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The Dynamic Interdependence of Developmental Domains Across Emerging Adulthood

Joel R. Sneed · Fumiaki Hamagami · John J. McArdle · Patricia Cohen · Henian Chen

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Abstract Emerging adulthood is a period in which profound role changes take place across a number of life domains including finance, romance, and residence. On the basis of dynamic systems theory, change in one domain should be related to change in another domain, because the concept of development according to this approach is a relational one. To evaluate this hypothesis dynamic systems analysis was applied to data from narrative interviews of 200 respondents covering the years between 17 and 27 to examine how change in one domain affects change in another domain. In each dyad, the fit of the model significantly deteriorated when the coupling between domains was removed providing support for the assumption of interdependency. On average, assuming greater responsibility in one domain was associated with assuming greater responsibility in the other domain. However, imbalances were also observed in which role assumption in one domain far exceeded role assumption in another domain. These imbalances can have detrimental effects and indicate the utility of a balanced approach to development. The findings underscore the importance of studying the relational unit between domains, which is critical to understanding development over time within domains.

Keywords Emerging adulthood · Dynamic systems analysis · Developmental domains · Young adulthood · Transitions

The period referred to as emerging adulthood, the years between 18 and 29, are characterized by profound role changes across multiple life domains (Arnett, 2000). Prior

J. R. Sneed (✉)
Post-Doctoral Research fellow in Geriatric Neuro-Psychiatry at Columbia University, College of Physicians and Surgeons and the New York State Psychiatric Institute. He received his PhD in Clinical Psychology at the University of Massachusetts Amherst and his major research interests include statistical methods for evaluating psychiatric nosology, late-life depression, and the stability and change of personality and personality disorders across the lifespan. Department of Psychiatric, Columbia University, 1051 Riverside Drive-Unit 98.
New York, NY, 10032
e-mail: js2627@columbia.edu

F. Hamagami
Research Scientist at the University of Virginia. He received his PhD in Quantitative Psychology at the University of Virginia. His primary interests are in longitudinal data and applying dynamical concepts to structural equation modeling and multilevel methodology.

J. J. McArdle
Professor of Psychology at the University of Southern California. He received his PhD in Psychology at Hofstra University. He is principal investigator of the NIA funded National Growth and Change Study and has primary interests in the dynamics of cognitive ability over life span with special emphasis on longitudinal research designs, methodology, and statistical modeling.

P. Cohen
Research Scientist at New York State Psychiatric Institute and Professor of Public Health (Epidemiology) in Psychiatry at Columbia University College of Physicians and Surgeons and Columbia University School of Public Health. She received her PhD in social psychology at New York University. Major interests include quantitative methodology and statistics, developmental psychopathology, and lifespan development.

H. Chen
Assistant Professor of Psychiatry at Columbia University College of Physicians and Surgeons. He received his M.D. and Ph.D. in Biostatistics in China. His research interests include epidemiological studies, quality of life, and multivariate statistical methods.

to those years, most individuals live at home with parents, are enrolled in school, financially dependent, unmarried, and do not have children. After age 30, however, many are residentially and financially independent, no longer in school but working, in a committed romantic relationship, and parenting (Arnett, 2000). Thus, over the course of emerging adulthood, emerging adults increasingly take on adult-roles in a multitude of life domains that are necessary for living successfully as an adult.

These domains are separate but presumably interconnected in that change in one domain is likely to lead to change in other domains through the regulatory function served by identity in developing and maintaining a cohesive sense of self (Berzonsky, 1990; Lerner *et al.*, 2001; Sneed and Whitbourne, 2003). A number of studies have demonstrated interdependence in assuming adult roles across domains such as education, residence, and family. For example, one study found that time spent pursuing higher education increases the probability that an individual would enter adult roles in work and family prior to the completion of his or her schooling (Marini, 1984). Another study found that those who have home-returning episodes during college achieve significantly lower levels of educational attainment (White and Lacy, 1997). Goldscheider and Waite (1987) found evidence of interdependence between residence and romance. In particular, leaving the parental home at an early age was associated with delays in marriage. Taken together, these findings suggest dynamic interrelationships between adult-role assumption across a number of domains including finance, residence, and romantic relationships.

These studies, however, relied primarily on status markers such as leaving home, first job, and marriage. Although they suggest dynamic interrelationships between domains, they necessarily ignore the substantial range of meaning within such marker events. Leaving the parental home may reflect the affluence of parents rather than the role of an offspring, a "steady" romantic relationship may be a convenience rather than a commitment, continuing education may be associated with a social status role rather than a developing commitment to a career. These limitations suggest the utility of examining within-role behaviors in order to better assess the degree to which adult-like roles are actually assumed in particular developmental domains. Indeed, the characteristics that matter most to young adults in feeling as if they have reached adulthood are accepting responsibility for one's self and making independent decisions rather than achieving status markers themselves (Arnett, 1998).

One study using a continuous response coding system for measuring adult-role responsibility across multiple domains between the ages of 17 and 27 found that it tended to increase with age but that periods of greater independence often alternated with periods of dependence; moreover, development was not unitary across domains; that is, rate of change (assumption of adult roles) varied across the multiple domains (Cohen *et al.*, 2003). Although this study did not specifically address interdependence, the findings suggest that the assumption of adult roles in one domain may be connected to the assumption of adult roles in another domain.

The notion developmental interdependence is a core component of developmental systems theories (Lerner and Castellino, 2002). According to this framework, the concept of development is a relational one, both across different life domains as well as between the individual and his or her environment (e.g., person-context relations). The relationship between the person and his or her context (environment) or between the different domains of functioning are assumed to be bidirectional. For example, there is an obvious connection between the availability of financial resources and leaving the parental home: it takes resources to undertake the financing of a residence. Development of a romantic relationship tends to be fostered by the privacy permitted by an independent residence. Thus, increasingly serious romantic involvement is likely to increase the motivation for leaving a parental home. According to a developmental systems approach, the process of development involves changing relations between the person and his or her context, as well as between specific domains. Thus, the concept of development according to this approach is a relational one.

