emerge, if one peer has previously reached out to the other as a friend, compared to the emergence of a reciprocated friendship relationship from a non-existing relationship (Hallinan, 1978). Notwithstanding, one-sided friendship relationships such as these do not usually survive over a long period of time. Maintaining a friendship tie to someone who does not reciprocate would indicate an implicit agreement as to this person's higher status (Gould, 2002), which can explain why one-sided friendship relationships are significantly more likely to be dissolved compared to reciprocated friendship relationships (Hallinan, 1978). Block (2015) argues that an unreciprocated friendship is more likely to survive if it is embedded in a transitive triad. Transitive triads provide a forum, which makes one-sided friendships less apparent than unreciprocated friendships existing outside a transitive triad (Elmer et al., 2017; Rivas-Drake et al., 2017; Block, 2015). Therefore, we expect that unreciprocated ties are more likely to exist within transitive triads than unreciprocated ties outside transitive triads.

Are teenagers more popular as friends if many other peers have already nominated them as friends? Although teenagers could become less popular in evolving networks if they have a limited capacity to receive links or incur costs when receiving links (Amaral et al., 2000), we expect adolescents with a larger pool of existing friendships to be more popular (Barabási & Albert, 1999).

2.6 The salience of adolescents' manifest and latent attributes on the stages of friendship network evolution

The dynamic nature of friendship networks can be conceptualized according to the perspectives of life-cycle theory and evolutionary theory (Van de Ven & Poole, 1995). In life-cycle theory (Nisbet, 1970; Piaget, 1967; Levinson, 1978), adolescent friendship networks are seen as evolving entities that have an underlying logic or code that is prefigured in these entities, which regulates the process of change and transforms the friendship networks in a unitary cumulative sequence of stages toward a specific end, such that characteristics that are acquired in earlier stages are retained in later stages. The underlying logic or code can be interpreted as a utility function that is common to all adolescents within the same environment and thereby drives their decisions regarding the selection and retention of friends. On the one hand, teenagers' utility functions determine the traits that they consider in friendship selection. On the other hand, teenagers' utility functions can determine whether these traits have an impact on their own sociability, a tendency that is known as gregariousness (Benenson et al., 2015; Gifford & Gallagher, 1985), whether favorable expressions of these traits among their peers are considered as inclusion or exclusion criteria—and thus determine their popularity as potential friends (Bukowski et al., 1993)—or whether they prefer their friends to be similar on such traits, a tendency that is referred to as homophily (McPherson et al., 2001; Lazarsfeld et al., 1954). We expect that gregariousness, popularity and homophily are both shown in the tendency to form new friendship ties, as well as the tendency to dissolve existing friendship ties (Hallinan & Williams, 1989; Tuma & Hallinan, 1979).

In evolutionary theory (Aldrich, 1979; Campbell, 1969; Hannan & Freeman, 1977; Pfeffer, 1982; Weick, 1979), adolescent friendship networks are interpreted as entities that evolve in a sequence of two stages. At the selection stage, where adolescents know nothing about their peers, we assume that gender—as a manifest trait of their identity—is highly relevant for the formation of friendship (Eder & Hallinan, 1978).

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Hypothesis 3a (H3a). *Therefore, we expect that manifest traits are more salient than latent traits in the creation of new friendships between teenagers who have not spent much time with each other.*

However, at the retention stage, adolescents gradually learn more about what is important to their friends, as they spend more time with them. Values have been shown to be very powerful in explaining the formation of friendship in general (Kandel, 1978; Lazarsfeld et al., 1954; Newcomb, 1961). However—as latent traits of their identity—we assume that they are not as salient for the creation of new friendships as they are for the maintenance of existing friendships.

Hypothesis 3b (H3b). *Therefore, having spent much time with each other, we expect that latent traits are more salient than manifest traits for existing friendships between teenagers to persist.*

3. Data and method

Our study is designed as a longitudinal, three-wave panel. From October 2015 until December 2016, we commissioned three waves of surveys with pupils from both Switzerland and Poland who entered compulsory or voluntary secondary education in the 7th and 9th grades, respectively. Thus, for all pupils participating in the study, the observation period starts at a point when they are reassembled in new classes and assigned new teachers, such that, overall, they are equally exposed to a new pool of peers whom they did not know before.

3.1 Sites and samples

Schools can for many reasons be considered ideal environments to study the evolution of—and interdependencies between—the processes this project sets out to investigate. First, while the main function of schools is to provide an environment for children and adolescents to acquire cognitive and social skills, schools are also arenas for pupils to observe traits and behaviors of peers and thus validate their own. As a consequence, these processes display considerable dynamics. Second, while hierarchically nested class structures still dominate in primary education, pupils are no longer nested in single classes in secondary education but to some extent can self-select into performance classes for specific subjects. Such an environment can foster collaboration and knowledge exchange. Third, while schools are embedded in the regulatory environment of the government, pupils in the school environment are protected from various external contexts, which could potentially co-determine their behavior. Studying the evolution of friendship networks in school classes also makes it possible to capture a comprehensive part of adolescents' social universe, as the majority of decisions regarding relationships arguably occur among classmates. Fourth, Coleman (1961) argues that in adolescence, friends are at the center of this social universe. Following exemplary studies from previous research (Mercken et al., 2010; Steglich et al., 2010; Knecht et al., 2010; Solish et al., 2010; Ellwardt et al., 2012; Friemel, 2012; Haye et al., 2013), we conclude that this environment can be seen as an ideal context for our study.

3.2 Design

The waves in our longitudinal design correspond to the number of times the pupils were interviewed. The dynamics of the processes under consideration in this study are expected to be the highest at the beginning of the group formation process (Friemel, 2012). Thus, the timing of the administration of the surveys to the pupils is designed with proportionally increasing time windows between waves of data collection. The longitudinal design is intended to limit the exposure of respondents to surveys while ensuring that all dynamics in the processes under consideration are captured. The subjects in our compulsory and voluntary secondary school cohorts entered at the age of 12 or 13 and left at the age of 15 or 16. The sample sizes and compositions are summarized in Table 1.

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Table 1. Descriptive statistics

		Panel			Analysis			Descriptives	
Country	**Wave**	Sites	Classes	Participants	Sites	Classes	Participants	ϕ age	% female
Switzerland	1	8	55	1,183	7	44	890	13.2	52.5
	2	8	55	1,193	7	44	890	13.7	52.5
	3	7	44	890	7	44	890	14.2	53.3
Poland	1	31	105	2,733	6	29	670	14.6	53.7
	2	29	105	2,743	6	29	670	15.0	53.7
	3	29	105	2,700	6	29	670	15.6	54.5

3.3 Procedures

All procedures contributing to this work are in compliance with the ethical standards of the relevant national and institutional committees. The surveys commissioned in the various school classes were supervised by trained students. At each wave in each cohort, data were collected during a full school period of 45 min. To eliminate method bias, data were collected using the same method across all waves for each pupil. Respondents surveyed in Switzerland were provided with questionnaires in paper and pencil form, while the surveys commissioned in Poland were administered online. Pupils and their parents were informed about the design and purpose of the study several weeks before data collection started. Due to different regulations concerning data protection, we used different approaches to obtain parental consent for the participation of Swiss and Polish pupils in our study. All parents in Switzerland were provided with an opt-out possibility. Of the 1,193 pupils in the Swiss sample, none of the parents made use of that possibility. In contrast, parents in Poland were specifically asked to opt-in. From a total of 2,743 pupils sampled in Poland, approximately 67% of the corresponding parents provided their consent.

To make the school classes in the two countries comparable in terms of participation rates, we excluded 86 secondary school classes, where absences in any given wave exceeded 50% due to the opt-in and opt-out procedures. The result of this process can be seen in Table 1. The sample we used for our analyses includes 73 secondary school classes from Switzerland and Poland.

3.4 Measures

To investigate the emergence and evolution of adolescents' value priorities within friendship network structures of school classes, as well as the salience of adolescents' attributes along the stages of the evolution of friendship networks, this study uses the following measures.

