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The Dynamics of Self-Evaluation

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We conceptualize self-concept as a self-organizing dynamical system and investigate implications of this perspective for the dynamic and fixed-point attractor tendencies of self-evaluative thought. Participants who differed in self-concept valence (self-esteem) and coherence (self-certainty, self-stability) engaged in verbal self-reflection for several minutes, then used a computer mouse to track the moment-to-moment self-evaluation expressed in their recorded narrative. Prior to self-reflection, participants recalled positive or negative past actions (positive vs. negative priming), or did not recall past actions (no priming). Priming affected overall self-evaluation (i.e., greatest positivity under positive priming), but only early in the narrative. The effects of self-concept, in contrast, became stronger over time. Self-esteem affected overall self-evaluation, whereas self-certainty and self-stability affected the dynamic properties (e.g., rate of movement between self-evaluative states) and attractor tendencies of self-evaluation. Discussion centers on the interplay between structure and dynamics in the self-system.

The self is arguably the largest and most accessible structure in the cognitive system. It encompasses virtually every facet of one's experience, from the nuances of physical appearance to personal aspirations and self-perceived traits, and it is never more than a stranger's glance from being activated. In recognition of its size and ease of accessibility, the self is commonly imbued with substantial importance as well. Specific elements of self-understanding (e.g., goals, values, obsessions) are said to provide platforms for action and self-regulation, and basic properties of self-structure—most notably, global criteria of self-evaluation—are considered central to one's subjective well-being and the quality of one's interpersonal relations. These functions suggest that the self-structure plays a prominent, if not decisive, role in shaping the spontaneous flow of cognitive elements during self-reflective thought and in dictating how the stream of self-reflective thought accommodates incoming information and other factors capable of biasing self-perception in some fashion. The precise nature of the interplay between structural properties of the self and the dynamics of self-reflection, however, is largely unexplored. Accordingly, our aim in this article is to consider how key properties of self-structure are manifest in the stream of thought when people think about themselves.

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Coherence in Self-Evaluation

Our theoretical rationale is derived from a model we recently developed to depict the emergence of global properties (e.g., self-esteem, self-certainty) in self-un-

derstanding as a result of internal integration processes (Nowak, Vallacher, Tesser, & Borkowski, 2000). The model assumes that the self-structure can be conceptualized as a complex system composed of cognitive elements representing specific pieces of self-relevant information. These elements are diverse by many criteria (e.g., episodic memories, self-perceived skills, physical features) but all can be scaled with respect to the common parameter of evaluation. This information invariably runs the gamut of possible self-evaluation, from memories of social *faux pas* and the awareness of personal shortcomings to memorable accomplishments and personal values. Everyone's self-structure, in other words, consists of cognitive elements that are diverse with respect to valence.

The elements of self-structure are not static in valence or passive, but rather influence each other in order to achieve a common evaluation. In this process, an element that is evaluatively incongruent with neighboring (thematically related) elements may change its valence or, conversely, change the valence of its neighbors, so as to establish evaluative coherence with the related elements. The self-perception of "clumsiness," for example, may take on positive valence in the context of other self-perceived qualities that collectively convey an image of oneself as a charming, absent-minded professor. As a result of this press for integration, specific subsets of self-relevant information become increasingly coherent with respect to a shared evaluation. By the same token, the self-structure becomes differentiated, with different sets of elements stabilizing on different values of self-evaluation. A person may have a coherent and positive view of him or herself as a professor, for example, and an equally coherent but negative view of him or herself as an athlete. Using computer simulations with a cellular automata platform, Nowak et al. (2000) demonstrated a tendency for self-relevant information to become differentiated into evaluatively coherent substructures (cf. Showers, 1992, 1995), each corresponding to a distinct aspect of self-perception (e.g., social roles, areas of competence). The emergence of evaluative differentiation in self-structure is portrayed in Figure 1.

There is reason to suspect variability in the extent to which self-structure achieves differentiation. First of all, the valence of some elements may be fairly resistant to change. In Figure 1, this feature is represented by the relative height of the elements; the higher the element, the greater the resistance to change. Elements that are defined in relatively high- as opposed to low-level terms, for example, are correspondingly more stable and resistant to redefinition (cf. Vallacher & Wegner, 1987). "Making a critical comment," for instance, can be identified at higher level in either positive or negative terms (e.g., "being constructive" vs. "being rude"), but these higher-level identities are themselves difficult to re-identify in ways that change