The present study

Despite its intuitive appeal, few studies have empirically tested the assumption of interdependence across domains over time. In the present study, we used data from 200 adults born over a 7-year period (1967–1973), who gave narrative descriptions of role changes that took place from age 17 to 27, to examine the reciprocal relationship between changes in adult-role responsibility in three, presumably interdependent, life domains: residence, finance, and romance. Thus, we first test the assumption that life domains are dynamically interdependent over time using a graded measurement of adult-role responsibility assumption rather than status markers. Following the developmental systems principles of change and interdependence, we expected that each domain couple (e.g., finance-romance, romance-residence, and residence-finance) would be described by reciprocal, interdependent change over time.

We predicted that this interdependent change would be characterized on average by positive growth given that responsibility across life domains increases over the emerging adulthood period (Arnett, 2000). Presumably, increases in adult-role responsibility in one domain over time are related to increases in adult-role responsibility in other life domains over time because of identity processes that function to maintain equilibrium, self-consistency, and balance in the self (Berzonsky, 1990; Lerner *et al.*, 2001; Sneed and

Whitbourne, 2003). Thus, on average, we expected that identity processes would influence the motivations for dynamic changes in each role as a function of the level of the other role maintaining a relative balance across coupled domains.

It was also expected, however, that imbalances would emerge with extreme assumption of adult-role responsibility in one domain leading to deficits in the other coupled domain consistent with a developmental systems perspective. According to Lerner *et al.* (2001), devoting one's resources exclusively to a particular domain might be "insufficient for providing a basis for the variability in the behavioral repertoire that would be needed for continued healthy growth." In other words, the exclusive assumption of an adult role in one domain might detrimentally impact adult-role assumption in another domain. For example, assuming a fully adult role in finance without taking any responsibility in one's romantic relationships might detrimentally affect the quality of one's interpersonal life leading to further regression in romantic involvement.

The present study tests a critical assumption of dynamic systems theory (dynamic interdependence) and further seeks to characterize this interdependence over the emerging adulthood period. To test these dynamic relational hypotheses, we estimate and graph linearly dependent dynamic systems using dynamic systems analysis (Hamagami and McArdle, 2001; Hamagami *et al.*, 2000; McArdle, 2001; McArdle and Hamagami, 2001). Dynamic systems analysis makes use of structural equation modeling and combines features of difference equations, deterministic linear dynamics, and individual differences on some parameters to model relational change over time. These new models are designed to estimate dynamic parameters including self-feedback, coupling, latent growth scores, initial conditions, and inter-individual variations of some latent scores.

Method

Subjects

The participants were 200 adults (52% women, 48% men, 92.5% Caucasion, 7.0% African American, and .5% Native American) ranging in age from 27 to 30 years, who completed detailed narrative interviews describing their transition from adolescence (17th birthday) to adulthood (27th birthday) with regard to a wide range of developmental domains. The narrative interviews were conducted by telephone between 1997 and 2000. The participants in the present study were members of a larger cohort of 821 young adults who had been studied since childhood when they were randomly selected on the basis of residence in one of two upstate counties. Families in this cohort were representative of families in the sampled region with regard to most demographic variables (see http://nypisys.cpmc.columbia.edu/childcom, for a more detailed description).

The current study participants were selected from the larger cohort with a probability that enhanced the statistical power to detect effects of personality disorder symptoms reported either in adolescence or later, as well as being in the appropriate age range and willing to participate in this lengthy (3–5 hours) narrative interview. Although the resulting sampling probabilities are potentially relevant to ensuring that the sample represented the general population from which it was drawn, they would not affect the magnitudes of estimated dynamic effects. The use of these sampling procedures did not affect the estimated effects of demographic or symptom variables on the study outcomes or the association of age with functioning in the developmental domains that have been investigated (Cohen *et al.*, 2003). Approximately 80% of those invited from the larger study participated. Of those who agreed to participate, 1 discontinued prematurely.

Narrative interview procedure

The narrative interview began by establishing a framework for the period of interest (age 17 to 27) through asking participants to complete a "life chart," which charted the changes that took place over this 10-year period in where the participant lived, worked, and studied, and the dates of important milestones and significant experiences. A large literature in the cognitive investigation of autobiographical memory indicates the importance of contextual cues in the storage and retrieval of memories (Bradburn, 2000; Brown and Rutter, 1966). The life chart was reviewed with the interviewer in order to establish a common framework for the subsequent narrative. Six domains including residence, finance, romance, school, career, and parenting were assessed on scales ranging from 0 to 100 with regard to the maturity of roles that were assumed and qualitative aspects of role change in each of the 120 months during the ten year interval. Changes in variables were dated based on the month when they occurred. If there was more than one change within a month, the changes were attributed to consecutive months, retaining the sequence reported by the respondent. Using this procedure, 120 monthly records were obtained from each respondent. Participants were asked to report as many behavioral descriptions as possible (e.g., "Who paid for that?" "What did you do there?' "Who signed the lease?" "How often did you see each other?" "Who did the shopping?") in order to allow the interviewers to assess level of independence and responsibility assumed within each domain.

The central construct of the Transition Study was the degree to which the subject's behavior approximated a fully adult role. These ratings of Transition Level (TL) were quantified by interviewers in each of five domains—residence, finance, career (combination of education and employment), romantic relationships, and family formation. All scores were conceived on a 100 point scale, where 0 represents a completely child-like role and 99 a fully and adequately adult role. For example, the financial TL of zero indicates that a subject was completely supported by others, with essentially no control over the allocation of the financial resources. Scores under 50 indicate partial self-support and control; the highest rating (99) indicates that the respondent provided stable, secure, and adequate financial support for him or herself (and potential dependents). The procedures were identical for all domains. Interrater reliabilities for residential TL, financial TL, and romantic TL were .92, .91, and .98, respectively. For the present study, the 120 monthly values of each variable were averaged for each respondent in order to produce the 10 consecutive annual values employed in the analyses.

