

Chapter 3

Analyzing Small Groups

Program *GroupSimulator* simulates interactions in small groups, providing insights into, for example, what kinds of emotional dynamics arise during a family meal, or what kinds of behaviors occur during deliberations of a jury, or what patterns of domination arise in a group of criminals.

Like program *Interact*, program *GroupSimulator* uses affect control theory to predict behaviors, emotions, and tensions. (See the beginning of Chapter 2 for the key ideas in ACT.) However, *GroupSimulator* has capabilities that *Interact* lacks, like handling up to 25 interactants, deciding which interactant will take the next turn as actor, and tracking the development of social structure during group processes. On the other hand, *GroupSimulator* is less specific than *Interact* in characterizing behaviors and emotions, and *GroupSimulator* lacks the ability to switch interactants' identities during an analysis, or for interactants to have different definitions of the situation.

Getting *GroupSimulator*

You can run *GroupSimulator* as an applet within your Internet browser by going to this address:

<http://www.indiana.edu/~socpsy/ACT/SmallGroups/GroupSimulator.html>

After a few moments, you will see the display in Figure 3.1.

Above the display is an instruction, "Scroll down for information." Doing so takes you to a terse description of the program and provides hyperlinks for obtaining various materials.

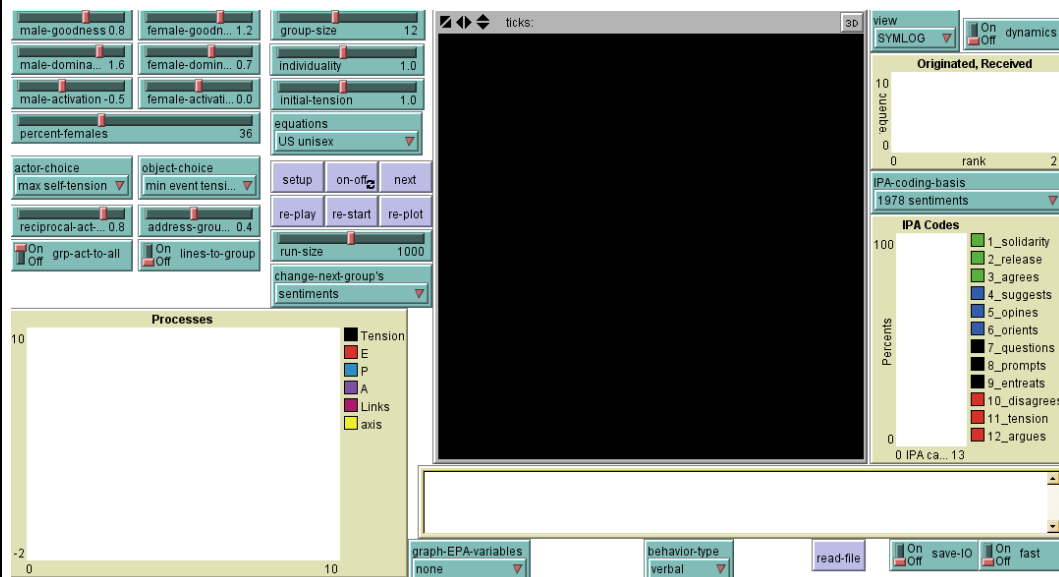


Figure 3.1. GroupSimulator's interface.

One hyperlink takes you to a directory where you can download a more complete version of *GroupSimulator* than the Java applet. Running the complete version of *GroupSimulator* requires NetLogo software, which you can get free of charge by clicking another hyperlink.

The first part of this chapter focuses on the applet version of *GroupSimulator*, and later sections discuss the added capabilities of the complete version. The applet works the same as the complete version, but the applet cannot read or save files, as the complete version does.

Interface Overview

As Figure 3.1 reveals, *GroupSimulator* has an intricate interface with many controls and output boxes. Groups of items will be discussed in sections below. Here we just consider the geography of the display.

The grey elements at the upper right comprise various controls for setting up different kinds of groups. Among them are widgets for setting the number of interactants in the group, the psychological characteristics of interactants, and constraints on how social interaction can occur.

Four kinds of widgets are used in the setup: sliders, choosers, switches, and buttons. You change a slider's value with your computer mouse, dragging the slider's tab along the slider scale until the desired number appears. In the case of a chooser (or drop-down menu), you click on the downward-pointing arrow, and

then highlight and click on the desired option in the panel that appears. In the case of a switch, you drag the tab to *on* or *off*. A button starts some process when you click it.

During analyses the large black box shows the **group space** with each individual represented by a cartoon face, plotted to show the Evaluation-Potency-Activity – EPA – position that the interactant has. Crude facial expressions indicate emotions that an interactant experiences during interaction. Lines emerge between interactants who frequently act toward one other, showing the evolution of the group’s interaction network. The drop-down menu and the switch at the top-right of the display control what is shown in the box.

A cluster of buttons halfway up the left side of the black box start and stop analyses in various ways. A slider below the buttons sets the maximum length of a group interaction, and a menu below the slider determines how one group is substituted for another.

The white and grey box at lower left displays temporal graphs of several variables. One variable charts how the tension of actors changes during group process. Another variable plots the growth of interpersonal links. The menu at the bottom-right of the box can be used to show EPA profiles for emotions, behaviors, or impressions.

The oblong white box at the bottom middle is used to print values of ACT variables and to describe actions that occur in the group. A menu below the box determines whether actions are verbal or physical. A button and two menus at the lower-right of the box relate to reading and writing files.

The right side of the display offers different perspectives on behaviors that occur during group interaction. The top-most box displays two bar charts during analyses, one indicating how often each group member initiates action, the other showing how often each member is object of an action. The middle box displays another bar chart showing how behaviors distribute into the categories of a system for coding group actions.

Note. If you are working with the full version of *GroupSimulator* rather than the applet then the program will appear with a window titled “Command Center” covering the bottom of *GroupSimulator*’s display. The Command Center is not needed when using *GroupSimulator*, so remove the Command Center by clicking its **Clear** button.

Defining Members

Figure 3.2 shows the sliders and drop-down menus that are used to define the composition of the group to be analyzed.

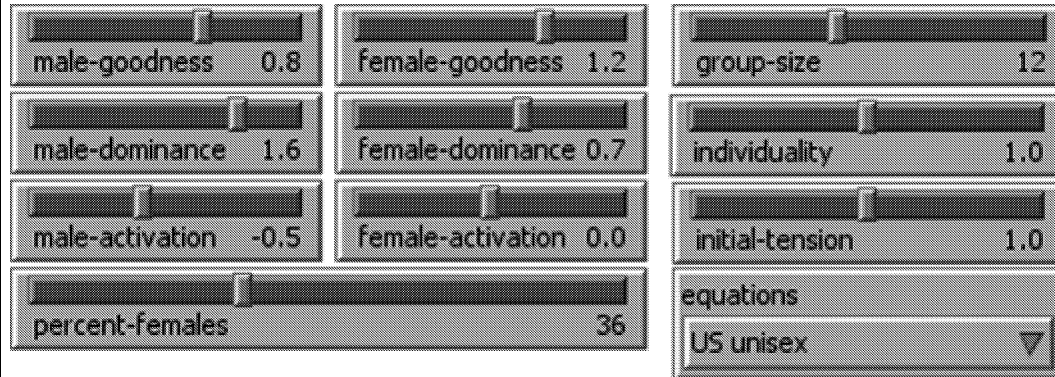


Figure 3.2. Elements for defining group members.

Group Size

You set number of group members with the slider that is labeled **group-size**. The lowest value on this slider is 3, and the largest value is 25. Thus, a triad is the smallest group you can analyze with *GroupSimulator*, and an aggregate of twenty-five is the largest.

A reasonable definition of a small group is:

A set of individuals committed to enacting one interpersonal action at a time, with anyone in the group being a possible actor, and with all individuals cognizant of each interpersonal action's affective and instrumental consequences.

By this definition, aggregates of twenty-five individuals usually do not constitute small groups because they divide into multiple foci of interaction. However, *GroupSimulator* allows for the possibility of 25-member groups in order to permit analyses of large assemblages in which the one-at-a-time principle is imposed, like classroom discussions.

Gender Composition

The nature of group members is specified in several stages. First you set the proportion of females versus males in the group. This is done with the slider labeled **percent-females**. The slider varies from zero percent, signifying no females are in

the group, to 100 percent, which signifies that the group consists entirely of females. The actual composition of the group rounds off to the nearest whole individual. For example, Figure 3.2 shows a specification of 36 percent females in a twelve-person group, so *GroupSimulator* implicitly sets the percentage to 33.3% and creates a group with four females and eight males.

The choice made with the **percent-females** slider divides group members into two sets that are displayed with different visages in the group diagram, and that can operate with different self-sentiments. It is worth noting that differences need not actually relate to gender. For example, *GroupSimulator* could be used to divide an all-female group into two sets of individuals that are confirming different self-sentiments. Doing so requires reading the word *male* in some controls as *set 1* and *female* as *set 2*, and tolerating set-one's male visages in the group diagram.