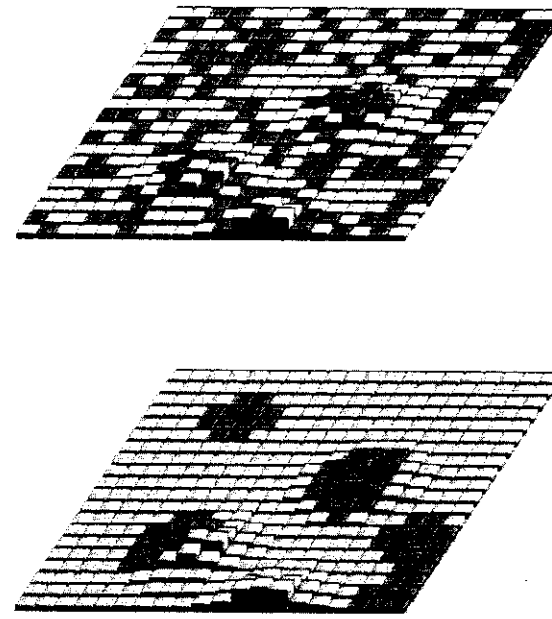

Figure 1. The Emergence of Coherence in Self-Evaluation. Light gray cells denote positively valenced elements of self-relevant information; dark gray cells denote negatively valenced elements of self-relevant information. Resistance to change in valence is represented by the height of cells (higher cells have greater resistance and thus are more stable in valence). The top figure represents a self-system with a random configuration of positive and negative elements. The bottom figure represents a self-system that has become differentiated as a result of self-organization.

their valence. Even a lower-level element, however, may have a fixed valence that is resistant to change if salient social feedback or unequivocal social norms dictate how the element is evaluated. Driving while intoxicated, for example, is a fairly basic depiction of action, but one that is difficult to identify at higher level in other than negative terms. Second, the press for evaluative integration may vary across different regions of self-structure, and those regions associated with weaker press may achieve less coherence as a result (Nowak et al., 2000). Private as opposed to public aspects of the self, for example, may be associated with a relatively weak press for integration because of diminished self-presentation concerns. For these reasons, then, specific regions of self-structure may vary with respect to their evaluative coherence. Conceivably, in fact, an entire self-structure could be devoid of any regions with high coherence.

Coherence and Self-Reflection Dynamics

We hypothesize that evaluative coherence plays a primary role in shaping the dynamic properties of self-evaluation. When attention is directed toward a relatively coherent region of self-structure, self-evalu-

ation should show correspondingly low variability. Because the majority of elements in such regions share a common valence, their activation will produce relatively univalent self-relevant thoughts. When attention is directed toward a relatively incoherent region, on the other hand, the elements are mutually inconsistent in valence, so their activation should promote correspondingly high variability in self-evaluation.

Beyond dictating self-evaluation within a region of self-structure, coherence also plays a role in generating the flow of self-evaluative thought across regions of self-structure. We suggest that the temporal trajectory of self-evaluation can be framed in terms of the system's tendency to maximize its evaluative coherence. In this view, each region of self-structure is characterized by a specific value of a coherence function. The greater the evaluative consistency among elements within a given region, the higher the value of the coherence function for that region. In an unperturbed system, the flow of self-reflective thought tends to move from regions with low coherence values toward those with higher values. Over time, then, self-evaluative thinking in an unperturbed system should evolve toward regions characterized by relatively coherent self-relevant thoughts (i.e., thoughts that share a common valence). Even if the particular thoughts and images that arise in the course of self-reflection are highly disparate with respect to content, their shared valence ensures that self-evaluation will remain relatively stable over time.

The notion of attractor is useful in capturing this relationship between structure and dynamism. An attractor corresponds to a state toward which a system evolves asymptotically over time. A system at its attractor state tends to remain at rest if unperturbed by external influences, and will return to this state if slightly perturbed by such influences. The strength of an attractor is reflected in its basin of attraction (i.e., the number and variety of alternative states of the system that evolve toward it) and in its resistance to external influence (i.e., the strength of perturbation required to move the system out of the basin of attraction to an alternative attractor). With respect to self-reflection, an attractor corresponds to self-relevant thoughts that are evaluatively coherent and provide mutual support for one another.[1] The stream of consciousness tends to evolve toward such thoughts, and once they are activated, subsequent self-reflection tends to be resistant to alternative thoughts and incoming information of a conflicting nature. In a region of self-structure with low evaluative coherence (i.e., a weak attractor), in contrast, self-evaluation is characterized by inconsistency and is easily perturbed by incoming information. Over time, the stream of thought will move away from such regions (i.e., weak attractors) to areas of self-structure characterized by higher evaluative coherence (i.e., strong attractors).

This depiction has implications for individual differences in self-evaluation tendencies. Because the self-structure tends to be become differentiated into distinct regions of evaluatively coherent elements (Nowak et al., 2000), a person is likely to have more than one attractor for the flow of self-evaluative thought. Thus, someone with high self-esteem can converge on regions of self-structure that convey a relatively coherent but negative view of him or herself, just as someone else with lower self-esteem can stabilize to some extent on regions comprised of fairly coherent positive self-relevant thoughts. What determines a person's characteristic level of self-esteem, then, is the relative coherence of positive and negative regions in his or her self-structure. Stated differently, a person's level of self-esteem is determined by those regions of self-structure with maximal coherence. A person with mediocre talents and a mixed record of accomplishment in most areas of life, for example, might nonetheless have high self-esteem if his or her relatively few self-perceived assets form a coherent and positive self-view. By the same token, someone with low self-esteem may have a wide variety of talents and positive attributes, but if these elements do not form coherent regions, the person may not be able to sustain thoughts concerning those elements.