To maximize the reliability and validity of these quantitative ratings, the narrative study employed several critical design aspects that have been identified in previous research to elicit accurate recall. First, as previously indicated, participants completed a life chart prior to the interview, which provided a context for the narrative. Second, the interview focused on concrete aspects of settings and roles. Participants were asked for concrete descriptions of their varied settings and role related behaviors. This allowed the subject to reconstruct sufficiently the context in memory to enable further accounts of their behavior in the setting. Third, during interviewer training, it became clear that cross-referencing between different events and settings was a major assistance to subjects for sorting out the sequence of their experiences. Consequently, interviewers crossed-referenced between settings to assist participants in more accurately sequencing events. Fourth, interviewers were trained to ask about participant experience and behavior rather than participant evaluations of situations.

It has long been recognized that autobiographical narratives necessarily reflect a person's history as seen through the filter of their own motivational and cognitive schema (Neisser and Fivush, 1994). By asking, for instance, what chores they performed when they lived with their parents, interviewers gathered the behavioral evidence about the living situation rather than their interpretation of it. Eliciting behavioral evidence allows ratings to be made on the basis of study definitions and coding guidelines. This is the method of "investigator-based" rating (Brown and Rutter, 1966). It ensures that the codes relate to the variables as defined in the study (which the participant could not know), avoids emotion-based evaluations by the participants, and assures consistency across all interviews. Although autobiographical descriptions can never free themselves entirely from engaging motives to organize one's past in the service of a coherent self-presentation (Barclay, 1994), the elicitation of information on settings and concrete behaviors rather than on evaluations and motivations enables the investigator to maximize the objectivity of the assessment.

Interviewer training and coding

A detailed interviewer manual defined the study variables, suggested questions to elicit the desired information, and gave detailed rating instructions and examples. During interviewer training, which included audiotaped pilot interviews, several addenda clarified coding issues. Without extremely clear definitions of the study variables and codes, narrative interviews would gather an unpredictable set of data for each individual and many variables could not be consistently rated.

Training for conducting and coding these narrative interviews was longer than is usually required for field interviewers. Taped interviews were also monitored by a supervisor and feedback was provided to interviewers so that the quality of interviews quickly improved. The most frequent feedback to interviewers related to avoiding reinforcement of feelings or behaviors reported by participants. Interviewers also coded the interviews they completed as well as blindly coding randomly assigned narratives obtained by other interviewers. More information on training and other procedures including reliability details are available elsewhere (Cohen *et al.*, in press).

Prospective and retrospective agreement

To determine the validity of the retrospective reporting method used here, Cohen *et al.* (in press) used multilevel modeling procedures to estimate prospective and retrospective agreement for the means and slopes (rate of change) of the TLs for each domain in an independent sample of 149 participants. These participants were interviewed three times over approximately 5 years, twice covering shorter intervals and once "retrospectively." The average test-retest correlations for the means and slopes in Residence were $r = .92$ and $r = .79$, respectively. The test-retest correlations for the means and slopes in Finance were $r = .77$ and $r = .55$, respectively. The test-retest correlations for the means and slopes in Romance were $r = .92$ and $r = .90$, respectively.

Data analysis and specification of difference score models

Dynamic systems analyses of repeated measures formulate how events change over time and begins with a conceptual model of change or rate of change as the dependent variable. Here we describe a difference score between two adjacent occasions as a Greek symbol, Δ. The difference score is then described in terms of a previous state of the variable (x) as well as a previous state of an external influence (y).

There are several critical elements in dynamic systems. To simplify the situation, consider a hypothetical dynamic system involving only two variables. A self-feedback effect (α_x) characterizes how the previous state of a target variable ($x[t-1]$) will influence its own current change score ($\Delta x[t]$). This self-feedback is algebraically represented as

$$\Delta x[t] = \alpha_x x[t-1]. \tag{1}$$

A coupling effect (γ_{xy}) characterizes how the previous state of another variable would influence a change score in the target variable. This coupling is algebraically expressed as

$$\Delta x\,[t] = \gamma_{xy}\,y\,[t-1]. \tag{2}$$

Finally, a constant effect (s_x) could be added to a change score. This additive constant is equivalent to a linear time effect, representing systematic change over time.

$$\Delta x[t] = s_x \tag{3}$$

And combining these equations builds a fundamental skeleton for the dynamic system.

$$\Delta x[t] = \alpha_x x[t-1] + \gamma_{xy}\,y\,[t-1] + s_x. \tag{4}$$

A model for two parallel repeated measures needs to describe two concurrent change scores ($\Delta x[t]$ and $\Delta y[t]$). Thus, the overall dynamic equation becomes

$$\begin{aligned}\Delta x[t] &= \alpha_x x[t-1] + \gamma_{xy}\,y\,[t-1] + s_x.\\ \Delta y[t] &= \alpha_y y[t-1] + \gamma_{yx}\,x\,[t-1] + s_y.\end{aligned} \tag{5}$$

This fundamental bivariate linear dynamic system is depicted in Fig. 1. In this diagram, a latent change score is represented by a circle, while observed measures are represented by squares. Three elements point to a latent change: (i) the previous state of the target variable, (ii) the previous state of the counterpart variable, and (iii) a linear constant as specified in Eq. (5).

In order to fit a dynamic model to empirical data, it is necessary to integrate the system of difference equations to express expected scores as dependent variables. To do so, we manipulate the current score, the past score, and the change score between them. A current score is considered a sum of a previous score and a change score. Thus, for the bivariate dynamics,

$$\begin{aligned}x[t] &= x[t-1] + \Delta x\,[t]\\ y[t] &= y[t-1] + \Delta y\,[t].\end{aligned} \tag{6}$$

Substituting Eqs. (5) into (6), we have

$$\begin{aligned}x[t] &= (\alpha_x + 1)\,x[t-1] + \gamma_{xy}\,y\,[t-1] + s_x.\\ y[t] &= \left(\alpha_y + 1\right)\,y[t-1] + \gamma_{yx}\,x\,[t-1] + s_y.\end{aligned} \tag{7}$$