3.4.1 Values

Our study uses two versions of the Portrait Value Questionnaire (Schwartz et al., 2012) to collect data on respondents' values. These versions differ only in the number of items contained therein. The common set of items used in both versions includes 13 items asking respondents to compare themselves to people described in brief statements and to evaluate how similar they are to these persons on a six-point scale ranging from "not similar at all" to "very similar" (Beierlein et al., 2014). The Portrait Value Questionnaires used for the Swiss and Polish panels are listed in Figures 3 and 4–6 of the Online Supplementary Information.

3.4.2 Friendship

Data on networks were collected with a roster design. All names of the pupils in each class were displayed on a list, including those who did not participate in the survey or those absent from class on the dates scheduled for the waves.

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Pupils were asked "How strong is your friendship with your classmates?" They responded on a six-point scale ranging from "no friendship at all" to "very close friends." In line with the companionship item of the friendship quality scale (Bukowski et al., 1994), pupils were consistently given instructions to determine the strength of friendship by the proportion of leisure or recreation time they voluntarily spent together. The weighted friendship scale we used in our study is shown in Figure 7 of the Online Supplementary Information. However, the methodology we applied in our analyses is restricted to the analysis of binary network data. All possible thresholds for dichotomization were tested. Thresholds above and below the cut-off level of five on the six-point scale create very sparse or dense networks, respectively, which result in little network dynamics. Therefore, the weighted friendship networks were dichotomized at the cut-off level of five. Consequently, pupils' decisions not only cover situations in which friendships are created from non-existing relationships but also situations in which casual relationships are upgraded to friendships. Similarly, pupils' decisions are not restricted to situations in which existing friendships are dissolved completely but also include situations in which existing friendships are downgraded to casual relationships.

3.5 Analytical approach

The social networks of the school classes in the current study can be described by graphs. In social network analysis, graphs are mathematical representations expressing how *nodes* are affiliated with each other, as represented through *ties*. Most approaches used to model dynamic network structures focus on fitting a model to a specific series of observed networks. Depending on the research context and the research questions under investigation, there are two approaches that are predominantly used to model dynamics in social network structures.

Hanneke & Xing (2007); Robins & Pattison (2001); Frank & Strauss (1986) introduced an exponential random graph model (ERGM) framework capturing the transition from a network observed at time t to a network observed at time $t+1$. ERGMs treat each network as a single observation and model the probability of observing a network with a specific structure of ties in relation to every possible alternative network—meaning every possible permutation of ties in a network with the same number of nodes—given a set of statistics on the network. In this framework, the evolution of network structures over time is modeled through stepwise ERGMs. The set of statistics can measure effects endogenous to the networks under investigation (endogenous processes) and the effects of exogenous covariates (exogenous processes).

An alternative approach to model network dynamics was introduced by Snijders (2001); Snijders et al. (2010) and implemented in RSiena by Ripley et al. (2011), which is commonly referred to as a stochastic actor-oriented network model (SAOM). As the terminology implies, this approach is based on the idea that *actors* are *nodes*, which have agency and thus evaluate network structures in an effort to obtain a configuration of ties with the highest possible utility. In other words, actors are assumed to pursue their own objectives under the restrictions of their social context, and in doing so, actors themselves are part of each others' changing contexts. Similar to the ERGM framework, the utilities driving actors' decisions in SAOMs are determined by a set of statistics representing endogenous or exogenous effects. In contrast to the ERGM framework, actors in SAOMs make their choices based on the present state without memory. Moreover, when using the SAOM approach, actors' choices are not restricted to the evolution of network structures but include choices regarding dynamics in both the network and attribute space, as illustrated in Figure 8 in the Online Supplementary Information.

Both the research context and the research questions this article seeks to investigate call for the SAOM approach, whereby pupils are regarded as the primary agents pursuing their own goals under the constraints of the social network structures in their school classes. The following paragraphs are devoted to a discussion of both approaches and their respective suitability to investigate our research questions.

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Unlike ERGMs, SAOMs are particularly qualified to model dynamics in attributes. Changing the priorities assigned to basic human values can be viewed as decisions, where pupils can increase or decrease the emphasis they place on specific values and maintaining their current priorities. SAOMs have been used in a wide variety of contexts to study network dynamics (Van de Bunt et al., 2005; Van Duijn et al., 2003; De Nooy, 2002; Schaefer et al., 2011) or the co-evolution of networks and actor behavior (Checkley & Steglich, 2007; Burk et al., 2007; Pearson et al., 2006; Steglich et al., 2010; Lewis et al., 2012). Both ERGMs and SAOMs are similarly qualified to capture the dynamic nature inherent in social networks. While ERGMs model the probability of observing networks with specific structures, SAOMs allow actors to make decisions regarding their social network structures and thus modify the structure of the relationships with their peers. In research contexts, where ties are affiliations between nodes without agency or where the emergence and persistence of ties is the outcome of negotiations and collective decision-making, ERGMs are more appropriate, as they do not make assumptions such as those listed in Section 4 of the Online Supplementary Information for SAOMs. However, in the research context of this article, pupils have agency to invest resources in the formation and maintenance of friendship ties or free said resources through their dissolution. Therefore, both approaches are appropriate to investigate specific sets of attributes and how they are considered when teenagers select friends.

In this article, we draw on SAOMs primarily because of their capacity to capture mechanisms simultaneously driving both value and network structure changes. First, the dynamics of attributes and network structures are conditioned on the first observation. Therefore, no assumptions regarding the respective states of equilibrium have to be made. Second, the multinomial nature of the models allows each process to be estimated net of the other. As such, SAOMs are uniquely qualified to investigate the dynamic processes of value change in the context of friendship networks. Changes in attributes and network ties between panel waves are at the core of SAOMs. On the one hand, the attributes of actors can change over time. Such changes can either be the outcome of actors' characteristics (e.g., attributes change because of attributes the actors currently possess) or of their peers' characteristics (e.g., attributes change because of attributes that actors' friends possess). On the other hand, relationships between actors can emerge or disappear over time. Such changes in the network structure can be the outcome of an actor's structural position within the network (e.g., forming ties to people because they are friends of friends), an actor's characteristics (e.g., attractiveness of actors because of attributes they possess), or characteristics shared by actors (e.g., attractiveness of actors because of similarity in attributes).

3.5.1 Estimation procedure

By modeling the changes in attributes and network ties, SAOMs are applied to longitudinal attributes as well as complete, directed, and longitudinal networks. Although these types of data are measured in discrete waves, SAOMs assume a continuing underlying process with attribute or network tie changes occurring sequentially. Actors can make decisions regarding their attributes (e.g., increasing or decreasing their value priorities, as well as maintaining their current state) or their network structure (e.g., creating or dissolving network ties, as well as maintaining the current state).

In the SAOM framework, each individual decision an actor makes is called a mini-step. A mini-step is modeled by two underlying processes. In the first process, the actor who is allowed to make a decision is selected through a rate function. Using a period-wise constant rate function, we assume no difference in the rate of change between actors. In the second process, the selected actors evaluate all potential changes in their attributes and personal networks. Under the assumption that specific dynamics will occur, an objective function including the corresponding parameters is specified, and actors consider how each change in their attributes or network structure would affect their utility regarding these parameters. For factors that are combined

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in the objective function and thus determine actors' decisions, SAOMs use the term "effects." Homophily is an example for such effects. If the parameter for homophily is positive, actors are more likely to create or maintain ties to other actors who are similar to themselves. Thus, actors compare the outcome of the objective function for each attribute—or network state—that results from every possible change in attributes or network structure. At the conclusion of each mini-step, the attributes—or network states—that are most likely to be chosen by actors are those with the highest value in the objective function. In a series of mini-steps connecting empirical observations, parameters that attach relative importance to different effects are estimated. The interpretation of effects is similar to parameters from a multinomial logistic regression, where θ is the log odds ratio, which co-determine the relative likelihood of a mini-step to be realized. For a non-technical introduction to the method, including different methods of parameter estimation, we refer to Snijders (2001); Steglich et al. (2006); Snijders et al. (2010).