As noted earlier, self-structures can vary in their overall degrees of coherence. Despite the press for integration, some people may have relatively weak coherence, with neither positive nor negative self-relevant thoughts providing an attractor for self-reflection. Because the local interactions in each region do not provide sufficient mutual support to stabilize the system, self-evaluation is characterized by changes over time and heightened susceptibility to external influences. Such influences (e.g., social feedback) may push the system to one attractor, but the inconsistent influences of neighboring elements in that region quickly dislodge the system and restore its volatility. The incoherence, instability, and susceptibility to external influence associated with this type of self-structure are likely experienced as self-concept uncertainty (e.g., Campbell et al., 1996; Kernis, 1993; Pelham, 1991; Vallacher, 1980).

Overview of Research Strategy

Assessment of the hypothesized link between structure and dynamics in self-reflection calls for sampling the stream of thought with a fairly high degree of tem-

[1]Because our primary concern in the present context is the relative stability of self-evaluative states, we consider only the notion of fixed-point attractor, which is equivalent to the notion of stable equilibrium in many psychological theories (see Nowak, Vallacher, & Zochowski, 2002). Other types of attractors (i.e., periodic, quasi-periodic, chaotic) have been identified in dynamical systems, however, and these may be relevant to various psychological phenomena (e.g., Vallacher & Nowak, 1997).

poral resolution. To do so, we recently adapted the mouse paradigm employed in previous research on the intrinsic dynamics of social judgment (Vallacher & Nowak, 1994, 1997; Vallacher, Nowak, & Kaufman, 1994). In this approach, participants use a computer mouse to control the position and movement of a cursor on a computer screen. Two symbols are presented on the screen: a small circle positioned in the middle of the screen that represents the target of judgment and an arrow showing the current position of the cursor. Participants are instructed to position the cursor with respect to the circle to express their current feelings about the target, with less distance indicating more positive feelings. By tracking the position of the cursor over time, then, it is possible to track the pattern of changes in participants' feelings about the target.

This approach has been modified to enable insight into the dynamics of self-evaluation. Participants are instructed to describe themselves by speaking into a microphone, and their self-description narratives are stored as wave files or audiotapes. They are encouraged to describe themselves as fully and completely as possible with respect to personality traits, goals, plans, relationships, or whatever else comes to mind. Upon completion of the recording, participants listen to it and use the computer mouse procedure to indicate on a moment-to-moment basis the positivity versus negativity of their self-descriptive comments. Specifically, they position the cursor close to the circle if the momentary self-description conveys positive feelings about themselves and position the cursor distant from the circle if the self-description conveys negative self-relevant feelings. By tracking the cursor's position several times a second, it is possible to chart a trajectory of self-evaluation for participants' stream-of-thought narrative and to derive dynamic properties from the trajectory, such as the variability in self-evaluation over time and the rate of change between self-evaluative states.

Preliminary Research

Procedure

In our initial investigation, we recruited 69 undergraduates (23 men, 46 women) for a two-part study. The first part consisted of several mass testing sessions, at which participants completed several self-report instruments, including a set designed to assess global properties of self-concept. Self-esteem was assessed with a test developed by Rosenberg (1965). Using Likert-type scales, participants expressed their agreement vs. disagreement with 10 statements tapping a sense of personal worth (e.g., "I feel I have a number of good qualities"). Self-concept stability was assessed with an additional 4 items developed by Rosenberg that measure agreement vs. disagreement with statements tapping aspects of temporal consistency in self-concept (e.g., "Some days I have a very good opinion of myself; other days I have a poor opinion of myself," "I have noticed that my ideas about myself seem to change very quickly"). To measure self-concept certainty, we asked participants to indicate how certain vs. uncertain they were of their standing with respect to 20 common personality traits (e.g., sincerity, sociability, independence). These ratings were made on 7-point response scales, anchored by *not at all certain* and *very certain*.

Several days later, participants returned individually to take part in the second part, an ostensibly unrelated experiment involving memory and judgment. Some participants were asked to think about 5 past actions that reflected positively on themselves (positive priming); other participants were asked to think about 5 past actions that reflected negatively on themselves (negative priming). In both conditions, participants entered brief (one- or two-sentence) descriptions of each act into a computer. The remaining participants were not asked to think of past actions (no priming). Participants then were instructed to describe themselves by speaking into a microphone positioned next to the computer. They were encouraged to say whatever came into their minds as they thought about themselves, although they were advised not to mention their names or other information that might identify them. We assured them that their audiotapes would be treated as confidential material and erased upon completion of the study. After answering questions about this procedure, they were left alone for up to five minutes to create the audiotape.

Upon completion of their self-descriptive narratives, participants listened to the audiotape and indicated how positive vs. negative their self-description was by using the modified mouse procedure (described earlier). Thus, they used a computer mouse to control the cursor's position *vis a vis* a small target circle in the middle of the screen to indicate the moment-to-moment valence conveyed in their self-descriptive narrative. The less the distance from the target circle, the more positive the momentary content of the narrative. By tracking changes in cursor position, then, we could capture the moment-to-moment self-evaluation conveyed in participants' stream of thought protocols. The recordings ranged from 1½ min to the allowable 5 min (M = 2 min, 52 sec), so the length of the corresponding mouse trajectories varied in the same manner.