We assume that an observed score ($X[t]$ and $Y[t]$) is the sum of a true score ($x[t]$ and $y[t]$) and measurement error ($ex[t]$ and $ey[t]$). Thus, the final expression of a bivariate dynamic system is in the form of an observed score as a dependent variable,

$$\begin{aligned}X[t] &= (\alpha_x + 1)\,x[t-1] + \gamma_{xy}\,y\,[t-1] + s_x + ex\,[t].\\ Y[t] &= (\alpha_y + 1)\,y[t-1] + \gamma_{yx}\,x\,[t-1] + s_y + ey\,[t].\end{aligned} \tag{8}$$

A self-feedback effect and coupling effect are considered 'multiplicative' over time. These effects at successive time points are multiplicatively compounded, propagated, or contaminated by self-feedback and coupling effects of all the previous time points. For example, a change score at the

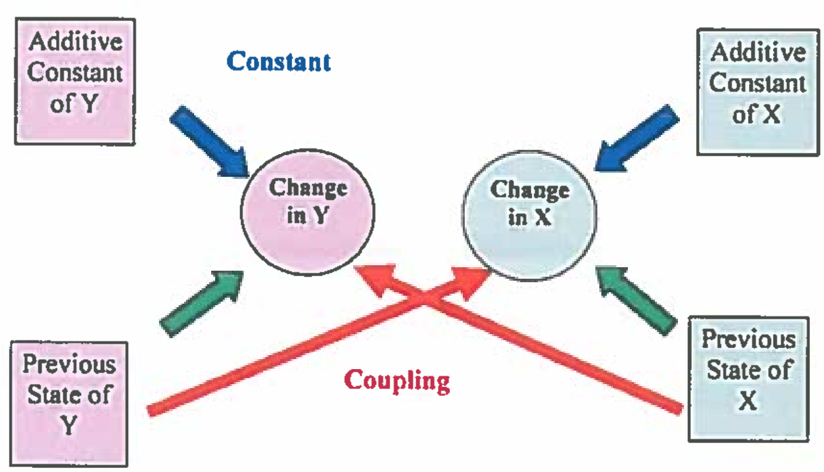

Fig. 1 A pictorial representation of the bivariate dynamic system including critical dynamical elements in the model

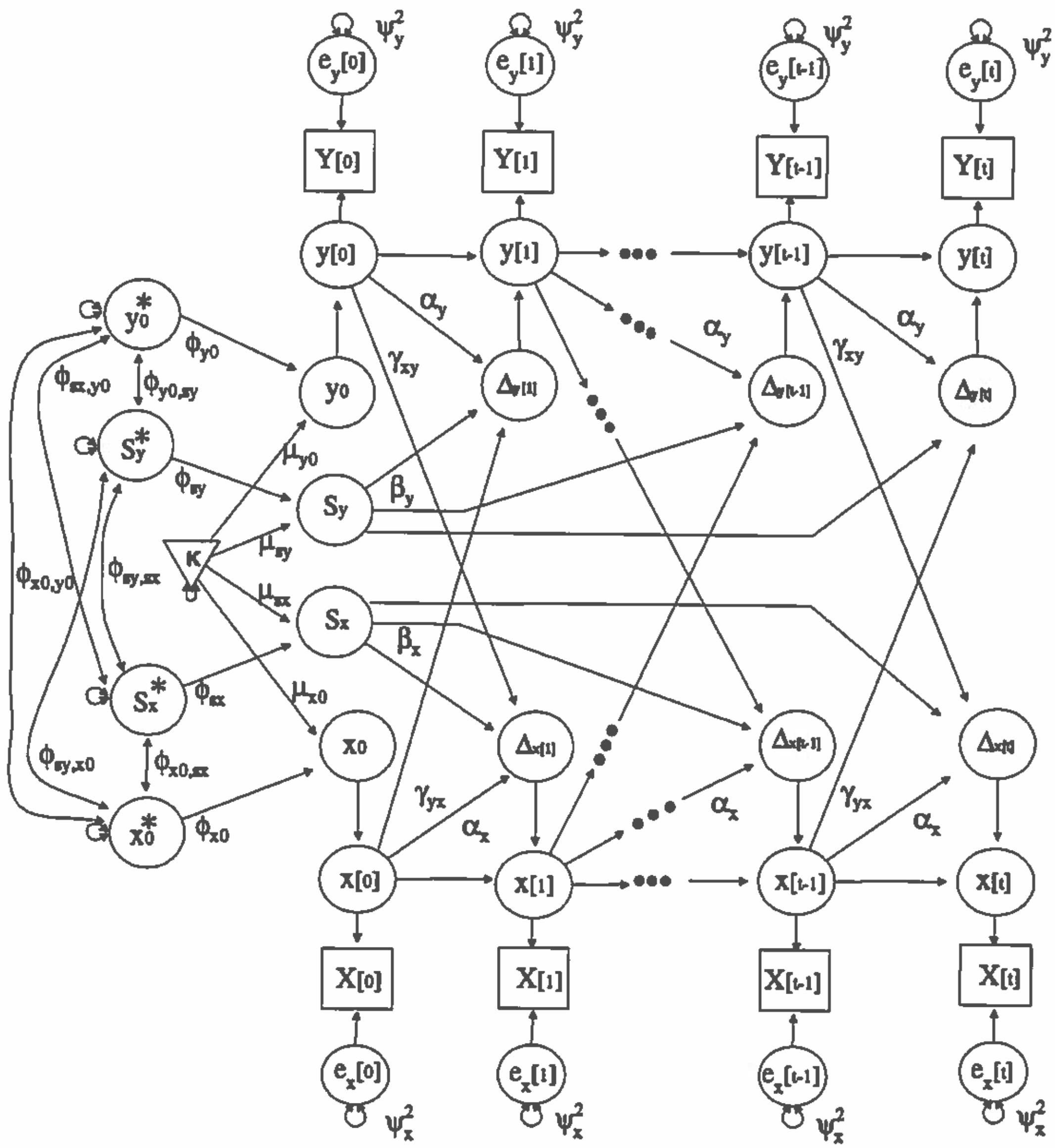

Fig. 2 A path diagram representing a bivariate dual change score model

second time point is only influenced by self-feedback and coupling from the first time point. However, a change score at the 10th time point is not only determined by the effect of the immediately preceding time but also by the states of all the previous time points. Figure 2 depicts the complete path diagram of the latent variable dual change score model.