3.5.2 Model specification

The structural effects we include in our analyses have been selected on the basis of theoretical considerations based on past experience with these models and based on results from previous studies using this method with similar data (Steglich et al., 2010). *Outdegree* $s_i^{net}(x) = x_i$ determines the average degree and can be compared to an intercept in regression analyses. *Reciprocity* $s_i^{net}(x) = \sum_j x_{ij}x_{ji}$ is the tendency of actors to reciprocate ties to each other. *Transitivity* $s_i^{net}(x) = \sum_{j=1}^{n} x_{ij}e^{\alpha}\left\{1-(1-e^{-\alpha})^{\sum_{h=1}^{n} x_{ih}x_{hi}}\right\}$ models the tendency of actors to be linked to friends of friends. *Outdegree activity* $s_i^{net}(x) = x_i^2$ controls for the tendency to nominate friends depending on the number of current friendship nominations. *Indegree popularity* $s_i^{net}(x) = \sum_j x_{ij} \sum_h x_{hj}$ controls for dispersion in indegrees and investigates whether an individual who already has many incoming ties is more popular as a target for further friendship nominations. *Linear shape* $s_i^{val}(z) = z_i$ and *quadratic shape* effects control for the tendency to change one's value priorities in general and for the corresponding tendency depending on one's current emphasis on the respective values.

In addition to these main structural effects, we report results on interactions between the effect of *reciprocity* and the effects of *transitivity* as well as *outdegree activity* in the analyses. The statistics for both interaction effects are calculated as the product of the respective statistics for the effect of *reciprocity* with the effects of *transitivity* and *outdegree activity*. Thus, the relevant statistics for the interaction effects take larger values if pupils emphasize both reciprocity and transitivity or if pupils have higher tendencies of both reciprocity and outdegree activity. Otherwise, the corresponding statistics take lower values.

The first focus of this article is on value change. In all analyses reported in Table 2, models include the *average similarity* effect, which measures the tendency to adapt one's value priorities to become more similar to one's friends. Additional models further include effects of *gender*, *age,* and *values*. The former effects estimate gender differences and differences in the tendency to change one's value priorities based on the level of maturity. Moreover, the change in priorities on a specific value dimension might be a function of the change in priorities on other value dimensions. Therefore, the latter effects estimate how priorities on a specific value change in co-evolution with the priorities assigned to other values.

The second focus of this article is on friendship selection. In all analyses, we include *ego- and alter effects* of *value priorities*, which refer to the tendency to send or receive friendship ties based on such priorities, and interactions between these tendencies to measure the preference for having friendships with peers who similarly prioritize values. Additional models further include the effect of having the *same sex* and the *same level of maturity*. The statistic for these effects is equal to one if the sender and recipient of the tie share the same gender and level of maturity and zero otherwise. We excluded ego- and alter effects for gender and level of maturity from the analyses. First, we did

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Table 2. Values in friendship networks

Hypothesis	effect	Function	Self-transcendence μ_θ σ_θ	Self-transcendence Fisher's p Fisher's [l,r] p	Conservation μ_θ σ_θ	Conservation Fisher's p Fisher's [l,r] p	Self-enhancement μ_θ σ_θ	Self-enhancement Fisher's p Fisher's [l,r] p	Openness to change μ_θ σ_θ	Openness to change Fisher's p Fisher's [l,r] p	Appendix
	Friendship selection:										
	Density	**Eval**	−1.317	***	−1.372	***	−1.352	***	−1.429	***	
			0.145	[0, 1]	0.122	[0, 1]	0.127	[0, 1]	0.138	[0, 1]	
	Reciprocity	**Eval**	2.964	***	2.811	***	2.893	***	2.826	***	
			0.186	[1, 0]	0.233	[1, 0]	0.228	[1, 0]	0.245	[1, 0]	
	Transitivity	**Eval**	0.474	***	0.483	***	0.459	***	0.443	***	
			0.043	[1, 0]	0.045	[1, 0]	0.040	[1, 0]	0.044	[1, 0]	
	Reciprocity*transitivity	**Eval**	−0.170	***	−0.230	***	−0.198	***	−0.176	***	**Table 3**
			0.051	[0, 0.999]	0.054	[0, 1]	0.043	[0, 1]	0.054	[0, 0.995]	
	Popularity	**Eval**	−0.155	***	−0.133	***	−0.142	***	−0.115	***	
			0.025	[0, 1]	0.022	[0, 1]	0.023	[0, 1]	0.024	[0, 0.998]	
	Activity	**Eval**	0.075	***	0.052	**	0.061	***	0.060	***	
			0.015	[1, 0]	0.019	[0.998, 0]	0.017	[1, 0]	0.018	[1, 0]	
	Reciprocity*activity	**Eval**	−0.294	***	−0.246	***	−0.259	***	−0.265	***	
			0.049	[0, 1]	0.055	[0, 1]	0.051	[0, 1]	0.057	[0, 1]	
	Friendship selection:										
	Same age	Endow	−0.162		−0.104		−0.107		−0.057		
			0.160	[0.015, 0.535]	0.168	[0.079, 0.499]	0.130	[0.182, 0.65]	0.174	[0.244, 0.338]	
H3a	Same age	Create	0.125		0.054		0.003		0.094		**Table 4**
			0.116	[0.762, 0.13]	0.109	[0.655, 0.537]	0.122	[0.356, 0.335]	0.156	[0.619, 0.111]	
	Same age	Eval	0.009		−0.002		0.027		0.053		
			0.047	[0.161, 0.164]	0.046	[0.262, 0.358]	0.041	[0.34, 0.119]	0.041	[0.738, 0.173]	

H3a	**Same gender**	**Endow**	0.435	***	0.575	***	0.551	***	0.283	
			0.153	[0.99, 0]	0.178	[0.999, 0]	0.183	[0.985, 0]	0.224	[0.826, 0.001]
	Same gender	**Create**	0.439	***	0.295	*	0.307	*	0.394	*
			0.111	[0.998, 0]	0.142	[0.861, 0]	0.133	[0.863, 0]	0.177	[0.747, 0]
	Same gender	**Eval**	0.376	***	0.346	***	0.350	***	0.375	***
			0.059	[1, 0]	0.052	[1, 0]	0.048	[1, 0]	0.053	[1, 0]
H3b	**Value alter**	**Endow**	−0.000		−0.103		−0.141	†	−0.049	
			0.074	[0.797, 0.776]	0.073	[0.486, 0.763]	0.073	[0.037, 0.959]	0.098	[0.505, 0.946]
	Value alter	Create	0.018		0.039		0.007		0.011	
			0.070	[0.657, 0.598]	0.065	[0.547, 0.833]	0.055	[0.630, 0.796]	0.099	[0.799, 0.694]
	Value alter	**Eval**	−0.035		−0.052	†	−0.034		−0.078	*
			0.028	[0.145, 0.970]	0.026	[0.036, 0.986]	0.022	[0.026, 0.947]	0.035	[0.112, 0.944]
H3b	Value ego	endow	0.326		−0.178		−0.282		0.565	
			0.440	[0.416, 0.102]	0.495	[0.180, 0.480]	0.461	[0.012, 0.088]	0.621	[0.458, 0.019]
	Value ego	create	−0.380		0.372		0.402		−0.769	
			0.458	[0.067, 0.446]	0.449	[0.622, 0.081]	0.452	[0.130, 0.004]	0.635	[0.005, 0.614]
	Value ego	**eval**	−0.071	*	0.042		0.023		−0.063	
			0.035	[0.001, 0.886]	0.035	[0.644, 0.011]	0.023	[0.541, 0.041]	0.041	[0.017, 0.834]
H3b	**Value similarity**	**endow**	−0.064		1.037	†	0.883	†	−0.072	
			0.460	[0.775, 0.763]	0.609	[0.986, 0.200]	0.501	[0.961, 0.181]	0.585	[0.966, 0.523]
	Value similarity	create	0.125		−0.598		−0.133		0.206	
			0.427	[0.763, 0.695]	0.559	[0.385, 0.937]	0.475	[0.520, 0.862]	0.608	[0.738, 0.673]
	Value similarity	**eval**	0.184		0.158		0.243	†	0.300	†
			0.151	[0.955, 0.136]	0.178	[0.845, 0.468]	0.133	[0.981, 0.044]	0.172	[0.992, 0.133]