Self-Sentiments

Each of the sliders displayed at the upper left of Figure 3.2 allows you to choose a value from -3.0 to +3.0. You use these sliders to define the average EPA sentiments of male and female group members. The slider labeled **male-goodness** sets males' average self-evaluation, the one labeled **male-dominance** sets males' average self-potency, and the one labeled **male-activation** sets males' average self-activity. Similarly, the sliders labeled **female-goodness**, **female-dominance**, and **female-activation** set the average EPA values for females' self-sentiments. (Slider names may be truncated if space is lacking to print them in full.)

Affect control theory presumes that identities determine the self-sentiments that individuals adopt in a situation, but *GroupSimulator* is not equipped to define self-sentiments in terms of verbal identities. Instead use *Interact* to get EPA profiles for the verbally-defined identities of interest in your analysis, and then enter those numeric profiles with the sliders in *GroupSimulator*.

Individual Differences

The male and female EPA sliders set the expected values of male and female self-sentiments. The actual values for group members are obtained by drawing randomly from a multivariate normal population of self-sentiments, centered at the expected values. The slider named **individuality** sets the standard deviation of the multivariate normal population on each of the EPA dimensions.

For example, in Figure 3.2 the EPA sliders set the expected sentiment for females at 1.2 0.7 0.0; and the **individuality** slider sets the standard deviation on each dimension to 1.0. *GroupSimulator* then generates random collections of females clustered around the expected sentiment—different collections in different ana-

lyses. To illustrate, one analysis with the settings in Figure 3.2 had four females with EPA profiles of 3.2 1.4 -0.1; 1.7 -1.00 -0.1; 0.3 0.6 -1.1; and -0.1 2.1 0.6. The next analysis had females with EPA profiles of 1.28 1.97 1.83; 2.95 1.95 -0.4; 1.23 1.07 -0.38; and 2.32 -1.49 0.44.

In effect, random draws populate each group with individuals having various status characteristics and personality traits. That is, EPA sliders define the core identity being maintained, and the individuality slider defines the extent of variations in self-sentiments resulting from amalgamating statuses and traits with the identity. For instance, if the core identity is *co-worker*, then the random draws populate a group with such variations as a *middle-aged co-worker*, a *Black co-worker*, a *careless co-worker*, a *quarrelsome co-worker*, and a *hardworking co-worker*.

GroupSimulator operates on the assumption that group members are cognizant of their own self-sentiments, and of others' too, soon after group process begins. Following affect control theory it further is assumed that all act to maintain their own and others' identities as much as possible. So, if someone adopts the identity of a *middle-aged co-worker* then she tries to maintain the corresponding self-sentiment within the group situation, and others—who infer her identity from her appearance, her behavior and her self-references—also act to maintain her self-sentiment.

An individuality of 1.0 is a good choice because that is approximately the standard deviation obtained when amalgamating all traits in an *Interact* dictionary with an identity. However, you can set individuality to zero, in which case all individuals maintain exactly the same self-sentiment. A zero setting might be useful in analyzing intergroup relations, with “males” treated as group 1 and “females” as group 2, and each group maintaining its group identity. Individuality also can be set as high as 2.0.

Initial Tensions

GroupSimulator presumes that as individuals gather together, they manifest various emotional states, such as *relaxed*, *gleeful*, *sentimental*, *cheerless*, *irate*, or *anxious*. The emotions derive from temporary self-impressions in combination with the individuals' situational self-sentiments. The **initial-tension** slider determines the extent to which initial impressions differ from self-sentiments and thereby create a variety of emotional states.

The **initial-tension** slider sets standard deviations on EPA dimensions, just as the **individuality** slider does. However, in the case of initial tensions, each multinormal distribution is centered on an individual's self-sentiment, and the random draw defines the EPA profile of the individual's initial impression, somewhere around that self-sentiment.

A value of 1.0 on the **initial-tension** slider generates impression states corresponding to typical emotions, since 1.0 is approximately the standard deviation obtained when amalgamating all emotions in an *Interact* dictionary with an identity. However, you can set the value as high as 2.0. You also can set the value to zero, in which case individuals start interacting with self-impressions exactly equal to self-sentiments.

The setting on the **initial-tension** slider affects group processes only for a short while, until members' impressions about themselves and others change from participating in social interaction.

Impression Dynamics

The **equations** drop-down menu allows you to select a set of equations for transforming pre-event impressions about interactants into post-event impressions, and for computing the EPA profile of an actor's ideal behavior. The selection you make also sets equations determining how an interactant's emotion EPA profile is computed from the interactant's self-sentiment and current self-impression. *GroupSimulator* uses Actor-Behavior-Object equations to compute changes in impressions about the actor and object of an action, and Emotion-Identity equations to compute emotion EPAs. The Emotion-Identity equations used in *GroupSimulator* average coefficients based on male data and female data.

The first three options—*US unisex*, *US male*, and *US female*—specify equations based on data collected from American college students in 1978. The “unisex” equations average male and female coefficients.

The next three options—*Canadian unisex*, *Canadian male*, and *Canadian female*—designate equations based on 1985 data from Canadian college students. Again, the “unisex” equations average male and female coefficients.

German unisex equations are based on combined male and female data from Germans on the Internet.

Selecting *random acts* on the **equations** menu obtains behavior EPAs by random draws from a multivariate normal distribution centered at an EPA of 0 0 0, with standard deviations as specified on the **initial-tension** slider.

Selecting *identity echoes* obtains behavior EPAs by random draws from a multivariate normal distribution centered at the actor's self-sentiment EPA, with standard deviations as specified on the **initial-tension** slider.

The *one individual* option selects equations that were derived from data provided by a single respondent.

GroupSimulator does not switch between male and female equations depending on the gender of the actor, as *Interact* does. However, you can run a sample of analyses with male equations and then with female equations to see if there is any significant gender effect from equations.

Defining Interpersonal Processes

Small group interaction requires one-at-a-time turn-taking (with over-lapping actions being quickly resolved when they do occur), but how are the interpersonal actions constructed?

GroupSimulator applies affect control theory to determine what behavior a given actor will enact toward a given object. The selected behavior – defined in terms of an EPA profile – is the one that transforms current impressions about the actor and object into new impressions that are as close as possible to the self-sentiments of actor and object.

However, affect control theory has not specified who will act and who will be recipient in the next event. Uncertainty about initiator and recipient is problematic even in a dyad where there are only two possibilities. However, perplexity abounds in a small group where any of multiple individuals might initiate the next action, and any other individual, or even the group as a whole, might be the recipient of an actor's behavior. Consequently, a number of *GroupSimulator* controls are oriented toward selecting actors and objects of action.

Figure 3.3 shows controls used to define interpersonal selections in the group.

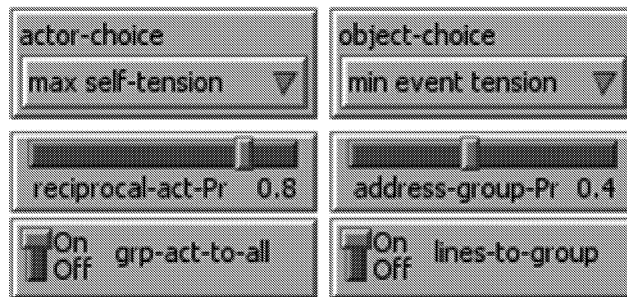


Figure 3.3. Elements for defining how actions are formed.

Who's Next?

Since allocation of the next turn is poorly understood outside of conversational routines like question-answer sequences, *GroupSimulator* offers several different bases for choosing an actor when the choice is open. In particular, the **actor-**

choice drop-down menu offers five basic approaches to selecting the next actor (though one of the five approaches has 26 options, so the panel has many more than five rows).

Min event tension

First in the list is *min event tension* (minimum event tension). This criterion allocates the privilege of acting next to the individual whose action can confirm actor and object self-sentiments, along with the behavior sentiment, better than anyone else’s action. The social psychological interpretation is that humans favor events corroborating their understandings of the world, so they prefer that the next event is the one that best validates the affective meanings of interactants and their behaviors. The individual who can obtain the best validation of meanings is the preferred next actor.

Here is an example to illustrate how the criterion works. (The example was constructed with *Interact* using Indiana 2002-4 sentiments averaged across males and females, and using U.S.A. 1978 ABO equations with coefficients averaged across gender.) Suppose that a son, father, and mother are together, and the son insults the father—an action that creates a great deal of tension (deflection = 17.6). To apply the *min event tension* criterion, we have to examine every possible next action and choose as actor the group member who can achieve the lowest outcome tension (deflection) in one of her or his actions. Table 3.1 shows the ideal behaviors for all actions, defined in terms of computed EPA profiles, along with the deflections generated by the ideal actions, after the son insults father.