Dependent measures

Responses to the 10 self-esteem items formed an internally consistent scale (α = .87) and were averaged to yield a measure of global self-esteem. The stability items from the Rosenberg questionnaire were also highly intercorrelated (average r = .68) and thus were

averaged to general an overall measure of self-stability ($\alpha = .81$). The certainty ratings also formed a highly reliable scale ($\alpha = .83$) and were averaged to yield an overall measure of self-certainty. Self-esteem was reliably correlated with self-certainty ($r = .50$), in line with previous research (e.g., Baumgardner, 1990; Campbell et al., 1996; Kernis, 1993; Vallacher, 1978), and both variables were reliably correlated with self-stability ($r = .40$ for self-esteem, .47 for self-certainty).

From participants' mouse trajectories, we derived the following measures: *distance* from the target circle (in pixels), *variability* (standard deviation of distance), *speed* (pixels per 0.1 s), *acceleration* (change in the number of pixels traversed in 0.1 s), and *time at rest* (sec. without mouse movement). Distance provides a measure of self-evaluation, with greater distance indicating lower self-evaluation. Variability reflects difference in self-evaluative states—the greater the variability, the greater the spread in self-evaluation. Speed and acceleration both reflect volatility in self-evaluation (i.e., rate of change and instability in rate of change). Because these measures have similar meaning and were highly correlated, $r(69) = .79$, $p < .001$, they were averaged to create a measure of *dynamism*. Time at rest is a direct measure of the tendency for the self-system to settle on an attractor state for self-evaluation. To assess positive and negative attractor tendencies, time at rest was calculated separately for positions close to the target (positive self-evaluation) and positions distant from the target (negative self-evaluation). The close-far distinction was determined by dividing in half the total distance in each participant's mouse trajectory and computing the amount of rest time in each half. To determine if the dynamic properties of participants' self-narratives changed over time, we divided the mouse trajectories into 3 equal time intervals, and for each one we computed the mouse-derived variables (distance, variability, dynamism, rest-close, and rest-far).

Hypotheses

Our theoretical rationale holds that everyone's self-structure consists of both positive and negative self-relevant information, and that there is a tendency for these elements to become organized into evaluatively coherent regions. Presumably, everyone can think about themselves in either positive or negative terms if these respective regions are activated. We predicted, therefore, that in comparison to the absence of priming, positive priming would promote relatively positive self-evaluation (i.e., relatively small distance from the target circle), whereas negative priming would promote relatively negative self-evaluation (relatively large distance).

Because priming only temporarily activates certain regions of self-structure, however, it should have a correspondingly short-lived effect on the stream of self-evaluation. As the activation induced by priming dissipates, participants' self-evaluative tendencies should evolve over time toward their dominant attractors. The effect of priming on momentary self-evaluation (distance), then, should be most apparent early in participants' narratives (i.e., the 1st time period), whereas the association between individual variation in self-esteem and self-evaluation should become increasingly apparent at later points in their narratives (i.e., the 2nd and 3rd time periods). Thus, we expected participants with higher levels of self-esteem to show more positivity (less distance) in their momentary self-evaluation than those with lower levels of self-esteem, with the strength of this association growing over the three time periods. Because systems tend to rest in their attractor states, we also expected to observe a relationship between self-esteem and the rest-close and rest-far measures. In line with the positivity bias (cf. Taylor & Brown, 1988; Tesser, 1988), participants in general were expected to spend more time at rest close to the circle than far from the circle, but this asymmetry in positive vs. negative attractor tendencies was expected to be greater for those with relatively high as opposed to relatively low self-esteem. Because an attractor represents a state to which the system converges over time, we anticipated that the effects of self-esteem on asymmetry in rest-close vs. rest-far would become stronger from the 1st to the 3rd time period.

Predictions concerning variability and dynamism in self-evaluation centered on the certainty and stability of participant's self-concept. Compared to highly certain or stable participants, those with lower certainty or stability were expected to display a greater range of self-evaluative states and to evince more frequent and erratic changes in self-evaluation during self-reflection. Because self-certainty and self-stability are theoretically distinct constructs, however, they may display correspondingly distinct relationships with variability and dynamism. It could be argued, for example, that self-uncertainty reflects conflicting self-evaluative attractors, whereas self-instability represents a self-structure that lacks any strong attractors for self-evaluation. If so, self-concept uncertainty should be associated with relatively high self-evaluation disparity (i.e., high variability), whereas self-concept instability should be associated with frequent and erratic changes in self-evaluation (i.e., high dynamism) during self-reflection. Because self-evaluation evolves over time to its attractor states, these relationships were expected to become more pronounced from the 1st to the 3rd time period.