Table 4

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Table 2. Continued

Hypothesis	effect	Function	Self-transcendence μ_θ σ_θ	Self-transcendence Fisher's p Fisher's [l,r] p	Conservation μ_θ σ_θ	Conservation Fisher's p Fisher's [l,r] p	Self-enhancement μ_θ σ_θ	Self-enhancement Fisher's p Fisher's [l,r] p	Openness to change μ_θ σ_θ	Openness to change Fisher's p Fisher's [l,r] p	Appendix
H2	*Value change:*										
	Linear	**eval**	0.257	***	0.131	***	0.063	†	0.208	***	
			0.051	[1 , 0]	0.035	[1 , 0.001]	0.036	[0.999 , 0.031]	0.050	[1 , 0]	
	Quadratic	**eval**	−0.054		−0.153	***	−0.113	*	−0.110		
			0.071	[0.305 , 0.998]	0.051	[0.019 , 1]	0.051	[0.094 , 1]	0.087	[0.217 , 0.999]	
	Average similarity	**eval**	1.831	**	0.895		0.459		1.529	†	**Table 3**
			0.711	[0.995 , 0.166]	0.726	[0.979 , 0.624]	0.719	[0.946 , 0.741]	0.785	[0.987 , 0.116]	
H1a, H1b	*Effects from:*										
	Age	eval	−0.017		0.014		−0.045		0.036		
			0.098	[0.792 , 0.787]	0.067	[0.721 , 0.737]	0.062	[0.65 , 0.941]	0.093	[0.886 , 0.625]	
	Gender	**Eval**	0.302	***	0.084		−0.126	*	0.150	*	
			0.076	[1 , 0.002]	0.057	[0.917 , 0.180]	0.055	[0.040 , 1.000]	0.074	[0.987 , 0.212]	
	Self-transcendence	Endow			0.024		−0.020		0.007		
					0.238	[0.821 , 0.448]	0.221	[0.761 , 0.612]	0.279	[0.923 , 0.426]	
	Self-transcendence	Create			0.112		−0.062		0.134		**Table 6**
					0.208	[0.682 , 0.815]	0.197	[0.564 , 0.916]	0.242	[0.706 , 0.812]	
	Self-transcendence	**Eval**			0.029		−0.089	*	0.120	*	
					0.037	[0.864 , 0.468]	0.038	[0.056 , 0.998]	0.053	[0.996 , 0.086]	
H1a, H1b	Conservation	Endow	−0.020				−0.228		−0.031		
			0.242	[0.733 , 0.744]			0.209	[0.543 , 0.918]	0.259	[0.759 , 0.852]	
	Conservation	Create	0.146				0.106		0.173		**Table 7**
			0.231	[0.743 , 0.745]			0.175	[0.792 , 0.782]	0.249	[0.821 , 0.687]	
	Conservation	Eval	0.001				−0.025		0.041		
			0.045	[0.557 , 0.691]			0.036	[0.197 , 0.953]	0.048	[0.725 , 0.631]	

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H1a, H1b	Self-enhancement	Endow	−0.019		0.082				0.338		
			0.214	[0.702 , 0.939]	0.189	[0.758 , 0.548]			0.233	[0.977 , 0.262]	
	Self-enhancement	Create	−0.133		−0.137				−0.199		**Table 8**
			0.216	[0.632 , 0.819]	0.185	[0.539 , 0.861]			0.227	[0.506 , 0.963]	
	Self-enhancement	Eval	−0.054		0.011				−0.023		
			0.040	[0.107 , 0.972]	0.031	[0.712 , 0.8]			0.039	[0.597 , 0.898]	
H1a, H1b	Openness to change	Endow	−0.076		0.171		−0.347				
			0.267	[0.634 , 0.635]	0.267	[0.81 , 0.426]	0.232	[0.262 , 0.971]			
	Openness to change	Create	−0.529		−0.037		0.238				**Table 9**
			0.886	[0 , 0.222]	0.241	[0.542 , 0.81]	0.201	[0.941 , 0.573]			
	Openness to change	**Eval**	0.108	†	0.019		−0.035				
			0.059	[0.991 , 0.115]	0.042	[0.69 , 0.394]	0.039	[0.14 , 0.96]			
	Goodness of fit:		μ_p	χ^2 test	μ_p	χ^2 test	μ_p	χ^2 test	μ_p	χ^2 test	
			σ_p	[converge / fit]	σ_p	[converge / fit]	σ_p	[converge / fit]	σ_p	[converge / fit]	
	GOF (outdegree)	theta	0.429	***	0.431	***	0.390	***	0.374	***	
		se	0.331	[47 , 38]	0.323	[55 , 45]	0.291	[58 , 47]	0.342	[50 , 39]	
	GOF (behavior)	theta	0.582	***	0.727	***	0.664	***	0.695	***	
		se	0.295	[47 , 47]	0.223	[55 , 54]	0.254	[58 , 58]	0.262	[50 , 49]	

Fisher's two-sided test: $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{\dagger}p < 0.1$

not find any theoretical support for their inclusion in the literature. Second, their exclusion could be empirically justified in our data.

The objective function for decisions regarding network structures is given as $e_i^{net}(x) = \sum_k \gamma_k^{net} s_{ik}^{net}(x)$. It assumes that the utility that actors can derive from creating a new tie is the same as the utility that they expect to lose if they were to dissolve that tie. However, the models reported in Table 4 of the Online Supplementary Information do not make this assumption. Instead, they divide the friendship network evolution process into two stages. In the first stage, actors only decide whether to create new friendships. In the second stage, actors only decide whether to maintain existing friendships or dissolve such ties. Therefore, the evaluation function of these models is replaced by *creation* and *endowment* functions, as indicated in the column labeled "Function." The creation function is a modification of the objective function giving zero weight to the dissolution of ties, while the endowment function assigns zero weight to the creation of ties. These effects reveal whether actors' homophilic tendencies are more relevant for friendship selection versus ignorance or for friendship maintenance versus dissolution.

The objective function for decisions regarding changes in value priorities is given as $e_i^{val}(x) = \sum_m^{M-1} \sum_i^n s_{ik}^{val}(x(t_{m+1}) - x(t_m))$. It assumes that the utility that actors expect to gain by increasing their current priorities on any given value is exactly offset by the utility that they would lose if they were to lower their priorities on the corresponding value to the same extent. The models reported in Table 4 of the Online Supplementary Information use modified objective functions including *creation and endowment effects from other values*. The creation function is a modification of the corresponding objective function giving zero utility to a decrease in value priorities, while the endowment function assigns zero utility to an increase in value priorities. These effects estimate whether an increase in priorities on a specific value depends more strongly on changes in priorities on other values compared to a corresponding decrease.

3.5.3 Meta-analytical procedure

Our research design, in which school classes are hierarchically nested in schools, calls for a two-stage procedure. In the first stage, we use an unconventional method of moments to separately estimate the model parameters for each school class. Subsequently, goodness-of-fit tests are performed on the results for each class. Goodness-of-fit tests simulate data on auxiliary statistics. To compare the data simulated using these auxiliary statistics with the observed data, they must be different from the statistics used for parameter estimation. Complying with the standard for publications using SAOMs, we require adequate fit on the auxiliary statistics of indegree and higher order value distributions, which was achieved for 63 out of 73 secondary school classes. In the second stage, the separately estimated parameters for each class are aggregated according to the meta-analytical method proposed by Snijders & Baerveldt (2003); Ripley et al. (2011). In this meta-analysis, the mean and variance of the θ vector—the true parameter values for all effects in the chosen model specification—are estimated across all school classes in both countries. The results are reported in columns denoted accordingly, where the upper value is the mean μ_θ and the lower value represents the standard error σ_θ. For any given effect, μ_θ is interpreted as the log odds ratio. If μ_θ is estimated to be 0.5, the odds ratio is $e^{\mu_\theta} = 1.65$, so the probability that this effect is present is 65% higher than the probability that this effect is absent. Then, the parameters μ_θ and σ_θ are tested using Fisher's combined probability tests, investigating for each effect whether the null hypothesis $\theta = 0$ can be rejected in at least one school class (Mercken et al., 2010). The tests are reported in each column and denoted accordingly, whereby the upper values are results of two-sided tests with the alternative hypothesis $\theta \neq 0$, and the lower values are the results of Fisher's left- and right-sided tests with alternative hypotheses $\theta < 0$ and $\theta > 0$, respectively.