Table 3.1. Ideal Actions Following “Son insults father”

Actor	Object	Ideal Behavior EPA	Deflection
Father	Mother	3.6 3.3 1.2	3.9
	Son	2.0 3.2 0.6	15.9
Mother	Father	4.3 1.7 1.0	9.5
	Son	2.2 2.1 0.9	11.3
Son	Father	4.0 -0.4 0.6	14.0
	Mother	3.8 0.5 1.2	6.2

The topmost action results in the lowest overall tension. So father will be the next actor according to the *min event tension* criterion.

The object of action is set at the same time as the optimal actor is chosen with the *min event tension* criterion. The object might be the whole group if the **address-group-Pr** slider is set above zero (the slider is discussed below). Otherwise the object is chosen using the *min event tension* criterion for objects (the **object-choice** menu is changed automatically to reflect this). Thus, the next action in the exam-

ple will be the father doing something extremely good, potent, and active toward the mother, such as "Father helps mother."

Since the *min event tension* criterion has to consider every possible outcome event in order to determine who will be the next actor, it is computationally burdensome in large groups. *GroupSimulator* slows down noticeably in such analyses. For the same reason the criterion is psychologically burdensome for individuals in large groups, raising a question about whether it actually is a realistic possibility in such cases. For example, in a group of eight individuals, each group member has to weigh the results of 56 different actions in order to decide who should act next.

Min self-tension

The minimum self-tension criterion selects as next actor the individual for whom self-impression is closest to self-sentiment (i.e., the one with lowest identity deflection). A theoretical justification for the criterion might be that group members yield to the individual who is least tense about self and thereby most able to make group contributions coolly and selflessly.

Returning to the son-father-mother example to illustrate this criterion, we have the following identity deflections right after the son insults the father.

Father deflection = 8.2
Mother deflection = 0
Son deflection = 8.7

The analysis started with everyone's self-impressions being the same as self-sentiments, and, since mother wasn't involved in the son-father action, her self-deflection remains at zero. Since mother's self-tension is lowest, she will be the next actor according to the *min self-tension* criterion.

Actually, *GroupSimulator* starts group members off with some random amount of self-deflection, as controlled by the **initial-tension** slider. So mother probably would not have a zero self-deflection in a *GroupSimulator* analysis. For instance, her self-impressions might be one unit away from her self-sentiment on all three EPA dimensions, giving her a fairly large self-deflection of 3.0. That would eliminate her as actor after some ordinary events. However, after the son insults father, mother is less stressed than either father or son, even with her self-tension of 3.0, so she would be the next actor according to the *min self-tension* criterion.

Max self-tension

With the maximum self-tension criterion, group members yield to the individual who is experiencing most personal tension. That is, the individual whose self-

impression most deviates from self-sentiment is the one who obtains the next opportunity for action. Social psychologically, the maximum personal stress criterion corresponds to the notion that action is a resource for reducing tension, and the individual in a group who most needs this resource seizes the moment, while others perceive that person's predicament and yield the floor. From a group standpoint, this corresponds to a strategy of controlling maximum tension within the group, not letting any member get so stressed out that she or he seems meaningless in the situation.

Again returning to the son-father-mother example, the self-deflections after son insults father are:

Father deflection = 8.2
 Mother deflection = 0
 Son deflection = 8.7

According to the *max self-tension* criterion, son will be the next actor because his self-tension is greatest.

Random

After each event, *GroupSimulator* determines whether a reciprocal interaction sequence is in progress (as described in the section below on the **reciprocal-act-Pr** slider). If not, *GroupSimulator* creates a list of potential actors for the next event.

The *random* criterion for actor selection assigns each potential actor an equal probability of selection, and randomly draws one of the potential actors to be the next actor. No personal characteristics enter into the selection.

Table 3.2. SYMLOG Value Directions

<i>Positive Evaluation</i>			
	<i>Low Activity</i>	<i>Medium Activity</i>	<i>High Activity</i>
<i>High Potency</i>	PF: love, tenderness, sympathy, affection	UPF: progress, authority, unanimity, orthodoxy	UP: popularity, cooperation, friendliness
<i>Medium Potency</i>	DPF: equality, conformity, love, religion	P: democracy, equality, friendliness; autonomy	UPB: relativism, permissive, equality, nurturance
<i>Low Potency</i>	DP: equality, trust in human goodness	DPB: underdogs (like the poor), anti-establishmentarianism	PB: trust, appreciating others
<i>Medium Evaluation</i>			
	<i>Low Activity</i>	<i>Medium Activity</i>	<i>High Activity</i>

<i>High Potency</i>	F: supernatural, immortality, religion, anti-science	UF: cooperation, loyalty, harmony	U: money, power, success, competition
<i>Medium Potency</i>	DF: contemplation, reverie, moderation	Ambivalence, uncertainty	UB: relativism, situational ethics, acting out
<i>Low Potency</i>	D: mind control, asceticism, mysticism	DB: martyrdom, superficial expressiveness, gratification	B: expressiveness, gratification, anti-religion, anti-establishment
<i>Negative Evaluation</i>			
	<i>Low Activity</i>	<i>Medium Activity</i>	<i>High Activity</i>
<i>High Potency</i>	NF: conscience, moderation, restraint	UNF: inhibition, discipline, purity	UN: determination, struggle, adventure, danger
<i>Medium Potency</i>	DNF: suffering, sacrifice, the everlasting, morality	N: independence, privacy, detachment, rationality	UNB: sensuality, action, change, nonconformity, self-reliance
<i>Low Potency</i>	DN: homeliness, aloofness, anti-materialism	DNB: simplicity, roughness, self-sufficiency	NB: conservatism, non-cooperative, cynicism, isolation

Value Directions

The final method of selecting an actor for the next event uses value directions¹ as briefly described in Table 3.2. The values constitute directional bearings in a three-dimensional space where the axes are named:

Positive-Negative (P-N). This is the same thing as Evaluation in the EPA system.

Forward-Backward (F-B). This is a rotation of Potency and Activity in the EPA system, and corresponds to P+A- versus P-A+.

Up-Down (U-D). This is a rotation of Potency and Activity in the EPA system, and corresponds to P+A+ versus P-A-.

¹ The descriptions of the value directions in Table 3.1 were compiled loosely from two books by Robert Freed Bales—*Personality and Interpersonal Behavior* (New York: Holt, Rinehart and Winston, 1970); *Interaction Systems: Theory and Measurement* (New York: Transaction, 1999)—and from a book he published with Stephen P. Cohen—*SYMLOG: A System for the Multiple Level Observation of Groups* (New York: Free Press, 1979).

The general idea is that every group has some sort of *raison d'être*, and its warrant can be described in general terms as a value direction. For example, many groups in the business world are focused on “money, power, success, competition” – direction *U* in Table 3.2. Groups in more bureaucratically oriented organizations may be focused on “cooperation, loyalty, harmony” – direction *UF* in Table 3.2.

GroupSimulator uses value directions to allocate the next turn by selecting the group member whose personal state currently is most in the group’s value direction. A social psychological justification is that this individual seems most tuned to the group’s overall objectives at the moment, and so other group members yield initiative to that individual.

Consider again the son-father-mother example to see how the value-directions criterion works. Plausibly, a family unit is supposed to advance the *PF* value direction – “love, tenderness, sympathy, affection.”

In EPA terms, *PF* values are good, potent, and quiet. A point that is three units away from the middle of EPA space in the *PF* direction has EPA coordinates of 1.73 1.73 -1.73.

To determine who the next actor will be, we have to measure how far each interactant’s transient impression is in the *PF* direction. The required measurement is obtained by multiplying the *PF* coordinates times the coordinates of an interactant’s transient impression, and summing the values for all three EPA dimensions.

After the son insults father, the three interactants have the following EPA impressions about themselves.

Father: 1.07 0.45 0.56
 Mother: 2.80 2.47 1.30
 Son: -0.89 0.87 1.72

Multiplying the corresponding numbers with the *PF* coordinates and summing gives:

Father: 1.66
 Mother: 6.87
 Son: -3.01

The son is in the opposite direction from where he should be to contribute in a family spirit, so he does not get an opportunity to act next. The father is somewhat in the right direction, notwithstanding the damage done to his self-impression by the son’s insult. However, the mother who remained unsullied by

the prior action is most in the *PF* direction, so she will be the one to act next according to the value-direction criterion.

Using the value-direction criterion in a *GroupSimulator* analysis requires identifying the appropriate value direction for the group being considered. Sociological studies of groups usually explicitly or implicitly communicate groups' guiding values well enough to find a match in Table 3.1 and to select the appropriate option in the **actor-choice** drop-down menu.

Reciprocation

Conversation analysts commonly find reciprocation in discourse, with actor and object roles passing back and forth between two individuals, other group members being excluded from participation for a while. Such interchanges occur in question-answer sequences, and in various kinds of more complex conversational structures. A back-and-forth exchange can extend through numerous events, especially when two individuals are in conflict over some issue.