Results

We performed analyses of variance (ANOVAs) to assess the effects of priming and time period on the mouse-derived variables (distance, variability, dyna-

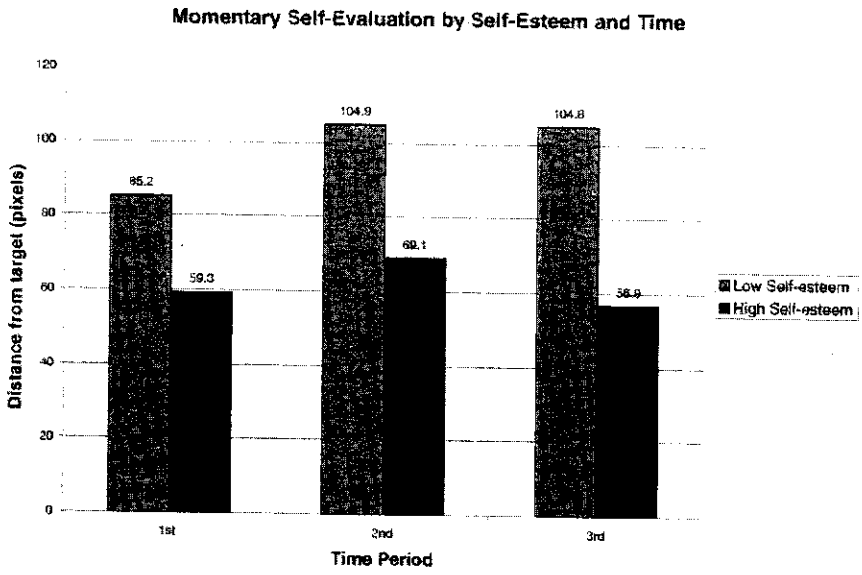

Figure 2. Momentary Self-evaluation (Distance) by Self-Esteem and Time

mism, rest-close vs. far). Correlational analyses were performed to assess the relationship between individual variation in global properties of the self (self-esteem, self-stability, self-certainty) and the mouse-derived variables.

Momentary Self-Evaluation. A priming *x* time period ANOVA performed on distance revealed a marginally reliable effect for priming, $F(2,66) = 2.73$, $p < .07$. Negative priming tended to promote greater distance ($M = 109.6$) than did no priming ($M = 75.6$) and positive priming ($M = 74.1$). With the data blocked on time period, results revealed a reliable priming effect for only the 1st time period, $F(2,66) = 3.85$, $p < .03$. Negative priming promoted greater distance early in participants' self-narratives ($M = 108.2$) than did no priming ($M = 64.0$) and positive priming ($M = 61.9$). So although inducing participants' to think about negative acts on their part rendered negative aspects of themselves salient, this effect was fairly short-lived. In line with our hypotheses, then, priming tended to create only temporary attracting tendencies for participants' stream of self-reflection.

Correlational analyses, meanwhile, demonstrated a reliable relationship between self-esteem and distance, $r(69) = -.24$, $p < .05$, with low self-esteem participants displaying more negative self-evaluation than high self-esteem participants. To determine if participants' self-narratives became more polarized over time in line with their predominant attractors, we performed the correlational analyses separately for each time period. Results revealed that the association between self-esteem and distance was marginally reliable in the 1st time period, $r(57) = -.23$, $p < .09$, and became progressively more reliable over time: $r(57) = -.28$, $p < .03$, for the 2nd time period, $r(57) = -.34$, $p < .01$, for the 3rd time period. (These analyses were replicated with self-certainty and self-stability each substituted for self-esteem. The results failed to demonstrate any clear pattern of association between these variables and distance.)

This effect is illustrated in Figure 2, which depicts the self-evaluative tendencies of high and low self-esteem participants at each time period. To create high and low self-esteem groups, we divided the distribution of self-esteem scores into the upper and lower 40%. In line with the correlational data, the results of ANOVAs revealed that the difference between low and high self-esteem participants became larger and increasingly reliable over time: $F(1,55) = 2.92$, $p < .09$, for the 1st time period, $F(1,55) = 4.80$, $p < .03$, for the 2nd time period, and $F(1,55) = 7.16$, $p < .01$, for the 3rd time period (see Fig. 2). Unlike the effect of priming, then, the effect of self-esteem became more pronounced as participants reflected on themselves, a pattern that is consistent with convergence on a stable attractor state.

Attractors for Self-Evaluation.[2] To test whether individual variation in self-esteem is associated with differential self-evaluative attractor tenden-

[2]Johnson and Nowak (2002) used recently developed software (Nowak & Vallacher, 2002) to identify fixed-point attractors in time series data collected on bipolar depressive individuals. In principle, this software is applicable to the data generated by the mouse procedure employed in the preliminary research. Because of specific properties of mouse-generated data (e.g., vastly different ranges of mouse movements across participants), however, the method utilized by Johnson and Nowak (2002) requires specific refinements before it can be reliably applied to the data obtained in the preliminary research reported in the present article. Work currently in progress is addressed toward generalization of this method to diverse types of time-series data (Nowak, Vallacher, Tesser, & Voss, 2002).