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4. Results

The following section reports the results of models that are estimated for each of the higher order values in a different column of Table 2, as indicated in the column headers. The results are summarized for a subset of effects used for hypothesis testing, as indicated in the column labeled "Section & Hypothesis." All meta-analyses including the complete lists of effects are shown in the corresponding tables of the Online Supplementary Information, as indicated in the column labeled "Appendix." The results of the goodness-of-fit tests corresponding to the models are reported at the bottom of each column in Table 2 and in every table of the Online Supplementary Information.

4.1 Internal validation

The results provide partial support for hypothesis H1a, as actors appear to experience conflicts when increasing their emphasis on self-enhancement alongside self-transcendence values. Our findings show that actors are 8% less likely to increase self-enhancement values alongside self-transcendence values (log odds ratio = −0.089, odds ratio = 0.915) as opposed to decreasing the emphasis on self-enhancement values or maintaining the current state. However, actors seem to experience no conflicts when increasing their emphasis on conservation alongside openness to change values.

Hypothesis H1b is also partially supported by our data. Actors seem to experience harmony when increasing their emphasis on self-transcendence alongside openness to change values. According to our findings, actors are 13% more likely to increase openness to change values alongside self-transcendence values (log odds ratio = 0.120, odds ratio = 1.127) and 11% more likely to increase self-transcendence values alongside openness to change values (log odds ratio = 0.108, odds ratio = 1.114) as opposed to maintaining their current state or decreasing their emphasis on the corresponding values. However, actors seem to experience neither conflicts nor harmony when adjusting their priorities on any other pair of adjacent higher order values.

4.2 External validation

The results provide sufficient evidence to confirm hypothesis H2, as actors appear to shift the emphasis they place on self-transcendence and openness to change values toward the average expression among their friends. Our findings show that actors are five times more likely to shift priorities on self-transcendence values (log odds ratio = 1.831, odds ratio = 6.240) and four times more likely to shift priorities on openness to change values (log odds ratio = 1.529, odds ratio = 4.614) toward the average expression among their friends compared to diverging further away from the average level on which their friends emphasize their values or maintaining their current state. However, regarding conservation and self-enhancement values, actors are more likely to consider their own current priorities rather than their friends' when adjusting their priorities. According to our findings, actors are 15% less likely to further increase their priorities on conservation values (log odds ratio = −0.153, odds ratio = 0.858) and 11% less likely to further increase their priorities on self-enhancement (log odds ratio = −0.113, odds ratio = 0.898), given the current level on which they emphasize these values.

4.3 The salience of manifest- and latent traits along the stages of friendship network evolution

We find partial support for hypothesis H3a in our data. Apparently, friendships are more likely to be formed if peers have the same gender. Our findings suggest that depending on the dynamics in basic human values, which are included in the corresponding models, actors are between 41% (log odds ratio = 0.346, odds ratio = 1.413) and 46% (log odds ratio = 0.376, odds ratio = 1.456)

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more likely to select each other as friends, as opposed to ignoring an opportunity to do so, if they have the same gender. Gender is salient during the selection stage of friendship network evolution, irrespective of the basic human values, for which the salience as inclusion or exclusion criteria is tested alongside gender. On the one hand, the salience is diminished or lost during the retention stage provided that self-transcendence values (log odds ratio and odds ratio = 0.439 and 1.551 for creation vs. 0.435 and 1.545 for persistence) and openness to change values (log odds ratio and odds ratio = 0.394 and 1.483 for creation vs. 0.283 and 1.387 for persistence) are specified as inclusion or exclusion criteria. On the other hand, the salience of gender is increased from the selection to the retention stage, provided that conservation values (log odds ratio and odds ratio = 0.295 and 1.343 for creation vs. 0.575 and 1.777 for persistence) or self-enhancement values (log odds ratio and odds ratio = 0.307 and 1.359 for creation vs. 0.551 and 1.735 for persistence) are specified as criteria for the inclusion or exclusion of friends. However, we were unable to find any evidence that the level of maturity is used as a criterion during either stage of friendship network evolution.

Our data also provide partial support for hypothesis H3b. First, actors are 7% less likely to create ties to peers or maintain ties with friends if they highly emphasize self-transcendence values (log odds ratio = −0.071, odds ratio = 0.931). Second, conservation values, self-enhancement values, and openness to change values are likely to be considered as inclusion or exclusion criteria. However, our findings suggest that this tendency is primarily shown at the retention stage of friendship network evolution, as these values are not given any consideration during the selection stage but are specifically considered during the retention stage (log odds ratio = −0.141, odds ratio = 0.868 in favor of the dissolution vs. the maintenance of friendships based on higher emphasis on self-enhancement values). Third, friendships are likely to emerge and persist if actors place similar emphasis on conservation values, self-enhancement values, and openness to change values. However, our findings indicate that this tendency is predominantly displayed at the retention stage of friendship network evolution, as friendships emerge irrespective of actors' similarity on these values but are more likely to persist if actors have similar priorities (log odds ratio = 1.037, odds ratio = 2.821 in favor of the maintenance vs. the dissolution of friendships based on similarity on conservation values and log odds ratio = 0.883, odds ratio = 2.418 in favor of the maintenance vs. the dissolution of friendships based on similarity on self-enhancement values).

5. Discussion

Scholars agree that values have the potential to profoundly impact not only adolescents' choice of social networks but also the selection of affiliations with peers within the social networks of their choice. Scholars have produced a multitude of value frameworks to demonstrate their cross-cultural universality and to create links to many sociologically relevant attributes. However, values have not yet been investigated in the dynamic context of social networks. On the one hand, our results demonstrate that teenagers internally and externally validate changes in their value priorities if their status quo is challenged. On the other hand, our results show that the evolution of friendship networks has two distinct stages, whereby manifest traits such as demographics are more salient for the initiation of new friendships while latent traits such as value priorities become more relevant for the maintenance of existing friendships.

5.1 How do teenagers validate changes in their value priorities?

We introduce a framework that interprets basic human values as alternative identities of a person, which are competing for the person's focus, allowing them to take their place in the spotlight and thus take charge of choosing desirable goals and effective actions to achieve those goals. If an action that is chosen by the identity currently in the spotlight creates conflict with the underlying

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goals of other alternative identities, the spotlight is not large enough for them to share the position with the incumbent. Thus, they have to wait until the status quo is challenged to replace the incumbent after having received a sufficient amount of the person's focus. However, if the chosen action does not interfere with the underlying goals of other alternative identities, or if the chosen action is also an effective means to achieve their underlying goals, the corresponding identities can co-exist in the spotlight.

On the one hand, our findings suggest that the alternative identities emphasizing self-transcendence values and openness to change values can co-exist in the spotlight. Spending time and financial resources on activities enhancing the welfare of other people or society help to express not only the benevolence and universalism goals underlying self-transcendence but also the stimulation goals underlying openness to change. Thus, our findings imply that activities such as these are not only effective in avoiding conflicts between the corresponding goals but also create such harmony that they can reinforce each other in the amount of focus they can attract from the person in the future. Surprisingly, this effect cannot be shown for any other pair of higher order values. This does not imply that there are no activities through which goals underlying other pairs of adjacent higher order values can be achieved. While exploring new relationships or features of new brands might create equifinality between openness to change values and self-enhancement values, giving gifts to friends or inviting them to engage in social consumption might create equifinality between conservation values and self-enhancement values or between conservation values and self-transcendence values. However, the implication is that the corresponding degrees of equifinality are not sufficient for the respective pairs of higher order values to reinforce each other in the amount of focus they receive from the person in the future.

On the other hand, our findings suggest that the alternative identities emphasizing self-transcendence values and self-enhancement values cannot share the spotlight. Spending time and financial resources in pursuit of activities to enhance one's own welfare are effective means to achieve the goals underlying self-enhancement values. However, every minute or unit of financial resources spent on such activities is a resource that is no longer available for the pursuit of goals to enhance the welfare of other people or society, which are underlying self-transcendence values. This implies that a challenge to the status quo that assigns more focus to the self-enhancement identity is associated with a corresponding decline in focus regarding the self-transcendence identity and vice versa. Surprisingly, although choosing activities such as spending time and effort to initiate new friendships and spending financial resources to buy new brands or products with new features might be considered effective for the expression of openness to change values, choosing such activities does not seem to affect the amount of focus assigned to conservation values. This implies that in the event that an alternative identity emphasizing conservation values can attract a sufficient amount of focus from teenagers to take their position in the spotlight, this identity does not regard security values as desirable enough to be selected as goals. Thus, the corresponding activities do not create any conflicts with the goals underlying openness to change values.