Vector field plots

The nature of a dynamic system can be portrayed with a vector field plot. A vector field plot is composed of directional arrows that represent the direction of joint movements in the future given current states of variables. Arrows in the vector field are therefore expected change scores given a present situation of variables. For two dimensional vector fields, there are several possible joint movements. Some examples are given: (1) both x and y move in a positive direction, (2) both x and y move in a negative direction, (3) x moves in a positive and y moves in a negative direction, or vice versa, (4) neither x nor y moves, and (5) x moves but y remains static, or vice versa. Figure 3 summarizes these alternative phases of joint movement in x and y. For Figs. 4–6 (vector field plots of the estimated bivariate dynamic models), we also include ellipses that indicate where 95% of the observed data fall; outside these ellipses, joint movements are likely not to occur.

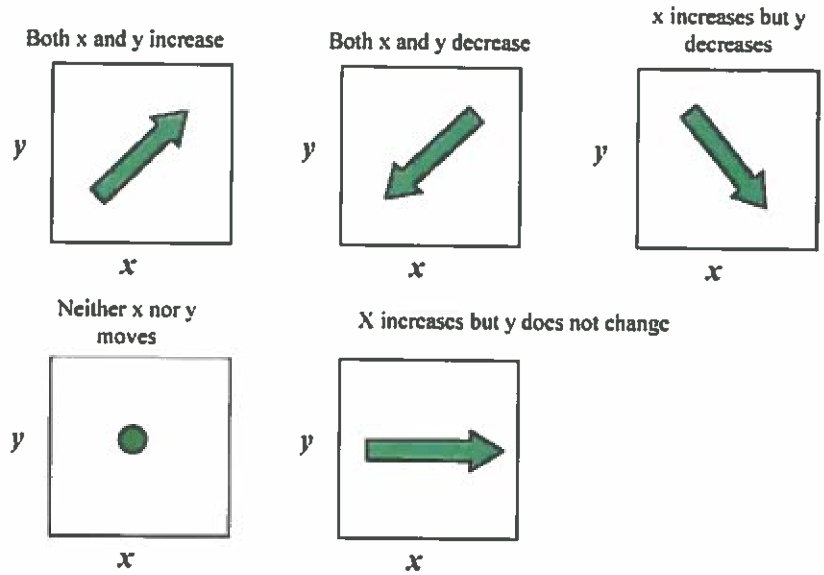

Fig. 3 A diagrammatic demonstration of several bivariate vector field examples

Results

Table 1 presents descriptive statistics on financial, residential, and romantic relationship TL ratings. The first, third and fifth columns include means of financial, residential, and romantic relationship TL as a function of age, respectively. The second, fourth, and sixth columns show the standard deviation of these TL scores at each age. As expected the mean TL increases substantially over this decade for each domain. On average the respondents were at moderately low levels at age 17, when most were still in high school, with mean scores in the 20's. By age 26, mean scores were all over 50, about 59 for financial TL and 63 for the other two domains. These levels seem consistent with reasonable expectations for changes over this decade. Note that increases in mean levels are also accompanied by increases in their standard deviations (Table 2).

Bivariate dynamics between financial and residential TL

According to our analyses, the full bivariate dual change score model between financial and residential TL ratings is

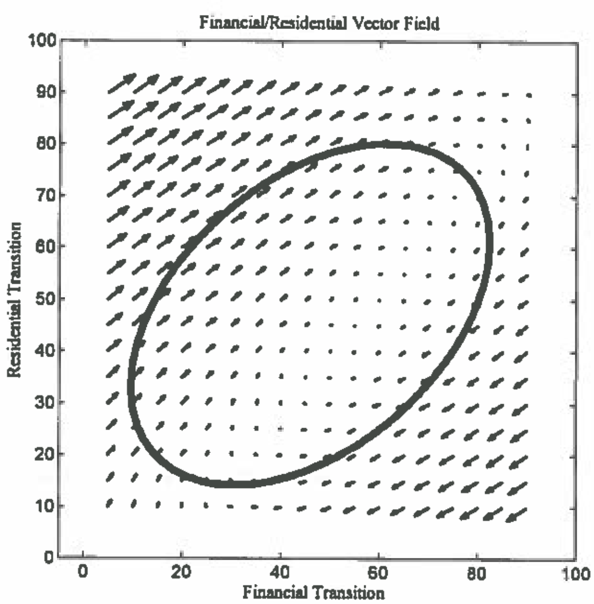

Fig. 4 An expected vector field of financial and residential transitional level dynamics with ellipses superimposed to indicate where 95% of the observed data fall

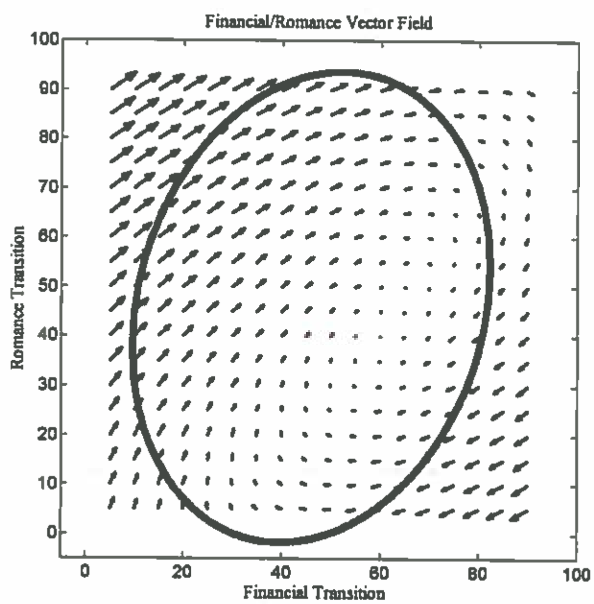

Fig. 5 An expected vector field of financial and romantic relationship transitional level dynamics with ellipses superimposed to indicate where 95% of the observed data fall