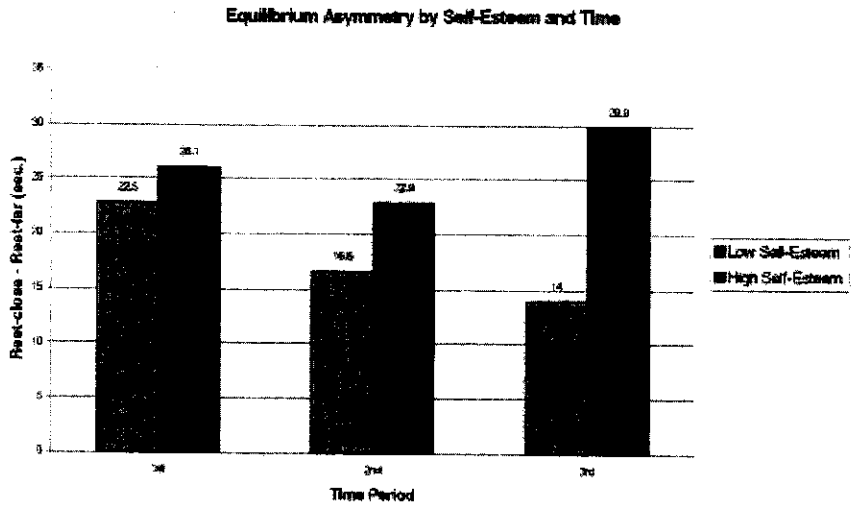

Figure 3. Equilibrium Asymmetry (Rest close-far) by Self-Esteem and Time

cies, correlations were computed between self-esteem and the rest time measures. For participants' self-narrative as a whole, self-esteem was reliably correlated with rest-close, $r(69) = .25$, $p < .05$, but not with rest-far, $r(69) = -.01$, *ns*. The association with rest-close was not reliable at the 1st time period, $r(69) = .16$, *ns*, achieved marginal reliability at the 2nd time period, $r(69) = .21$, $p < .08$, and became highly reliable during the 3rd time period, $r(69) = .30$, $p < .01$. We also computed correlations between self-esteem and the difference between rest-close and rest-far. For self-narratives as a whole, results revealed that the higher the self-esteem, the greater the difference in time spent at positive vs. negative attractor states (i.e., rest-close—rest-far), $r(69) = .27$, $p < .05$. This association was not reliable during the 1st and 2nd time periods, $r(69) = .08$ and .15, *ns*, respectively, but was highly reliable during the 3rd time period, $r(69) = .31$, $p < .01$. (Correlational analyses were also performed for self-certainty and self-stability. The results did not demonstrate reliable associations between these properties of the self and attractor tendencies.)

Figure 3 illustrates the relationship between self-esteem and convergence on differential self-evaluative attractor states. We performed ANOVAs comparing the difference between rest-close and rest-far for high and low self-esteem participants (based on the upper and lower 40% of self-esteem scores). High and low self-esteem participants did not reliably differ in the respective asymmetry of positive and negative attractors for the first two time periods, $F < 1$ in both cases. During the 3rd time period, however, high self-esteem participants displayed reliably greater asymmetry in positive vs. negative attractor tendencies, $F(1,55) = 6.18$, $p < .01$ (see Fig. 3). All participants demonstrated greater stability in momentary self-evaluation when their thoughts entered a region of self-structure corresponding to positive as opposed to negative self-evaluation, but over time this differential attractor tendency became greater for high than for low self-esteem participants.

Self-Evaluation Variability. To test whether the dynamics of self-structure can be described as a progression from regions of relatively low coherence to regions of relatively high coherence, we performed a prime *x* time period ANOVA on self-evaluation variability, with time period as the repeated measure. Results revealed only a reliable effect for time period, $F(1,66) = 4.88$, $p < .03$. Decomposition of this effect revealed that variability did not reliably differ between the 1st and 2nd time periods, $t(68) = -1.59$, *ns*, but that variability was reliably lower during the 3rd time period (M=60.3) than during the 2nd time periods (M=71.4), $t(68) = 2.21$, $p < .03$. In line with our rationale, then, participants' self-evaluation tendency converged over time on relatively coherent self-evaluative states.

Correlational analyses were also performed to assess whether uncertainty and/or instability in self-concept were associated with divergent self-evaluative states (i.e., high variability) in the course of self-reflection. Results revealed that higher self-certainty was associated with a narrower range of self-evaluation for participants' self-narrative as a whole, $r(69) = -.27$, $p < .05$, and for the 1st and 3rd time periods, $r(69) = -.27$ and $-.23$, $p < .05$ (for the 2nd time period, $r(69) = -.19$, $p < .10$). Results also revealed that higher self-stability was associated with a relatively narrow range of self-evaluation for the self-narrative as a whole, $r(69) = -.26$, $p < .05$, and for the 2nd time period, $r(69) = -.23$, $p < .05$ (for the 1st and 3rd time periods, $r(69) = -.14$ and $-.16$, *ns*). All participants displayed movement between different self-evaluative states in their stream of

thought narratives, but the difference between the most extreme positive and negative states was reliably greater for participants with conflicting or unstable assessments of themselves. (Although self-esteem was associated with momentary self-evaluation and attractor tendencies, this property of the self was not reliably correlated with variability in self-evaluation.)