Furthermore, our findings suggest that a status quo—as reached through the adjustment of priorities that are assigned to alternative identities according to the congruence, or conflicts that are experienced through the enactment of the respective underlying goals—can be challenged if the corresponding enactment is externally validated through social comparison. This tendency is specifically found for the adjustment of priorities given to self-transcendence values and openness to change values. According to Schwartz et al. (2012), higher order values are structured not only according to the congruence and conflicts experienced in the enactment of the respective underlying goals but also according to how the underlying goals are positioned on a continuum of anxiety or self-protection versus self-expansion or growth. According to Bilsky & Schwartz (1994), growth or self-expansion-related values—such as self-transcendence and openness to change—are pursued even after the gap between a person's perceived current state and the desired state has been eliminated. This implies that the priorities given to growth or self-expansion-related values such as self-transcendence and openness to change co-evolve in parallel and follow a continuous cycle of

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goal and action formation, social evaluation of actions, and corresponding adjustment of goals. In contrast, Bilsky & Schwartz (1994) suggest that self-protection or anxiety-related values—such as self-enhancement and conservation—are only pursued as long as there is a gap between a person's desired state and the perceived current state. Therefore, it is no surprise that social validation is traded-off against an evaluation of the current state for self-enhancement and conservation values. If anxiety or self-protection-related values—such as self-enhancement and conservation values—are currently emphasized on a higher level, there is a more pronounced likelihood that the respective desired states have been attained and the corresponding pursuits have been discontinued. If these values are currently emphasized on a lower level, it is plausible that gaps between the respective current and desired states still exist and that the discontinuation of the corresponding pursuits has not yet been triggered.

5.2 How do friendship networks form and change across the stages of their evolution?

Our framework assumes that friendship networks have an inherent logic or code that determines how they are formed and how they evolve. This logic is determined by the culture and regulatory environment of a country, by the organizational context of schools, and by the properties of organizational foci such as school classes. It is encoded within the utility functions of pupils for whom activities are organized around these school classes and thus dictates the salience of network properties, values, and attributes in the processes of friendship selection and value change. Our framework further assumes that friendship networks evolve across two stages in their evolution.

At an early stage of the evolution of a friendship network, teenagers focus on the initiation and exploration of new friendships. As they know very little about their peers at this stage, we find that they heavily rely on gender—and their associated stereotypes—to form new friendships (Eder & Hallinan, 1978).

However, at a more mature stage, friendship relationships have already been formed and explored. Therefore, the focus of teenagers shifts toward the maintenance of existing friendships. At this stage, the more time teenagers have been spending with their friends, the more likely they are to have learned what is important to their friends. In the previous section, we showed that based on the interdependencies in the structure of values, the priorities assigned to self-transcendence values co-evolve in parallel to the priorities given to openness to change values. Therefore, our findings do not exclude the possibility that teenagers also consider self-transcendence values for the selection and maintenance of friendships, if they believe these values to be reflected in openness to change values. Thus, we find that, overall, growth and self-expansion-related values—such as self-transcendence and openness to change—are equally relevant to initiate new friendships and maintain existing friendships, while anxiety and self-protection-related values—such as self-enhancement and conservation values—are only salient for the maintenance of existing friendships. This implies that teenagers, who have not yet achieved their desired states—as indicated by their pursuit of anxiety and self-protection-related values—seem to be reluctant to spend cognitive resources on the derivation and differentiation of values among their peers to initiate new friendships, let alone the evaluation of the similarity compared to their peers regarding this multi-dimensional system of values. Instead, they rely on gender stereotypes because their cognitive resources are preoccupied coping with their own situations and to achieve their own desired states.

6. Limitations

Although the data structure is hierarchically structured with classes nested in schools, this paper assumes identical utility functions for all classes. However, classes might be heterogenous in their effective utility functions, which could be captured by adding restrictions projecting unique utility functions accounting for the hierarchical data structure.

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For the sake of parsimony, individual values are aggregated to higher order values in this paper. However, the effects we identified for each higher order value might be driven by subsets of specific values on the corresponding dimension. Moreover, although we investigated the co-evolution of higher order values in this article, further research is needed to understand the complex interdependencies between specific values in a person's value system. Being exposed to behavioral expressions of specific values from peers might not necessarily make teenagers adjust their own corresponding values. Instead, their reactions might also be visible as changes in other specific values on the same or on other dimensions.

Furthermore, meta-analyses investigating the tendency for value adoption, popularity, and homophily have revealed considerable heterogeneity across classes. Further research is needed to investigate the capacity of macro-level properties in social systems to explain the heterogeneity in value adoption, popularity, and homophily on the micro level. In Table 13 of the Online Supplementary Information, we provide a comparison of results for early and late adolescents. Moreover, teachers or pupils can be seen as key informants of their classes and thus generate variables that are assets on the aggregated level of organizational foci (Algesheimer et al., 2018). Class-level variables such as these could be used to explain heterogeneity between school classes in multi-level analyses. However, multi-level analyses investigating the impact of other structural properties of organizational foci such as the size and composition of classes as well as classroom organizations would capture observed heterogeneity to a greater extent (Hallinan, 1979). Moreover, random coefficient analyses would allow parameters to vary across classes and thus capture unobserved heterogeneity.

Additionally, we call on future research to cross-validate our findings in other countries. In Table 14 of the Online Supplementary Information, we summarize the results for Swiss and Polish school classes. However, insights from studies in other countries could provide substantial contributions to a more comprehensive picture and thus fill the gaps in the multi-dimensional space of value orientations "intellectual and affective autonomy" versus "embeddedness," "harmony" versus "mastery," and "egalitarianism" versus "hierarchy," on the cultural level (Schwartz, 2006).

Finally, in this article, we argue that school classes are the center of the social universe for teenagers in general and thus capture most of their social activities. However, as they move from early to late adolescence, a significant proportion of their social activities can be expected to transcend the boundaries of school classes. Thus, investigating differences in the effects driving friendship selection and value adoption within and across school classes would provide invaluable information regarding the corresponding impact of organizational foci such as school classes.

7. Conclusions

We conclude that future research should investigate not only the multidimensionality of higher order values in greater detail but also the evolution of specific individual values making up the higher order values. Our study also shows that upcoming work should account for the hierarchical structure of classes embedded in schools, as well as the heterogeneity in adolescents' tendencies for value adoption, popularity, and homophily. In addition, more research is needed to investigate the extent to which the distinctive forms of value adoption, popularity, and homophily are present within or across different types of social networks such as systems of friendship, advice, or trust relationships.

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Conflict of interest. All authors have nothing to disclose.

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References

Aldrich, H. (1979). *Organizations and environments*. Englewood Cliffs, NJ: Prentice Hall.

Algesheimer, R., Bagozzi, R. P., & Dholakia, U. M. (2018). Key informant models for measuring group-level variables in small groups: Application to plural subject theory. *Sociological Methods & Research*, *47*(2), 277–313.

Amaral, L. A. N., Scala, A., Barthelemy, M., & Stanley, H. E. (2000). Classes of small-world networks. *Proceedings of the National Academy of Sciences*, *97*(21), 11149–11152.

Barabási, A.-L., & Albert, R. (1999). Emergence of scaling in random networks. *Science*, *286*(5439), 509–512.

Bardi, A., & Schwartz, S. H. (2003). Values and behavior: Strength and structure of relations. *Personality and Social Psychology Bulletin*, *29*(10), 1207–1220.

Bardi, A., Buchanan, K. E., Goodwin, R., Slabu, L., & Robinson, M. (2014). Value stability and change during self-chosen life transitions: Self-selection versus socialization effects. *Journal of Personality and Social Psychology*, *106*(1), 131.

Beierlein, C., Davidov, E., Cieciuch, J., & Rammstedt, B. (2014). The schwartz values short scale. *An economic measurement tool for cross-cultural research. referat na 28th international congress of applied psychology, paryż, francja*.

Benenson, J. F., Stella, S., & Ferranti, A. (2015). Sex differences in human gregariousness. *PeerJ*, *3*, 974.

Berger, P. L., & Luckmann, T. (1971). *The social construction of reality*. Harmondsworth: Penguin.