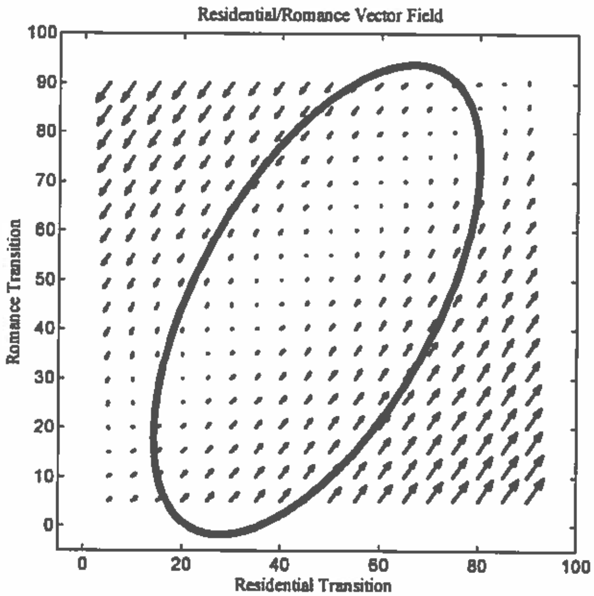

Fig. 6 An expected vector field of residential and romantic relationship transition level dynamics with ellipses superimposed to indicate where 95% of the observed data fall

estimated as

$$\Delta \text{ Finance} = .23 \text{ Finance}[t-1] - .35 \text{ Residence} \times [t-1] + 9.15$$

$$\Delta \text{ Residence} = -.45 \text{ Residence}[t-1] + .45 \text{ Finance} \times [t-1] + 4.71.$$

When we removed the coupling from financial to residential TL, this partial model significantly increased the misfit to the data ($\Delta\chi^2(1) = 146$, $p < .0001$). When we removed a coupling from residential to financial TL, the model similarly increased a misfit to the data ($\Delta\chi^2(1) = 156$, $p < .0001$). Therefore, we conclude that modeling the coupling (link) between finance TL and residence TL is critical to understand the process of assuming more adult-like roles in either domain.

The vector field plot for the joint movement of Finance and Residence Transitional Level is shown in Fig. 4. The oval indicates the range of variable values within which 95% of the observations appeared, indicating the positive relationship between these variables over the 10 year period. We see that the stable diagonal (smallest dots) tends to be maximal when financial TL was about 10 points higher than residential transition. Small changes in finance TL tend to lead to slightly larger changes in the assumption of adult-like roles in residency (angle of arrows). The graph also indicates that when Finance TL score is high and Residence TL is low (the lower right hand corner of the field) both levels tend to decline: however this circumstance rarely occurred. In contrast, when Finance TL is low and Residence TL is

Table 1 Descriptive statistics for financial, residential, and romance transitional level scores as a function of age ($N = 199$)

Age	Financial TL		Residential TL		Romance TL	
	Mean	SD	Mean	SD	Mean	SD
17	22.47	10.77	27.21	7.61	27.52	20.20
18	33.50	17.29	32.68	11.34	32.41	22.18
19	39.01	19.12	36.75	14.28	35.58	24.68
20	41.94	20.58	41.78	16.78	40.78	26.42
21	45.55	20.30	45.65	17.53	45.43	27.33
22	50.01	19.57	49.27	18.51	48.98	29.14
23	52.86	19.76	54.15	18.29	52.58	28.90
24	56.46	19.90	58.34	17.79	56.29	28.33
25	58.26	19.68	61.67	17.53	59.94	28.49
26	58.88	21.43	63.81	18.26	63.30	29.43

Table 2 Results of bivariate dual change score model for latent difference dynamics between financial and residential transitional scores ($N = 199$)

Parameters and fits	Bivariate DCS Financial transition	Residential transition
Proportion (α)	.2334 (.0189)	−.4536 (.0308)
Loading (β)	1	1
Coupling (γ)	−.3523 (.0219)	.4452 (.0342)
Initial mean ($\mu 0$)	26.16 (1.22)	28.07 (.86)
Slope mean (μs)	9.15 (.99)	4.71 (1.04)
Initial deviation ($\phi 0$)	12.92 (.77)	7.20 (.74)
Slope deviation (ϕs)	4.65 (.25)	7.38 (.56)
Correlation (ρ_{0s})	−.75 (.04)	.39 (.01)
Correlation ($\rho_{y0,x0}$)	−.21 (.09)	–
Correlation ($\rho_{y0,xs}$)	.48 (.05)	–
Correlation ($\rho_{ys,x0}$)	−.64 (.04)	–
Correlation ($\rho_{ys,xs}$)	.90 (.01)	–
Error Deviation (ψ)	11.96 (.25)	9.42 (.20)
Full model misfit (number of parameters)	1968 (20)	
Alternative dynamical models	Misfit of other models	Separate misfit test of alternative model against full BDCS model
No coupling F→R ($\gamma_{rf} = 0$)	2116 (19)	$\Delta\chi^2(1) = 146$
No coupling R→F ($\gamma_{fr} = 0$)	2126 (19)	$\Delta\chi^2(1) = 156$
No coupling	2212 (18)	$\Delta\chi^2(2) = 244$

Note. Misfit indices distributed as a χ^2 with 1 degree of freedom. $\Delta\chi^2$ is obtained by subtracting the misfit index of the model from the misfit value of the full bivariate dual change score model (BDCS). $\gamma_{rf} = 0$ denotes that a coupling from financial to residential TL is fixed at 0; $\gamma_{fr} = 0$ denotes that a coupling from residential to financial TL is fixed at 0; parenthesized values next to parameter estimates are standard errors.