The **address-group-Pr** slider sets the probability that actor and object of the last dyadic action simply reverse on the next event. Setting this probability at a high value like 0.8 increases the likelihood of substantial stretches of reciprocal interaction, such as occur in a conflictual group. Setting it at a low level like 0.2 generally will yield some short exchanges, as in questioning and answering. Setting the probability to zero eliminates forced reciprocation, though some reciprocal interchanges still might occur through regular processes of actor selection.

Reversal of actor and object from the last event is decided at random when beginning actor selection, before considering the criterion specified with the **actor-choice** drop-down menu. Actor-object reversal is forgone if the whole group was the object of the last action.

Who's the Recipient?

Little is known about who is targeted for action when the situation is free of ongoing conversational routines or reciprocal exchanges. *GroupSimulator* provides a variety of criteria for choosing an object of action, including all of the same criteria used in selecting actors, plus two forms of homophily wherein actors select as objects of their actions individuals who are most like themselves in some regard.

The whole group might be a possible target in which case its suitability as a target of action is assessed along with the suitability of each individual group member. That is, *GroupSimulator* considers potential objects as all the group members other than the actor plus possibly the group as a whole.

Group Simulator does not implement self-directed actions, so the self is not among an actor's potential targets.

Min event tension

The minimum event tension criterion selects as object a group member with whom one can produce the event that best confirms the sentiments associated with the actor's self-identity, the object person's self-identity, and the behavior.

In particular, taking each potential target in turn, the optimal behavior EPA is computed for an action with the given actor and the test object, and the deflection from implementing the action is computed. The potential target with the lowest deflection is selected as object for the next action.

Deflections after the optimal event for each possible actor in the "son insults father" example are shown in the last column of Table 3.1. The selected object person is the individual who yields the lowest deflection for a given actor. Therefore, if father is actor he will direct his behavior toward mother; if mother is actor she will direct her behavior toward father; and if son is actor he will direct his behavior toward mother.

Min alter tension

The criterion of minimum alter tension selects as recipient of the actor's forthcoming behavior the group member whose self-sentiment currently is most confirmed. A possible interpretation is that the actor prefers to act on the one that is best anchored affectively in order to minimize aberrant reactions.

Continuing with the father-mother-son example, identity deflections right after the son insults the father are as follows.

Father deflection = 8.2
Mother deflection = 0
Son deflection = 8.7

Consequently, by the criterion of minimum alter tension, mother will be the object of action if either the father or son is actor, and father will be the object of action if mother is actor.

Max alter tension

With the maximum alter tension criterion, the one whose self-sentiment currently is least confirmed is selected as recipient of behavior. A possible social psychological explanation is that the actor seeks to use the forthcoming action altruistically to help reduce other's tension, as well as to affirm the actor's self-sentiment.

In the example, this criterion leads to selecting the son as object if either mother or father is actor, and to the son selecting father as the object of action.

Emotion similarity

Individuals may prefer to interact with others whose emotional states are similar to the actor's. A happy person prefers to interact with others who are happy, not depressed; an angry person might prefer engaging another who is angry rather than deal with someone who is calm and serene. The *emotion similarity* criterion implements this idea, selecting as object the other whose emotion EPA is most similar to the actor's emotion EPA.

For example, after the son insults father each individual has the following emotions.

Father: -0.42 -1.66 0.27 (nervous)
 Mother: 2.70 2.51 1.16 (satisfied)
 Son: -1.68 -0.49 1.24 (angry)

Note that the mother was not involved in the insult, so she retains the characteristic emotion for her identity. Now computing the distance between emotion profiles yields the following values.

Father-Mother emotional distance: 5.28
 Father-Son emotional distance: 1.97
 Mother-Son emotional distance: 5.31

Thus by the emotion similarity criterion, father or son will choose the other as object of action if either of them is actor. If the mother is actor, she will choose father, though the preference of father over son is meager for her.

Similar self-EPA

A standard sociological idea is that individuals prefer interacting with others of similar social station. An interpretation of this idea in the framework of *GroupSimulator* is that actors choose objects who are most similar to themselves in self-sentiment, self-sentiments being *GroupSimulator's* basis for differentiating and positioning members within the group.

In the example, the self-sentiments of the three characters are as follows.

Father: 2.71 2.71 1.15
 Mother: 2.80 2.47 1.30
 Son: 1.95 1.66 1.89

Computing distances yields the following values.

Father-Mother self-identity distance: 0.30
 Father-Son self-identity distance: 1.45
 Mother-Son self-identity distance: 1.31

Thus father and mother always choose the other as recipients of their actions, while the son chooses mother.

This criterion imposes constancy in object choice. For instance, the criterion requires that father and son never choose the other as recipient of action while they are in the father and son roles, unless mother is absent. *GroupSimulator* analyses might be able to reveal whether such a constancy is unrealistic.

Random

The *random* criterion for object selection assigns each potential object an equal probability of selection, and draws one randomly to be the object of the next action.

Value Directions

The value directions described in Table 3.2 can be used to select the object of the next action, in the same way as they can be used to select actors. That is, a preferred direction for objects is chosen for the analysis – *U, UP, UPF, UF, UNF, UN, UNB, UB, UPB, P, PF, F, NF, N, NB, B, PB, DP, DPF, DF, DNF, DN, DNB, DB, DPB, or D*. Then this direction is used to select an object for the next event by determining how far the transient impression associated with each potential object projects in the chosen direction, and choosing the one whose projection is greatest.

Repeating the actor calculations done above in the family example, now to choose an object in the *PF* direction, we start with the EPA impressions about self of each interactant, after the son insults father.

Father: 1.07 0.45 0.56
 Mother: 2.80 2.47 1.30
 Son: -0.89 0.87 1.72

The projections of these profiles in the *PF* “family” direction are:

Father: 1.66
 Mother: 6.87
 Son: -3.01

Thus if individuals are choosing the individual who most conveys a family spirit, then after the son’s insult, father or son will direct his action at mother, and were mother the actor she would select father.

Addressing the Group

The **address-group-Pr** slider can be used to ensure that actors will direct some of their actions to the group as a whole rather than to specific individuals. The slider's scale ranges from -0.1 to 1.0.

Selecting -0.1 removes the whole group as a possible object of action in an analysis.

Slider values of 0.0 to 1.0 add a whole-group entity to the possible objects of action, this entity being represented in the **group space** as a blue face. The whole-group's EPA sentiment is computed as the average of the EPA sentiments of all individuals in the group. The current impression associated with the whole group equals the whole-group sentiment initially, but the impression of the group changes as different actors direct different actions toward the group as a whole. The state of the current impression relative to the sentiment is cued visually by changes in expression on the blue face.

A slider value of 0.4 assures that about forty percent of actions are directed to the whole group rather than to individuals. This is about the same as has been found in task-oriented groups.

Setting the slider to 0.0 stops forcing the whole group as an object of action. However, group-directed actions still can occur when the group entity is the most attractive object for an actor's behavior.

Setting the slider to 1.0 eliminates dyadic interaction in the group. In this case actors direct all of their actions to the group as a whole.

Distributing Actions toward Group

When incorporated into analyses, the group as a whole is an object with an associated sentiment and a current impression. The group as a whole cannot produce actions, but actions can be directed toward the whole group.

Acting toward the group as a whole changes the current impression of the actor and the current impression of the group. The **group-act-to-all** switch determines whether an action toward the whole group has additional effects.

Changes in impressions of the actor and group construct are all that happens when the switch is in the *off* position. In this case, the whole group is simply a possible object of action, and actions on that object have no entailments for group members other than the actor.

When the switch is in the *on* position, actions toward the whole group change impressions of the group construct, and additionally change impressions of all group members—not just the actor. The action is performed on the whole group object and on every individual besides the actor.

For example, suppose a neighborhood group consists of Tom, Joe, Mary, and Jean, and the four are together for a discussion. After a while Tom reprimands the group on some moral issue—e.g., he says, “It would be wrong for us to do that.” The reprimand changes everyone’s impression of Tom and of the neighborhood group. With the **group-act-to-all** switch in the *off* position that is all that happens in *GroupSimulator*. However, if the **group-act-to-all** switch is in the *on* position, then impressions of Joe, Mary, and Jean also change as a consequence of the entailed actions: Tom reprimands Joe, Tom reprimands Mary, and Tom reprimands Jean.

Showing Actions toward Group

The **lines-to-group** switch has no effect on interactions, but this switch does affect how cumulative actions toward the group are displayed on the group-space chart.

When the **lines-to-group** switch is in the *off* position, no lines are drawn between group members’ faces and the group avatar. When the switch is in the *on* position, a line links an individual face to the group avatar if that group member has acted towards the group as a whole.