Bilsky, W., & Schwartz, S. H. (1994). Values and personality. *European Journal of Personality*, *8*(3), 163–181.

Block, P. (2015). Reciprocity, transitivity, and the mysterious three-cycle. *Social Networks*, *40*, 163–173.

Bukowski, W. M., Hoza, B., & Boivin, M. (1994). Measuring friendship quality during pre- and early adolescence: The development and psychometric properties of the friendship qualities scale. *Journal of Social and Personal Relationships*, *11*, 471–484.

Bukowski, W. M., Hoza, B., & Boivin, M. (1993). Popularity, friendship, and emotional adjustment during early adolescence. *New Directions for Child and Adolescent Development*, *93*(60), 23–37.

Burk, W. J., Steglich, C. E. G., & Snijders, T. A. B. (2007). Beyond dyadic interdependence: Actor-oriented models for co-evolving social networks and individual behaviors. *International Journal of Behavioral Development*, *31*(4), 397–404.

Campbell, D. T. (1969). Variation and selective retention in socio-cultural evolution. *General Systems*, *16*, 69–85.

Checkley, M., & Steglich, C. (2007). Partners in power: job mobility and dynamic deal-making. *European Management Review*, *4*(3), 161–171.

Cieciuch, J., Döring, A. K., & Harasimczuk, J. (2013). Measuring schwartz's values in childhood: Multidimensional scaling across instruments and cultures. *European Journal of Developmental Psychology*, *10*(5), 625–633.

Coleman, J. S. (1961). The adolescent society: The social life of the teenager and its impact on education. New York, NY: *Free Press of Glencoe*, XVI-368.

Coleman, J. Sl. (2000). Social capital in the creation of human capital. In *Knowledge and social capital* (pp. 17–41). London: Elsevier. https://doi.org/10.4324/9780080509792

De Nooy, W. (2002). The dynamics of artistic prestige. *Poetics*, *30*(3), 147–167.

Eder, D., & Hallinan, M. T. (1978). Sex differences in children's friendships. *American Sociological Review 43*(2), 237–250. https://doi.org/10.2307/2094701

Ellwardt, L., Labianca, G. J., & Wittek, R. (2012). Who are the objects of positive and negative gossip at work?: A social network perspective on workplace gossip. *Social Networks*, *34*(2), 193–205.

Elmer, T., Boda, Z., & Stadtfeld, C. (2017). The co-evolution of emotional well-being with weak and strong friendship ties. *Network Science*, *5*(3), 278–307.

Feather, N. T. (1996). Values, deservingness, and attitudes toward high achievers: Research on tall poppies. In C. Seligman, J. M. Olson, & M. P. Zanna (Eds.), *The ontario symposium: The psychology of values*, (vol. 8, pp. 215–251). Mahwah, NJ: Lawrence Erlbaum Associates.

Feld, S. L. (1981). The focused organization of social ties. *American Journal of Sociology*, *86*(5), 1015–1035.

Feld, S. L. (1982). Social structural determinants of similarity among associates. *American Sociological Review*, *47*(6), 797–801. https://doi.org/10.2307/2095216

Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, *7*(2), 117–140.

Festinger, L. (1962). *A theory of cognitive dissonance*. Stanford, CA: Stanford University Press.

Festinger, L., & Hutte, H. A. (1954). An experimental investigation of the effect of unstable interpersonal relations in a group. *The Journal of Abnormal and Social Psychology*, *49*(4), 513.

Fischer, C. S. (1982). What do we mean by 'friend'? an inductive study. *Social Networks*, *3*(4), 287–306.

Frank, O., & Strauss, D. (1986). Markov graphs. *Journal of the American Statistical Association*, *81*(395), 832–842.

Freeman, L. C. (1992). Filling in the blanks: A theory of cognitive categories and the structure of social affiliation. *Social Psychology Quarterly*, *55*(2), 118–127. http://moreno.ss.uci.edu/57.pdf

Friemel, T. N. (2012). Network dynamics of television use in school classes. *Social Networks*, *34*(3), 346–358.

Giddens, A. (1991). Giddens' theory of structuration. a critical appreciation. In C. Bryant, & D. Jary (Eds.), *Structuration theory: Past, present and future*. London: Routledge.

Gifford, R., & Gallagher, T. M. (1985). Sociability: Personality, social context, and physical setting. *Journal of Personality and Social Psychology*, *48*(4), 1015.

https://doi.org/10.1017/nws.2019.16 Published online by Cambridge University Press

Gould, R. V. (2002). The origins of status hierarchies: A formal theory and empirical test. *American Journal of Sociology*, *107*(5), 1143–1178.
Hallinan, M. T. (1978). The process of friendship formation. *Social Networks*, *1*(2), 193–210.
Hallinan, M. T. (1979). Structural effects on children's friendships and cliques. *Social Psychology Quarterly*, *42*(1), 43–54. https://doi.org/10.2307/3033872
Hallinan, M. T., & Williams, R. A. (1989). Interracial friendship choices in secondary schools. *American Sociological Review*, *54*(1), 67–78. https://doi.org/10.2307/2095662
Hannan, M. T., & Freeman, J. (1977). The population ecology of organizations. *American Journal of Sociology*, *82*(5), 929–964.
Hanneke, S., & Xing, E. P. (2007). Discrete temporal models of social networks. In *Statistical network analysis: Models, issues, and new directions* (pp. 115–125). Berlin, Heidelberg: Springer. *54*(1), 67–78. https://link.springer.com/chapter/10.1007/978-3-540-73133-7_9
Hartup, W. W. (1996). The company they keep: Friendships and their developmental significance. *Child Development*, *67*(1), 1–13.
Haye, K., Robins, G., Mohr, P., & Wilson, C. (2013). Adolescents' intake of junk food: Processes and mechanisms driving consumption similarities among friends. *Journal of Research on Adolescence*, *23*(3), 524–536.
Haynie, D. L. (2002). Friendship networks and delinquency: The relative nature of peer delinquency. *Journal of Quantitative Criminology*, *18*(2), 99–134.
Heider, F. (1958). *The psychology of interpersonal relations*. New York, NY: Psychology Press. https://doi.org/10.4324/9780203781159
Hendrickson, B., Rosen, D., & Aune, R. K. (2011). An analysis of friendship networks, social connectedness, homesickness, and satisfaction levels of international students. *International Journal of Intercultural Relations*, *35*(3), 281–295.
Kalmijn, M. (1995). Intermarriage and homogamy: Causes, patterns, trends. *Annual Review of Sociology*, *24*(1), 395–421.
Kandel, D. B. (1978). Homophily, selection, and socialization in adolescent friendships. *American Journal of Sociology*, *84*(2), 427–436.
Kelvin, P. (1977). Predictability, power and vulnerability in interpersonal attraction. In S. Duck (Ed.), *Theory and Practice in Interpersonal Attraction* (pp. 355–378). New York, NY: Academic Press.
Kluckhohn, C. K. M. (1965). Values and value orientations in the theory of action. In T. Parsons, E. A. Shils, & N. J. Smelser (Eds.), *Toward a general theory of action: Theoretical foundations for the social sciences* (pp. 388–433). Cambridge, MA: Harvard University Press.
Knecht, A., Snijders, T. A. B., Baerveldt, C., Steglich, C. E. G., & Raub, W. (2010). Friendship and delinquency: Selection and influence processes in early adolescence. *Social Development*, *19*(3), 494–514.
Krackhardt, D., & Kilduff, M. (1999). Whether close or far: Social distance effects on perceived balance in friendship networks. *Journal of Personality and Social Psychology*, *76*(5), 770.
Larson, L. E. (1972). The influence of parents and peers during adolescence: The situation hypothesis revisited. *Journal of Marriage and the Family*, *34*(1), 67–74.
Laursen, B. P. (1993). *Close friendships in adolescence*. San Francisco, CA: Jossey-Bass, Inc. https://link.springer.com/chapter/10.1007/978-3-540-73133-7_9
Lazarsfeld, P. F. et al. (1954). Friendship as a social process: A substantive and methodological analysis. *Freedom and Control in Modern Society*, *18*(1), 18–66.
Levinson, D. J. (1978). *The seasons of a man's life*. Ballantine, NY: Random House Digital, Inc.
Lewin, K. (1951). In D. Cartwright (Eds.), *Field theory in social science: Selected theoretical papers*. Oxford, England: Harpers.
Lewis, K., Gonzalez, M., & Kaufman, J. (2012). Social selection and peer influence in an online social network. *Proceedings of the National Academy of Sciences*, *109*(1), 68–72.
Lin, M., Prabhala, N. R., & Viswanathan, S. (2013). Judging borrowers by the company they keep: Friendship networks and information asymmetry in online peer-to-peer lending. *Management Science*, *59*(1), 17–35.
Lorenz, J., Rauhut, H., Schweitzer, F., & Helbing, D. (2011). How social influence can undermine the wisdom of crowd effect. *Proceedings of the National Academy of Sciences*, *108*(22), 9020–9025.
March, J. G., & Olsen, J. P. (1979). *Ambiguity and choice in organizations*. Bergen, Norway: Universitetsforlaget.
Marsden, P. V. (1987). Core discussion networks of americans. *American Sociological Review*, *52*(1), 122–131. https://doi.org/10.2307/2095397
McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, *27*(1), 415–444.
Meeus, W. I. M., Oosterwegel, A., & Vollebergh, W. (2002). Parental and peer attachment and identity development in adolescence. *Journal of Adolescence*, *25*(1), 93–106.
Mercken, L., Snijders, T. A. B., Steglich, C., Vartiainen, E., & De Vries, H. (2010). Dynamics of adolescent friendship networks and smoking behavior. *Social Networks*, *32*(1), 72–81.
Merton, R. K., & Merton, R. C. (1968). *Social theory and social structure*. 1230 Avenue of the Americas, New, York, NY: Simon and Schuster.