Table 3 Results of bivariate dual change score model for latent difference dynamics between financial and romantic relationship transitional scores ($N = 199$)

	Bivariate DCS	
Parameter and fits	Financial transition	Romantic relationship transition
Proportion (α)	.0646 (.0447)	−.2169 (.0521)
Loading (β)	1	1
Coupling (γ)	−.2051 (.0502)	.2197 (.0464)
Initial mean ($\mu 0$)	25.73 (1.28)	28.33 (1.76)
Slope mean (μs)	9.91 (1.00)	3.82 (1.24)
Initial deviation ($\phi 0$)	13.70 (.88)	18.61 (1.32)
Slope deviation (ϕs)	4.20 (.94)	6.24 (1.07)
Correlation (ρ_{0s})	−.46 (.08)	.41 (.14)
Correlation ($\rho_{y0,x0}$)	−.05 (.11)	–
Correlation ($\rho_{y0,xs}$)	.65 (.09)	–
Correlation ($\rho_{ys,x0}$)	−.40(.09)	–
Correlation ($\rho_{ys,xs}$)	.76 (.14)	–
Error deviation (ψ)	11.77 (.25)	16.07 (.37)
Full model misfit (number of parameters)	1762 (20)	
Alternative dynamical models	Misfit of other models	Separate misfit test of alternative model against full BDCS model
No coupling F→O ($\gamma_{of} = 0$)	1788 (19)	$\Delta\chi^2(1) = 26$
No coupling O→F ($\gamma_{fo} = 0$)	1788 (19)	$\Delta\chi^2(1) = 26$
No coupling	1797 (18)	$\Delta\chi^2(2) = 35$

Note. Misfit indices distributed as a χ^2 with 1 degree of freedom. $\Delta\chi^2$ is obtained by subtracting the misfit index of the model from the misfit value of the full bivariate dual change score model (BDCS). $\gamma_{of} = 0$ denotes that a coupling from financial to romance TL is fixed at 0; $\gamma_{fo} = 0$ denotes that a coupling from romance to financial TL is fixed at 0; parenthesized values under parameter estimates are standard errors.

Table 4 Results of bivariate dual change score model for latent difference dynamics between residential and romantic relationship transitional scores ($N = 199$)

	Bivariate DCS	
Parameter and fits	Residential transition	Romantic relationship transition
Proportion (α)	−.6011 (.0332)	.3402 (.0205)
Loading (β)	1	1
Coupling (γ)	.5711 (.0335)	−.4522 (.028)
Initial Mean ($\mu 0$)	28.69 (.78)	26.14 (1.45)
Slope Mean (μs)	5.60 (1.09)	9.09 (.94)
Initial Deviation ($\phi 0$)	6.60 (.73)	16.90 (.92)
Slope Deviation (ϕs)	7.40 (.52)	4.79 (.25)
Correlation (ρ_{0s})	.06 (.10)	−.74 (.01)
Correlation ($\rho_{y0,x0}$)	.18 (.10)	–
Correlation ($\rho_{y0,xs}$)	−.72 (.03)	–
Correlation ($\rho_{ys,x0}$)	.17 (.10)	–
Correlation ($\rho_{ys,xs}$)	.90 (.01)	–
Error Deviation (ψ)	8.75 (.17)	16.04 (.07)
Full model misfit (number of parameters)	1405 (20)	
Alternative dynamical models	Misfit of other models	Separate misfit test of alternative model against full BDCS model
No coupling R→O ($\gamma_{or} = 0$)	1564 (19)	$\Delta\chi^2(1) = 159$
No coupling O→R ($\gamma_{ro} = 0$)	1698 (19)	$\Delta\chi^2(1) = 293$
No coupling	1744 (18)	$\Delta\chi^2(2) = 339$

Note. Misfit indices distributed as a χ^2 with 1 degree of freedom. $\Delta\chi^2$ is obtained by subtracting the misfit index of the model from the misfit value of the full bivariate dual change score model (BDCS). $\gamma_{or} = 0$ denotes that a coupling from residential to romance TL is fixed at 0; $\gamma_{ro} = 0$ denotes that a coupling from romance to residential TL is fixed at 0; parenthesized values under parameter estimates are standard errors.

high (toward the upper left hand corner), both tend to be positively affected. Higher levels of residency TL were associated with increases in financial TL. High levels of financial TL had negative implications for residency TL unless accompanied by at least moderately high levels of residential independence.

Bivariate dynamics between financial and romantic relationship TLs

Table 3 summarizes parameter estimates of bivariate dynamics between financial and romantic TL scores. According to our results, the full bivariate dual change score model between financial and romantic TL ratings is estimated as

$$\Delta \text{Finance} = .06\,\text{Finance}[t-1] - .20\,\text{Romance} \times [t-1] + 9.91$$
$$\Delta \text{Romance} = -.21\,\text{Romance}[t-1] + .22\,\text{Finance} \times [t-1] + 3.82.$$

When a coupling from financial to romantic TL was eliminated from the full model, the model fit significantly deteriorates over the full model ($\Delta\chi^2(1) = 26$, $p < .0001$). When we removed a coupling from romantic to financial TLs, the model similarly increased a misfit to the data ($\Delta\chi^2(1) = 26$, $p < .0001$). This indicates that the relational unit between finance and romance TL is necessary to understanding change in either domain.

The vector field plot for the joint motion of Financial and Romantic TL is shown in Fig. 5. On the whole, financial TL seems to have most influence on romance at more adult levels of romantic commitment, especially at starting values of relatively low financial TL. On the other hand, high levels of romantic commitment predict strong increases in financial independence but low levels of romantic commitment do not predict such increases. Low romantic maturity seems to handicap those assuming moderate to high financial responsibility. These relationships are sufficiently strong as to produce only a modest area in which "balance" in these TLs leads to equilibrium. This range appears where the Romantic TL is near its midpoint (between about 30 and 50), reflecting explorations of romantic commitment, and Financial TL is a little above its midpoint (between 50 and 70), reflecting self-support at moderate levels of stability and adequacy.