The *off* option may be desirable if you are interested in how a network of ties between individuals develops from interactions in a group. In that case, lines to the group avatar constitute unwanted clutter. The *on* position is desirable if you want an indicator of who in the group is addressing the group as a whole.

Starting and Stopping

Now we turn to the process of creating an operating group of agents, and starting their interaction with one another.

Setup

Clicking the **setup** button creates a new group of agents.

- The size of the group is as specified on the **group-size** slider.
- The gender composition of the group is as specified on the **percent-females** slider.

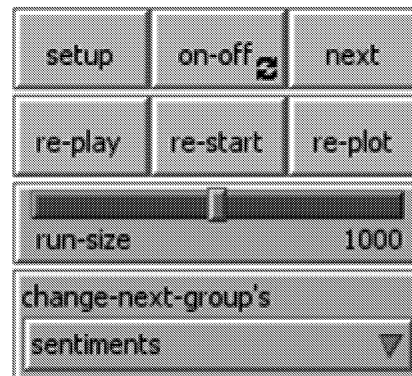


Figure 3.4. Elements for starting and stopping actions.

Figure 3.4 shows the relevant controls for this part of an analysis.

- Males' self-sentiments are centered on the EPA profile specified by the male goodness, dominance, and activation sliders, with the random variability of the male profiles determined by the **individuality** slider.
- Females' self-sentiments are centered on the EPA profile specified by the female goodness, dominance, and activation sliders, with the random variability being determined by the **individuality** slider.
- The agents have initial transient impressions centered on their self-sentiments, with the random variability being determined by the **initial-tension** slider.
- All agents are able to select optimal behaviors and generate impressions from events on the basis specified by the **equations** drop-down menu.

Clicking the **setup** button also produces two visual outcomes. First, any results from a prior analysis are erased. Second, the group is charted in the **group space**, as discussed below.

On-off, Next

Clicking either the **on-off** or the **next** button initiates interaction in the group. A *ticks* counter at the top of the group space graphic display (shown in Figure 3.5) shows how many events have occurred since the last setup or restart.

If you start with the **on-off** button, actions are generated continuously until you stop the process by clicking the **on-off** button again. You can slow down or speed up the process with the **speed slider** above the group space graphic display.

If you click the **next** button, a single action is generated and then the process stops, giving you a chance to examine that action and its consequences.

Each action involves the following.

- An actor is selected under the constraints discussed above in the “Who’s Next” section.
- An object is selected under the constraints discussed in the “Who’s the Recipient” section above.
- An optimal behavior EPA is computed from the self-sentiments and pre-event transient impressions of the actor and object. The solution is obtained with the equations specified in the **equations** drop-down menu.
- The actor-behavior-object action is performed by computing post-event impressions for the actor and object, again using the equations in the **equations** drop-down menu, this time applied to the actor and object’s pre-event impressions and the EPA profile of the optimal behavior.
- Emotions of group members are computed from their current impressions and self-sentiments, using amalgamation equations specified in the **equations** drop-down menu.

Re-play, Re-start, Setup

Clicking the **re-play**, **re-start**, or **setup** button while you are conducting an analysis of a group starts a new analysis. The group in the new analysis always will be the same size and have the same ratio of males to females as the previous group (if you do not change settings). Other characteristics of the group depend on which button you click.

Clicking the **re-play** button clears old results and sets up another analysis with agents having exactly the same self-sentiments and the same initial self-impressions as in the prior setup. Any random selections made by the program during interaction will be identical to those made in the prior analysis.

Clicking the **re-start** button clears old results and sets up another analysis with agents having exactly the same self-sentiments as in the prior setup, but not the same initial self-impressions. Random selections made by the program during interaction may vary from those in the prior analysis.

Clicking the **setup** button sets up another analysis with an entirely new group, created as discussed in the “Setup” section above.

Re-plot

Clicking the **re-plot** button re-draws the **group space**. Use this function if you change a control that might influence how the space looks. (See the “Different Views” section below.)

Multiple Automatic Analyses

The **run-size** slider determines how many events will be performed before quitting the analysis and starting a new analysis. The drop-down menu titled **change-next-group's** determines what kinds of changes in the group are made for the next analysis.

The **run-size** slider can be set to values of 50 to 2,000, at intervals of 50. Observations of actual groups indicate that about 1,000 actions occur per hour (somewhat more if monologues are partitioned into multiple actions). Thus you can set automatic group interactions to run a brief three minutes or as long as two hours, approximately. These are virtual times—interactions proceed much faster in *GroupSimulator* than in real life.

Setting the **run-size** slider to zero causes automatic actions to run without limit, until the **on-off** button is clicked a second time.

The **change-next-group's** menu has three options: *randomization*, *starting impressions*, and *sentiments*.

The *randomization* option causes new groups to form with the same self-sentiments and starting impressions for members, changing nothing except the sequence of random breaks for actions toward the whole group and for reciprocal exchanges. (If **reciprocal-acts-Pr** is zero and **address-group-Pr** is zero or -1 then results for the next group are identical to results for the last group with this option.)

The *starting impressions* option amounts to an automatic press of the **re-start** button. The new group has the same self-sentiments as the last group, but starting impressions and random breaks are different.

The *sentiments* option amounts to an automatic press of the **setup** button. The new group has members with different self-sentiments than in the last group, randomly centered on the EPA values specified with the male and female self-sentiment sliders. Initial self-impressions and random breaks are different, too.

The *sentiments* option works differently if the group was input from a file. In this case the group's new self-sentiments are randomly centered on the

original self-sentiments that were read from the file. The **individuality** slider determines how different the new sentiments will be.

These two controls mainly are of concern when saving outcome data from analyses of multiple groups for later statistical analysis (as discussed below in the “Files” section). For example, you can specify a particular kind of group as discussed above in the “Defining Members” section, then collect data on, say, 500 such groups by clicking the **on-off** button. Automatic actions in each group will terminate when the number of actions reaches the limit specified on the **run-size** slider. Then a new group will be formed following the specification on the drop-down menu, and that group will be started into automatic actions, without your intervention.

Output

As interaction proceeds in a group, *GroupSimulator* provides information about each action and its emotional consequences, about cumulative distributions of actions in various categories, and about the growth of interpersonal networks. The various outputs are presented in the group space graphic display, a line graph, two bar charts, and a text box.

Group Space

The most salient component of *GroupSimulator's* interface displays cartoon images of each group member on a black field, as shown in Figure 3.5. Males have orange faces and short hair, females pink faces and long hair. (*GroupSimulator's* colors are only partially conveyed in the grey-scale illustrations appearing in this document.) The graphic is a view of the three-dimensional group space from one or another perspective (as discussed in the “Different Views” section below).

The group shown in Figure 3.5 is an instance of innumerable groups that can be obtained with the settings shown in Figure 3.2—eight males centered on an EPA profile of 0.8 1.6 -0.5, and four females centered on an EPA profile of 1.2 0.7 0.0, with individual differences determined by an individuality setting of 1.0.

The emotional expressions on the faces in Figure 3.5 arise from members having various initial self-impressions, determined by an initial-tensions setting of 1.0. *GroupSimulator* has just eight emotion caricatures plus a neutral face, so it often displays emotions in exaggerated form.

Each face is positioned so as to suggest the group member's stable EPA sentiment in the group space. Alternatively, you can plot members' self-impressions (see the “Dynamics” section below).