Self-Evaluation Dynamism. We performed correlational analyses to assess whether uncertainty and/or instability in self-concept promoted rapid and erratic changes in self-evaluation during self-reflection. Results revealed that self-stability was reliably correlated with dynamism for the self-narrative as a whole, $r(69) = -.32$, $p < .01$, and for the 2nd time period of the narrative, $r(69) = -.35$, $p < .01$ (for the 1st and 3rd time periods, $r(69) = .01$, *ns*, and $-.20$, $p < 10$). Thus, participants who indicated that their feelings about themselves sometimes change from day to day were also more likely than their stable counterparts to demonstrate changes in self-evaluation on a considerably shorter time scale. Lacking a clear anchor for self-evaluation, unstable participants produce a stream of self-reflection that fails to converge on a stable attractor, but rather continually shifts among different self-evaluative states. Self-certainty was not associated with dynamism in these analyses, $r(69) < -.18$, *ns*, in all cases. (When the analyses were repeated with self-esteem substituted for self-stability, no reliable correlations were observed.)

Conclusions, Implications, and Future Iterations

The results of this preliminary research confirmed our general expectation that global properties of self-structure are meaningfully and systematically related to basic features of self-evaluative thought. Self-esteem, which represents global positivity in self-structure, shaped the evaluative tone of self-reflection, with higher levels of self-esteem promoting correspondingly positive self-relevant thoughts in subjects' self-reflection narratives. Self-certainty and self-stability, which reflect the coherence of self-structure, were manifest in the dynamic properties of self-reflection. Both uncertainty and instability were associated with heightened variability in self-evaluation, although at different points in participants' stream of self-reflective thought, whereas self-instability tended to promote rapid and erratic changes in self-evaluation over time.

The evaluative tone of participants' self-reflection was also affected by the priming of positive versus negative self-relevant information. Participants who were induced to recall past acts that reflected positively or negatively on themselves tended to express correspondingly valenced thoughts about themselves when subsequently asked to reflect on themselves. This effect, however, proved to be transitory, shaping self-reflective thought only during the early portions of participants' self-narratives. In contrast, the effect of self-esteem became stronger the longer participants reflected on themselves. This effect was observed not only for self-evaluation *per se* (i.e., less distance for higher self-esteem participants), but also for the relative time spent at positive versus negative attractor states. All participants tended to stabilize more on positive than on negative self-relevant thoughts, but by the end of participants' self-narratives, this asymmetry was reliably greater for those with higher levels of self-esteem. In terms of our theoretical rationale, the stream of self-reflection tended to converge on a self-evaluative state representing maximal coherence. For participants with high self-esteem, positive self-evaluation provided a coherent state and hence a stable attractor. For participants with low self-esteem, negative self-evaluation was relatively coherent and thus provided a relatively stable attractor that competed with their tendency to converge on positive self-evaluation.

The asymmetry in positive versus negative coherence has implications for people's response to external influence. When evaluatively inconsistent information (e.g., social feedback) enters a region with high coherence, it is likely to be undermined or changed in valence by the combined influence of other elements in that region (Nowak et al., 2000). If a person has an evaluatively consistent view of him or herself as a good parent, for example, the reminder that he or she forgot about a parent-teacher conference may have only a temporary effect on his or her self-image in this domain. As the person thinks about the event in the context of myriad sources of evidence painting a more flattering picture, the isolated incident diminishes in its relative impact and may even be reinterpreted in positive terms (e.g., a sign of how hard he or she works to maintain a quality life for his or her children). The same reasoning holds for a self-structure with coherent regions of negatively valenced elements. Inconsistent (i.e., positive) information about the self may have only a short-lived impact as the mutual influences among elements in the negative substructure reinforce one another and thereby diminish the impact of the new information. In short, a greater amount of evaluatively inconsistent information may be required to disrupt self-evaluation with respect to a coherent as opposed to an incoherent attractor state.

This reasoning resonates with contemporary research regarding self-concept and reactions to self-relevant feedback. The work on self-verification, for instance, has established that people tend to resist social feedback in a given domain that doesn't confirm their self-conception (cf. Swann, 1990). If people lack confidence in their self-view, however, they demonstrate

less resistance to inconsistent feedback and may embrace it as informative about themselves (e.g., Swann & Ely, 1984). In similar fashion, when people are induced to think about the specific elements comprising a region of self-structure rather than the region's global representation, they demonstrate vulnerability to social feedback regarding the purported implications of these elements for self-understanding (Wegner, Vallacher, Kiersted, & Dizadji, 1986). The research on threatened egotism, meanwhile, has shown that people with high self-esteem react defensively—even violently—when exposed to feedback that questions their self-image in domains about which they harbor private doubts (Baumeister, Smart, & Bowden, 1996).

Each of these empirical generalizations is consistent with the rationale concerning coherence and self-evaluation stability. Thus, for regions of self-structure that are experienced as certain, unitary, and free from doubt, inconsistent information is readily dismissed with little or no disruption to the person's predominant self-view. But for regions that are experienced as uncertain, fragmented, or otherwise open to interpretation, inconsistent information represents a threat and prompts either acceptance or highly defensive and active opposition. We recognize, of course, that the empirical generalizations described earlier were developed in the context of different assumptions and purported mechanisms. Hence, establishing that people's response to incoming information is mediated primarily by the relative coherence of the region of self-structure at issue constitutes an agenda for future empirical research.