Bivariate dynamics between residential and romantic relationship TLs

Table 4 summarizes parameter estimates of bivariate dynamics between residential and romantic TL scores. According to these analyses, the full bivariate dual change score model between residential and romantic TL ratings is estimated as

$$\begin{aligned}\Delta\,\text{Residence} &= -.60\,\text{Residence}\,[t-1] + .57\,\text{Romance}\\ &\quad \times[t-1] + 5.60\\ \Delta\,\text{Romance} &= .34\,\text{Romance}\,[t-1] - .45\,\text{Residence}\\ &\quad \times[t-1] + 9.09.\end{aligned}$$

When a coupling from residential to romantic TL was removed from the full model, the model fit significantly deteriorated over the full model ($\Delta\chi^2(1) = 159, p < .0001$). When we removed a coupling from romantic to residential TL, the model similarly increased misfit to the data ($\Delta\chi^2(1) = 293$, $p < .0001$). Again, this indicates that the relational unit between domains is important in understanding change within domains.

Figure 6 shows the vector field for the residential and romantic TL dyad. The top left corner above the "balanced" diagonal shows arrows generally pointing downward in both residential and romantic relationship TL scales. Thus, when individuals are in child-like residential roles, romantic commitment greatly suffers, except for those with no real romantic involvement (near the bottom of the graph). This effect is so extreme that cases with moderate romantic commitment do not even appear within the data (outside bounds) until residential role includes a non-family residence. However, when the residential TL is less than about 75 and the current romantic TL is above 75 there is a serious risk of decline in romantic commitment. The area below the balanced diagonal shows that high residential independence generally bodes well for romantic commitment. Increases in romantic commitment also tend to be associated with a continuing trajectory toward an adult residential role. On the average, the vector reflecting maximal stability in these variables begins with romantic TL at about 30 (going steady) and residential TL at about 20 (living with family with fair responsibilities) and continues as the two TLs increase more or less in parallel.

Discussion

This study tested the assumption based on dynamic systems theory that life domains are interdependent using dynamic systems analysis. In each dyad (e.g., finance-romance, residence-finance, and romance-residence), the fit of the model significantly deteriorated when the coupling between domains was removed. As can be seen in Fig. 1, the coupling characterizes how the previous state of one variable (e.g., romance) influences the change score in another target variable (e.g., finance). In other words, the statistical model fit the data less well when the correlation (coupling) between the domains was removed indicating that the relational unit between domains is critical to understanding development within domains, a central postulate of dynamic systems theory.

Studying the graded assumption of adult-like roles rather than status markers, we found that the assumption of a more adult-like role in finance led to greater assumption of a more adult-like role in residence, and this effect was dynamically reciprocal. Becoming more of an adult in residence generally led to the assumption of more adult-like roles in romance, and this effect was also dynamically reciprocal. Lastly, becoming financially self-sufficient on average led to more adult romantic relationships, in turn, more adult-like functioning in one's romantic relationships led to more independence in the domain of finance. Thus, the interdependence observed in this study was characterized on average by positive change. Furthermore, this positive interdependence was marked by points of equilibrium. We presume that this reflects a self-regulating process of identity, which aims to maintain a stable, balanced, and consistent (both internally and externally) sense of self across the life span (Berzonsky, 1990; Lerner *et al.*, 2001; Sneed and Whitbourne, 2003).

Although there was an overall tendency for these indices of adult-role assumption to increase throughout emerging adulthood in a balanced fashion, there were also deviations from equilibrium that qualified this general tendency. As expected, these deviations reflect "imbalances" in the level of adult roles assumed between two distinct although interdependent life domains that can have detrimental effects. For example, we found that high finance TL in conjunction with low residence TL was detrimental for subsequent change across both domains. High finance TL coupled with low romance TL was also detrimental for subsequent change in both domains. Finally, high romance TL combined with low residency TL was suggestive of sharp declines in romantic self-sufficiency.

The finding of both balance and imbalance are consistent with Baltes and Baltes' (1990) selection, optimization, and compensation (SOC) model, an exemplar of dynamic systems theory (Lerner *et al.*, 2001). The SOC model describes how people select, pursue, and maintain or disengage from their goals. In the context of the present study, these goals would be achieving adult-role responsibility in the domains of finance, residence, and romance. Selection refers to directing and focusing resources toward specific goals while avoiding diffusion. Optimization refers to acquiring and applying goal-relevant means in order to achieve higher levels of functioning. When goal achievement is blocked, people compensate by devoting extra resources to the desired goal. Thus, the SOC model provides a platform for understanding relational change across multiple, interdependent life domains. Regulation of goal achievement (e.g., adult-role assumption in a particular life domain) through the use of selection, optimization, and compensation is a balanced and coordinated process that is used in order to maximize goal achievement. When specific domains are over selected or exclusively focused upon, the model would suggest that deficits might develop in neglected domains. Thus, while the SOC model predicts that on average a positive balance would describe the progressive assumption of adult-role responsibility across different life domains, it also allows for negative imbalances with over selection in one domain leading to deficits in another domain.

The limitations of this study are balanced by its unique strengths. For example, while most studies of developmental processes rely on convenience samples of college students, this study was conducted on a representative population-based sample of randomly selected households in two upstate New York counties in 1975. However, at the time of sampling in 1975, upstate New York consisted of predominantly Caucasian Americans limiting the generalizability of the present findings. Also, the sample was necessarily limited to those old enough to reflect on the period of emerging adulthood and willing to participate in a lengthy narrative interview. The study is also limited by its reliance on retrospective reports; however, the rigor with which this was carried out and the special study design considerations implemented have yielded impressive reliability and validity data on the accuracy of these reports.

At the same time, this study improves over previous investigations in that it relied on graded measurements of adult-role assumption rather than status markers, which necessarily ignore the substantial range of meaning within these critical life domains. It is also the first study to use dynamic systems analysis to test assumptions of dynamic systems theory and characterize interdependent growth across coupled domains during emerging adulthood. Although it would be of interest to fit models that examine interdependence across more than two domains at a time, the complexity of these models, both statistically and graphically, prevented us from including these analyses in the present report. Bivariate dynamic systems analysis can be readily extended, however, to include more than two domains of functioning. The present study contributes to the literature in two ways. First, it contributes to our understanding of growth during emerging adulthood by highlighting the importance of domain interdependence. Second, it makes methodological contributions by outlining a statistical model that can be used to test dynamic theory.

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