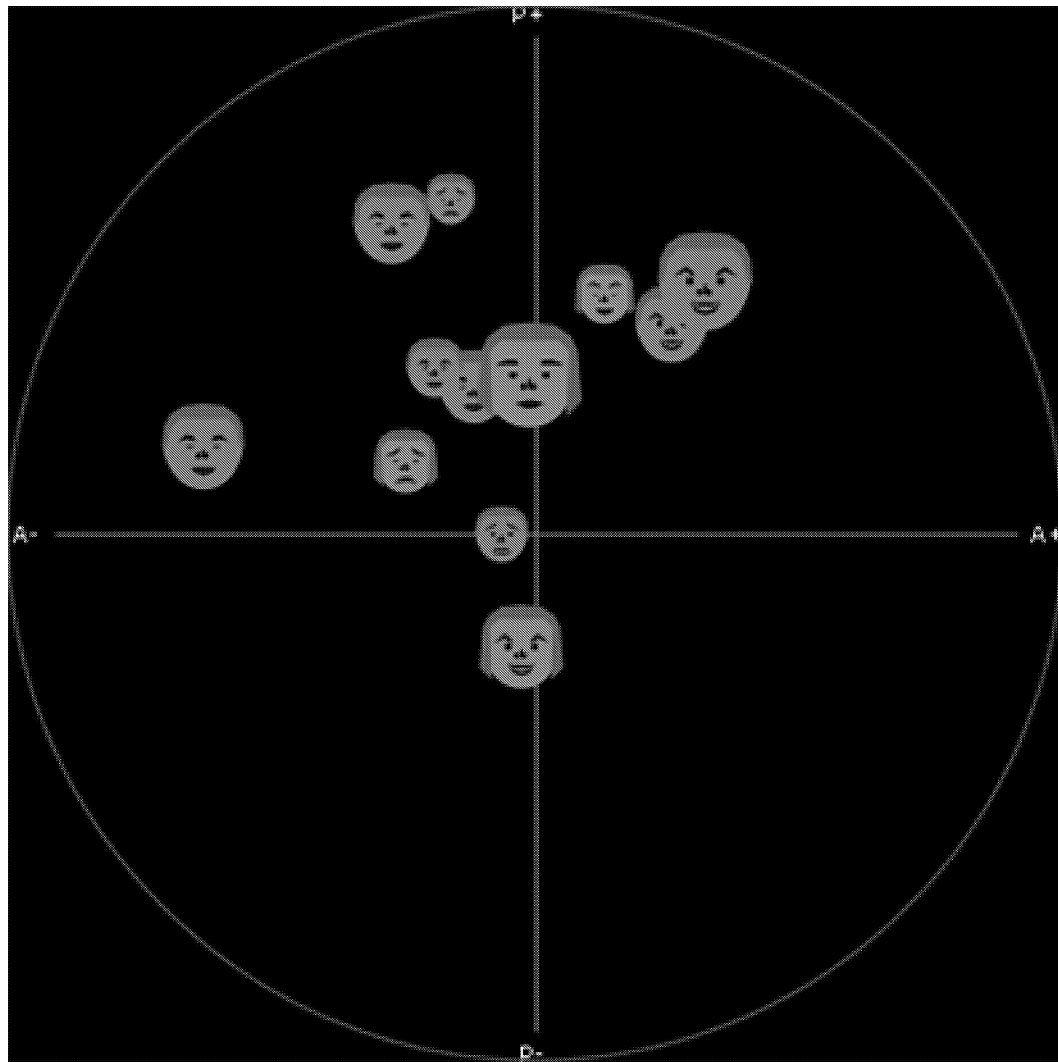


Figure 3.5. The Group Space populated by some members.

Figure 3.5 has Potency for the vertical axis, as indicated by $P+$ at the top and $P-$ at the bottom. The horizontal axis in this graph is Activity, as indicated by $A-$ on the left and $A+$ on the right. The distance from the center of the graph to its outermost points (indicated by the circle enclosing the group) is 4.5 EPA units.

Thus, for example, the male at the upper left is nearly halfway out with respect to positive Potency, and also about halfway out with respect to negative Activity. Roughly speaking, then, the sentiment for this agent has a Potency value of $4.5/2 = 2.25$, and an Activity value of $-4.5/2 = -2.25$.

The third dimension—Evaluation in this case—is represented by the size of faces, with positive values indicated by bigger faces and negative values by smaller faces. Numerical values on the third dimension cannot be estimated from the graph, but the male at upper left is one of the larger images, so we can infer that he is more positively evaluated than those represented by smaller images.

(Superimposed faces convey no information about EPA profiles. A face that is drawn later is superimposed on a face that was drawn earlier in the same place. For instance, female faces are superimposed on male faces since the program always draws female faces after male faces.)

The face in a blue circle (not visible in Figure 3.5) represents the concept of the whole group. It is positioned initially at the mean values of the self-sentiments of all agents, though its position might change if you chose to plot in terms of self-impressions rather than self-sentiments.

Different Views

The graph of agents can be viewed from different perspectives using the **view** drop-down menu shown in Figure 3.6. NOTE: Changing the option displayed in the **view** menu has no effect until you click the **re-plot** button (shown in Figure 3.4)

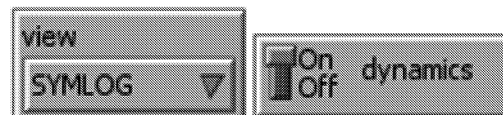


Figure 3.6. Elements for changing the plot in the Group Space.

The **view** menu has five options.

- $E \times A (P)$: Evaluation on the vertical axis and Activity on the horizontal axis, with Potency represented by size of faces.
- $P \times A (E)$: Potency on the vertical axis and Activity on the horizontal axis, with Evaluation represented by size of faces. This is the perspective shown in Figure 3.5.
- $P \times E (A)$: Potency on the vertical axis and Evaluation on the horizontal axis, with Activity represented by size of faces.
- *symlog*: Forward-Backward on the vertical axis and Positive-Negative on the horizontal axis, with Up-Down represented in the sizes of faces. This option keeps the quantitative scale used in the first three options.

- *SYMLOG*: This is the same thing as the previous option, except the dimensions are rescaled so that the group just fits on the graph, following the convention in *SYMLOG* studies.

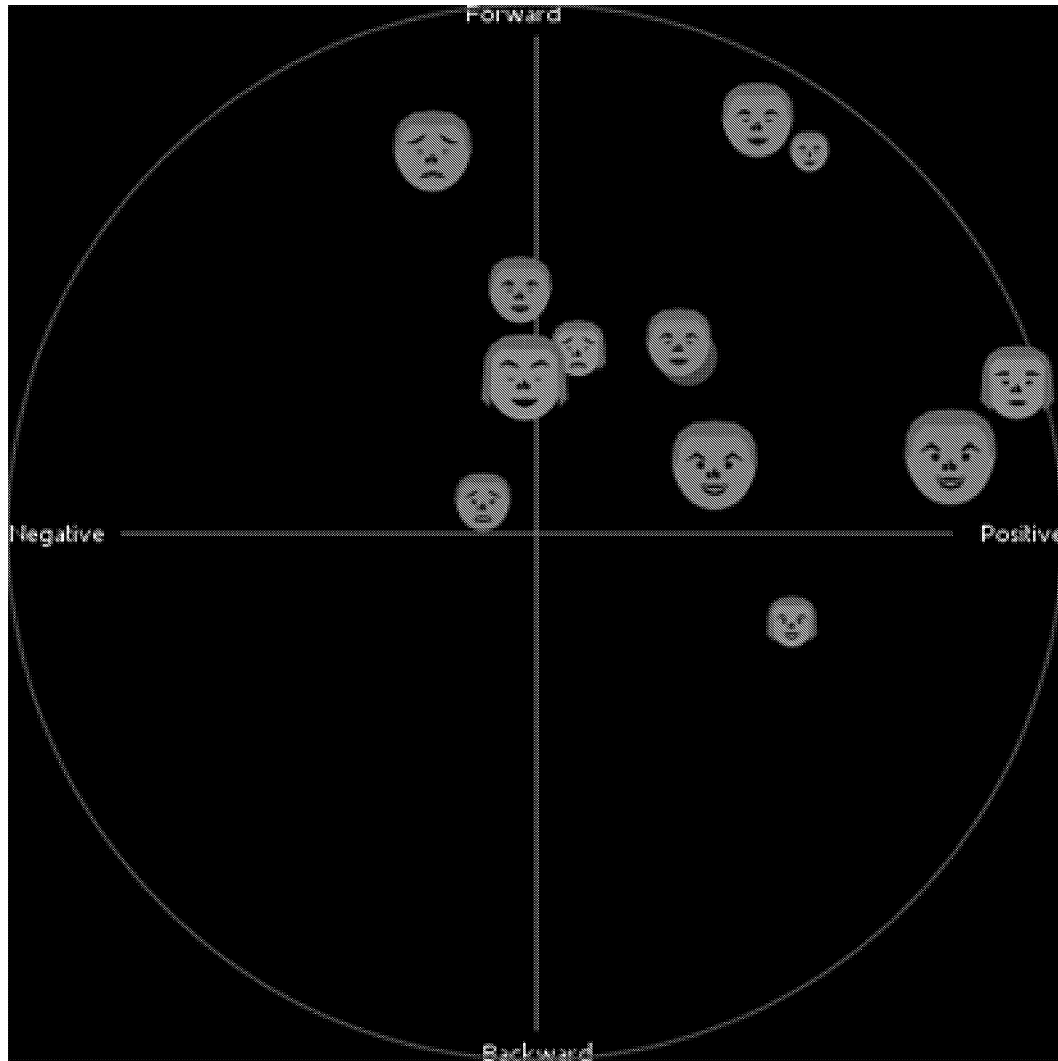


Figure 3.7. The SYMLOG view of the Group Space.

See the “Value Directions” section in the “Who’s Next?” section above for more information about the SYMLOG dimensions.

Figure 3.7 shows the same group as is shown in Figure 3.5, this time from the perspective obtained by choosing the *SYMLOG* option. This view is somewhat

like the $P \times E (A)$ view, except the horizontal axis is labeled *Negative* versus *Positive* rather than E^- versus E^+ , and the vertical axis of *Forward* versus *Backward* combines Potency and Activity, $P+A^-$ versus $P-A^+$. The third *Up-Down* dimension also combines Potency and Activity, $P+A^+$ for *Up* versus $P-A^-$ for *Down*, with *Up* associated with larger faces.