Despite the press for evaluative coherence, people vary in the extent to which they develop strong attractors for self-evaluation. The lack of coherent self-evaluative states is likely to be experienced in phenomenal terms as uncertainty or instability in self-evaluation (e.g., Kernis, 1993; Vallacher, 1980). By this reasoning, uncertain people should be particularly vulnerable to social feedback regarding any region of their self-structure (e.g., Vallacher & Wegner, 1989). They may feel negative about themselves after an interaction with someone who is critical, for example, only to rebound to a positive view when subsequently exposed to a flattering assessment from someone else. Such malleability in response to social feedback is consistent with the absence of a single dominant attractor for self-evaluative thinking. In the absence of social feedback or other sources of incoming information, an uncertain person should demonstrate sustained dynamism in self-evaluation over time as conflicting elements are activated in the stream of thought. In contrast, the stream of self-reflection for a person with a high degree of self-concept certainty should display relatively little variability in self-evaluation over time, because the elements that achieve activation provide mutual support for one another and thus function as an attractor for self-reflective thought. In accord with this reasoning, uncertain and unstable participants in the preliminary research moved between relatively divergent self-evaluative states, none of which were sufficiently coherent to stabilize participants' assessments of themselves, and unstable participants did so in a relatively rapid and erratic manner.

The inability to stabilize on a coherent region of self-structure would seem to pose a serious challenge for self-regulation. As noted by Carver and Scheier (2002), self-regulation involves maintaining congruence between one's behavior and a desired state or goal. To the extent that regulatory goals reflect regions of self-structure (e.g., specific identities or self-images), self-regulation is facilitated by coherence in such regions. Lacking coherence, self-regulation with respect to these aspects of the self is likely to be erratic and to falter when obstacles to goal attainment are encountered. For individuals whose self-structure is largely devoid of coherent regions, then, action is likely to reflect momentary impulse, external influence, and opportunity rather than commitment, purpose, and other criteria of self-regulation. It remains for future research, of course, to subject this reasoning to empirical test (see, however, Johnson & Nowak, 2002).

Evaluation is not the only basis for organization in the self-system. Although everyone presumably experiences a press for evaluative integration in self-understanding (cf. Nowak et al., 2000), this press coexists with a tendency to integrate self-relevant information in terms of social roles, personal concerns and interests, and other aspects of content. Indeed, this basis for self-structure has been investigated empirically (e.g., Linville, 1985) and has been forwarded as an integrative principle that can outweigh the tendency to organize self-relevant information on the basis of evaluation (cf. Showers, 1992, 1995). When integrated in this fashion, a region of self-structure may consist of elements that are evaluatively incongruent and thus give rise to self-reflective thought that changes notably over time in valence.

Conceivably, uncertain or unstable participants in the preliminary research had self-structures that were organized in terms of content rather than evaluation. If so, their dynamism and lack of attractor tendencies with respect to evaluation may have masked temporal stability with respect to content-based self-understanding. An unstable person, for example, might focus on his or her academic qualities, exhausting the available self-relevant information in this domain—negative as well as positive—before moving on to another content-defined self-aspect. Of course, the fact that this person's sense of self is experienced as incoherent (i.e., uncertain or unstable) attests to the importance of achieving evaluative integration in self-structure. Nonetheless, the possibility that people with an uncertain or unstable self-concept demonstrate relative stability in terms of content

during self-reflection warrants further investigation. Research underway in our respective labs (United States and Poland) is intended to shed light on this issue.

The preliminary research emphasized fixed-point attractors for self-evaluation. The stream of self-reflective thought, however, may conform to temporal patterns other than convergence on a stable state. Indeed, the work on nonlinear dynamical systems has shown that a fixed-point attractor represents only one of several possible temporal patterns for many phenomena (cf. Schuster, 1984), including social psychological processes (cf. Arrow, McGrath, & Berdahl, 2000; Nowak & Vallacher, 1998). A system may display a sustained pattern of periodic evolution, for example, with a macro-level property of the system (e.g., evaluation in social judgment) moving between (among) two (or more) states in a regular or quasi-regular manner. These states effectively operate as "repellors" (Nowak, Lewenstein, & Tarkowski, 1994)—as the system approaches one of the states, it is repelled and moves toward another state, and so on, creating a periodic temporal pattern. A system's macro-level property can also display chaotic evolution, such that the system appears to move randomly and erratically among a variety of states. Far from being random, however, a chaotic attractor represents the (deterministic) interaction of system elements, often very few in number. We are currently developing software to identify and distinguish among fixed-point, periodic, and chaotic attractors in time-series data (Nowak & Vallacher, 2002). In subsequent iterations of the stream of self-reflection paradigm, this method will be used to provide insight into the various temporal trajectories of self-evaluation and their relation to self-structure.

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