https://doi.org/10.1017/nws.2019.16 Published online by Cambridge University Press

Milardo, R. M. (1982). Friendship networks in developing relationships: Converging and diverging social environments. *Social Psychology Quarterly*, *45*(3), 162–172. https://doi.org/10.2307/3033649
Morris, C. (1956). Varieties of human value. *Humanist*, *16*, 153.
Neale, M. A., & Northcraft, G. B. (1991). Behavioral negotiation theory-a framework for conceptualizing dyadic bargaining. *Research in Organizational Behavior*, *13*, 147–190.
Newcomb, T. M. (1961). The acquaintance process. New York, NY: *Holt, Reinhart & Winston*.
Nisbet, R. A. (1970). Developmentalism: A critical analysis. *Theoretical Sociology: Perspectives and Developments*, *167*, 206.
Pearson, M., Steglich, C., & Snijders, T. (2006). Homophily and assimilation among sport-active adolescent substance users. *Connections*, *27*(1), 47–63.
Pfeffer, J. (1982). *Organizations and organization theory*. Boston: Pitman.
Piaget, J. (1967). *The child's conception of the world*. Totowa, NJ: Littlefield Adams & Company.
Ripley, R. M. et al. (2011). Manual for rsiena (vol. 1). *University of Oxford, Department of Statistics, Nuffield College*.
Rivas-Drake, D., Umaña-Taylor, A. J., Schaefer, D. R., & Medina, M. (2017). Ethnic-racial identity and friendships in early adolescence. *Child Development*, *88*(3), 710–724.
Robins, G., & Pattison, P. (2001). Random graph models for temporal processes in social networks. *Journal of Mathematical Sociology*, *25*(1), 5–41.
Rohan, M. J. (2000). A rose by any name? the values construct. *Personality and Social Psychology Review*, *4*(3), 255–277.
Rokeach, M. (1973). *The nature of human values.* New York, NY: Free Press.
Schaefer, D. R., Kornienko, O., & Fox, A. M. (2011). Misery does not love company: Network selection mechanisms and depression homophily. *American Sociological Review*, *76*(5), 764–785.
Schwartz, S. (1996). Value priorities and behavior: Applying a theory of integrated value systems. In U. C. Seligman, J. M. Olson, & M. P. Zanna (Eds.), *The Ontario Symposium: The Psychology of Values* (vol. 8). Hillsdale, NY: Erlbaum.
Schwartz, S. H., Cieciuch, J., Vecchione, M., & Davidov, E. (2012). Refining the theory of basic human values. *Journal of Personality and Social Psychology*, *103*(4), 663–688.
Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries. *Advances in Experimental Social Psychology*, *25*, 1–65.
Schwartz, S. H. (1999). A theory of cultural values and some implications for work. *Applied Psychology*, *48*(1), 23–47.
Schwartz, S. H. (2006). A theory of cultural value orientations: Explication and applications. *Comparative Sociology*, *5*(2), 137–182.
Schwartz, S. H. (2013). Culture matters: National value cultures, sources, and consequences. In *Understanding culture* (pp. 137–160). New York, NY: Psychology Press.
Selfhout, M., Burk, W., Branje, S., Denissen, J., Van Aken, M., & Meeus, W. (2010). Emerging late adolescent friendship networks and big five personality traits: A social network approach. *Journal of Personality*, *78*(2), 509–538.
Shanahan, M. J. (2000). Pathways to adulthood in changing societies: Variability and mechanisms in life course perspective. *Annual Review of Sociology*, *26*(1), 667–692.
Shrum, W., Cheek, N. H., Jr., & MacD, S. (1988). Friendship in school: Gender and racial homophily. *Sociology of Education*, *61*(4), 227–239. https://doi.org/10.2307/2112441
Skimina, E., Cieciuch, J., Schwartz, S. H., Davidov, E., & Algesheimer, R. (2018). Testing the circular structure and importance hierarchy of value states in real-time behaviors. *Journal of Research in Personality*, *74*, 42–49.
Snijders, T. A. B. (2001). The statistical evaluation of social network dynamics. *Sociological Methodology*, *31*(1), 361–395.
Snijders, T. A. B., & Baerveldt, C. (2003). A multilevel network study of the effects of delinquent behavior on friendship evolution. *Journal of Mathematical Sociology*, *27*(2–3), 123–151.
Snijders, T. A. B., Van de Bunt, G. G., & Steglich, C. E. G. (2010). Introduction to stochastic actor-based models for network dynamics. *Social Networks*, *32*(1), 44–60.
Solish, A., Perry, A., & Minnes, P. (2010). Participation of children with and without disabilities in social, recreational and leisure activities. *Journal of Applied Research in Intellectual Disabilities*, *23*(3), 226–236.
Steglich, C., Snijders, T. A. B., & West, P. (2006). Applying siena: An illustrative analysis of the co-evolution of adolescents' friendship networks, taste in music, and alcohol consumption. *Methodology*, *2*(1), 48–56.
Steglich, C., Snijders, T. A. B., & Pearson, M. (2010). Dynamic networks and behavior: Separating selection from influence. *Sociological Methodology*, *40*(1), 329–393.
Tuma, N. B., & Hallinan, M. T. (1979). The effects of sex, race, and achievement on schoolchildren's friendships. *Social Forces*, *57*(4), 1265–1285.
Van de Bunt, G. G., Wittek, R. P. M., & de Klepper, M. C. (2005). The evolution of intra-organizational trust networks: The case of a german paper factory: An empirical test of six trust mechanisms. *International Sociology*, *20*(3), 339–369.
Van de Ven, A. H., & Poole, M. S. (1995). Explaining development and change in organizations. *Academy of Management Review*, *20*(3), 510–540.
Van Duijn, M. A. J., Zeggelink, E. P. H., Huisman, M., Stokman, F. N., & Wasseur, F. W. (2003). Evolution of sociology freshmen into a friendship network. *Journal of Mathematical Sociology*, *27*(2–3), 153–191.

https://doi.org/10.1017/nws.2019.16 Published online by Cambridge University Press

Vaquera, E., & Kao, G. (2008). Do you like me as much as i like you? friendship reciprocity and its effects on school outcomes among adolescents. *Social Science Research*, *37*(1), 55–72.
Verbrugge, L. M. (1977). The structure of adult friendship choices. *Social Forces*, *56*(2), 576–597.
Weick, K. E. (1979). *The social psychology of organizing*. Columbus, OH: McGraw-Hill.
Wright, P. H. (1984). Self-referent motivation and the intrinsic quality of friendship. *Journal of Social and Personal Relationships*, *1*(1), 115–130.

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