Dynamics

Faces are plotted on the basis of group members' self-sentiments if the **dynamics** switch is *off*. This provides a stable visual framework for watching the development of a group network as actions proceed.

Turning the **dynamics** switch *on* causes faces to be plotted on the basis of group members' current self-impressions. Self-impressions change substantially during interactions, so faces move about in the group space when the switch is *on*. In some analyses all members may converge within a small region and move around like a flock.

Networks

The display of the group space develops into something like Figure 3.8 after actions are performed. This particular image resulted at the six-hundredth action, corresponding to approximately 36 minutes of interaction within a real group.

In Figure 3.8 the arrow from a female near the center of the group to a male at the upper right (colored green in *Group Simulator*) betokens the action currently taking place: the female is actor and the male is object of her action. Other lines on the chart summarize the frequency of interactions between group members and indicate the development of network ties.

The thicker and brighter the line connecting two members, the more often the two individuals have been involved in actions with each other. So, for example, the female at the bottom of the chart has interacted frequently with her two interaction partners, while the three males near the horizontal axis have shared only a few actions, and the three males at the top never have interacted with each other.

Lines connecting individuals to the whole-group avatar indicate how often individuals have performed actions toward the whole group. These lines are colored blue in *Group Simulator* to help distinguish them from the interpersonal network. They can be forgone entirely by setting the **lines-to-group** switch to the *off* position.

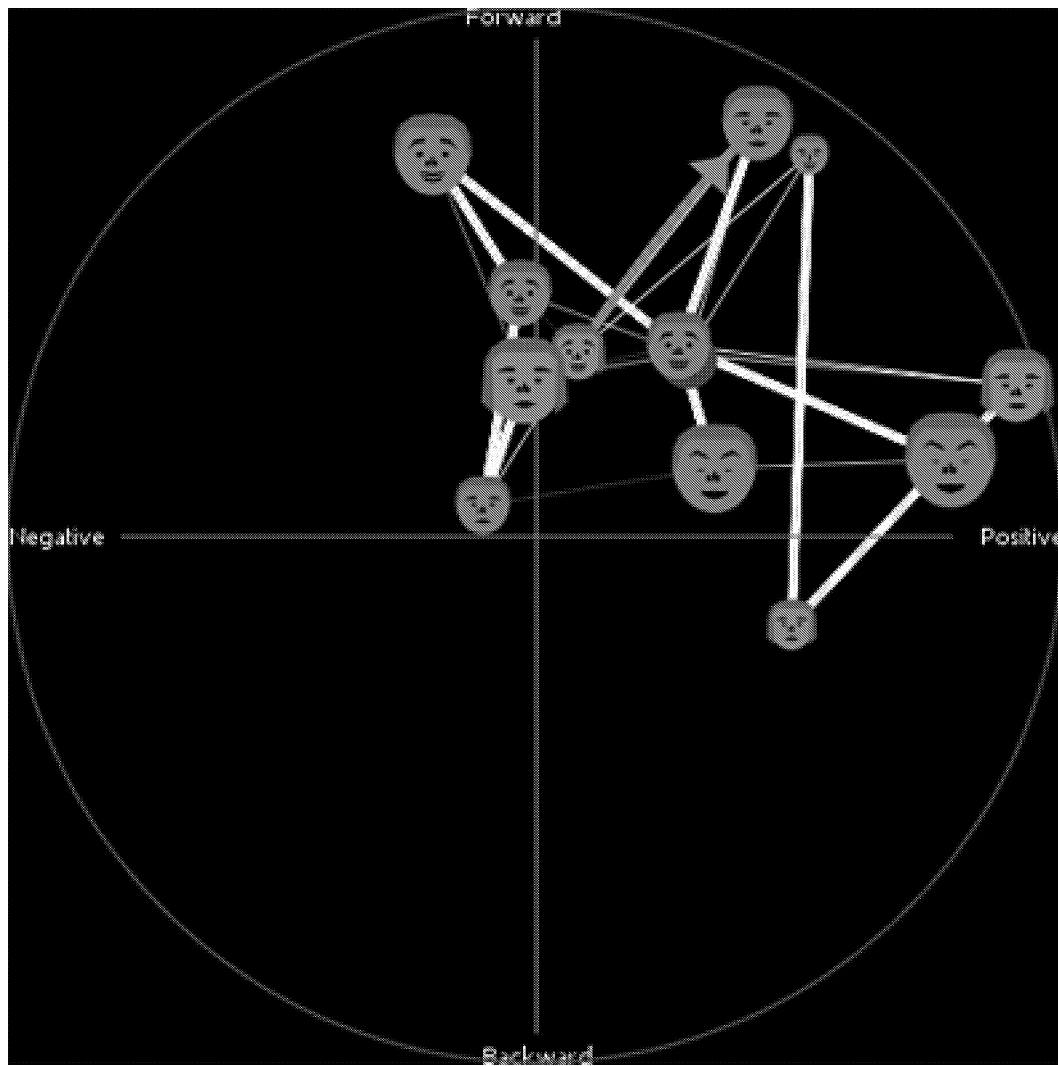


Figure 3.8. A group network that emerged during 600 actions.

A line turns red if more than half of the past actions between the two connected interactants have been bad (i.e., behavior Evaluation less than or equal to -0.5). The red coloring signals that the tie has different network significance than positive ties developing out of pleasant interpersonal actions.

Process Graph

GroupSimulator graphs time variations in event tension and the number of network ties in the group. Figure 3.9 shows results of one analysis that was continued through 600 actions.

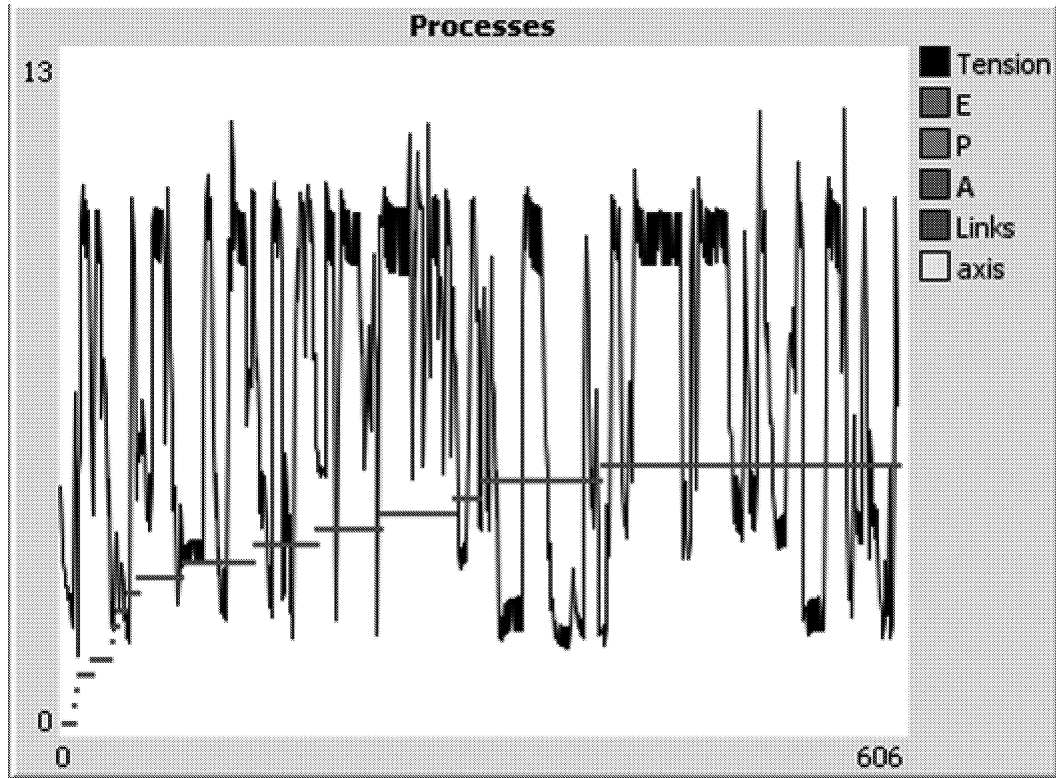


Figure 3.9. Over-time graph of tension and the formation of network ties.

The jagged line shows how tension (deflection) produced by events varied in this analysis. Some events produced very little tension, while others produced substantially more tension—almost 13 units in a few cases. Reciprocal exchanges are evident from rapid alternation of tension within a narrow range. No general trend toward reduced tension or increased tension is evident in this analysis.

The broken line shows the growth of the group's interpersonal network. Each value on this line is the percent of existing ties between individuals prior to the current action, relative to the maximum number that is possible in the group, divided by five. The ties are undirected, just one for each dyad, and ties to the whole-group entity are not included. For example, a twelve-person group has 66 possible undirected ties among its members, and if three have been realized, then the percentage of realized ties is $100 \cdot (3/66) = 4.54$. The chart will show this value divided by five.

In the analysis presented in Figure 3.9, new interpersonal ties were created rapidly at the beginning of the group interaction, and new ties continued to form at a

slower pace until halfway through the sequence. After that the network stabilized, with only a single new tie being added.

Other Graph Variables

You can graph some additional variables with the **graph-EPA-variables** drop-down menu at the bottom-left of the processes graph. Figure 3.10 shows the menu

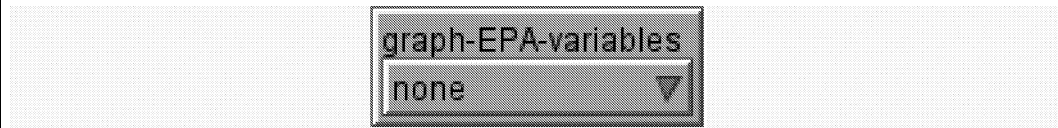


Figure 3.10. Drop-down menu for selecting quantities to graph.

Besides *none*, the menu options are *actor emotion*, *actor impression*, and *behavior*.

Selecting *actor emotion* plots the EPA values for the actor's emotion, and selecting *actor impression* plots the EPA values for the actor's transient self-impression. In either case, the focal group member changes from one action to the next depending on who is acting. Selecting *behavior* plots the EPA values for the behavior in each action.

Figure 3.11 shows an example in which behavior EPAs are plotted through the first twenty actions in an analysis. As before, the dark line at the top is tension, and the broken line shows the growth of interpersonal links. The three continuous lines toward the bottom of the chart show behavior EPAs.

GroupSimulator plots Evaluation in red, Potency in blue, and Activity in violet. In Figure 3.10 Potency is the line that ends highest, Evaluation is the line that ends next highest, and Activity is the line that ends lowest. The faint straight line passing through the Activity line is the horizontal axis positioned at a vertical value of zero on the graph.

Numbers on the horizontal and vertical axes in Figure 3.10 show the computer cursor's position on the graph. (The cursor is displayed as an outline arrow in Figure 3.11.) Thereby we can estimate the tension level at about 9.7 during the sixteenth action. The reading on the horizontal axis is 14.89 suggesting that the arrow is at the fifteenth action, but counting of events starts at zero, so it really is the sixteenth action.

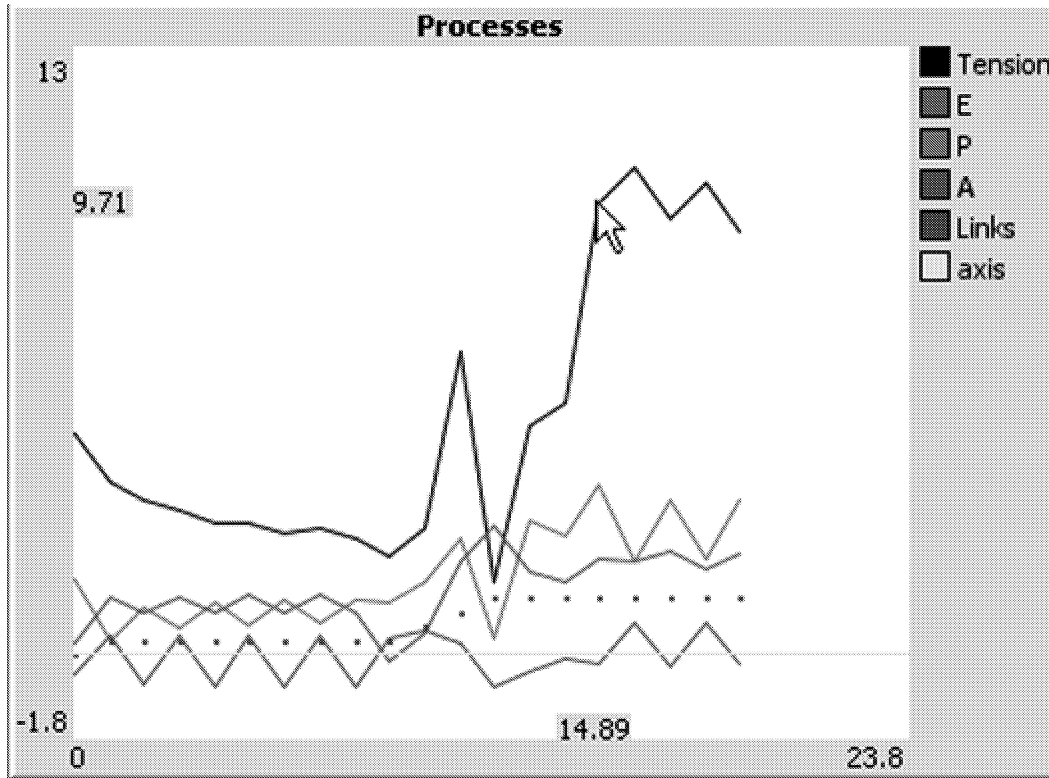


Figure 3.10. Over-time graph, including EPAs of implemented behaviors.

Rank-Frequency Charts

GroupSimulator plots two frequency bar charts in the same graphical space, as shown in Figure 3.12.

The chart on the left plots the number of actions initiated by each group member, with group members ordered by the rank of their number of initiations.

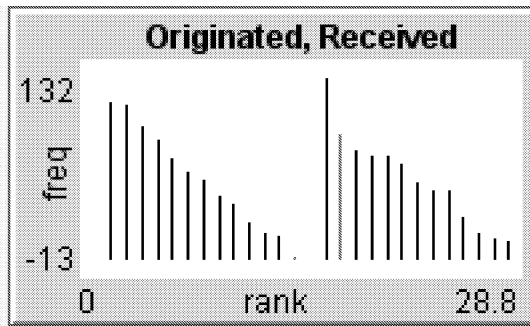


Figure 3.12. Rank-frequency charts for initiators and objects of action.

The chart on the right plots the number of actions each group member has received from others, with group members ordered by the rank of their attractiveness as a target for others' actions. The grey bar (colored orange in *GroupSimulator*) shows the frequency of actions directed to the whole group.

Real-life charts of these kinds often are similar to Figure 3.12 with the highest ranked individuals having exceptionally high frequencies, and the lowest ranked individuals creating a tail of low frequencies.

IPA Classifications of Actions

Interaction Process Analysis—IPA—is a methodology for coding types of actions observed in groups. The classification system has the twelve categories listed in Table 3.3.

GroupSimulator codes each behavior into these categories by comparing the behavior EPA with EPAs for the IPA categories, and assigning the behavior to the category whose EPA is closest.

Category EPAs were obtained by searching instructions for training IPA coders in order to find example behaviors in each category. Then *Interact* dictionaries were searched for three example behaviors in each category, and male and female EPA profiles for the three behaviors were averaged in order to obtain a category EPA profile.

Table 3.3. Sample behaviors in IPA categories and category EPAs, for three surveys.

IPA Category	U.S.A. 1978 Instances	Mean EPA	U.S.A. 2004 Instances	Mean EPA	Canada 2001 Instances	Mean EPA
1 Shows solidarity	help,	1.78	help,	2.78	help,	2.46
	compliment,	1.29	compliment,	2.22	compliment,	1.56
	gratify	0.21	reward	1.20	honor	0.64
2 Shows tension release	josh, laugh with,	1.48	joke with, laugh	2.71	josh, laugh with,	1.72
	cheer	0.91	with, thank	1.90	thank	0.77
		1.12		1.78		0.73
3 Agrees	agree with,	1.60	agree with,	1.24	agree with,	1.70
	understand,	0.78	concur with,	0.64	understand,	0.80
	accommodate	0.01	mind	0.32	accommodate	0.34
4 Gives suggestion	encourage, cue,	1.28	direct, cue,	1.03	direct, cue,	1.29
	coach	1.18	suggest	1.07	coach	1.20
		0.25	something to	0.64		0.35
5 Gives opinion	persuade,	0.88	address,	1.12	influence,	0.78
	influence,	1.48	analyze,	0.96	address,	0.89
	interest	0.46	confess to	0.02	analyze	0.18

6 Gives orientation	inform, educate, explain to	1.68	inform, discuss something	1.98	inform, educate, explain	1.70
		1.62	with, explain something to	1.54	explain something to	1.25
		-0.14		0.42		0.37
7 Asks for orientation	quiz, question, ask about something	0.50	quiz, question, ask about something	0.68	quiz, question, ask about something	0.67
		0.62		0.81		0.54
		0.45		0.38		0.20
8 Asks for opinion	consult, prompt, query	0.48	sound out, prompt, request	0.22	consult, prompt, coax	0.69
		0.74		0.25		0.67
		0.16		0.27		0.23
9 Asks for suggestion	entreat, ask, beseech	0.30	entreat, beseech, query	0.21	entreat, beseech, query	0.38
		0.24		0.38		0.39
		0.09		0.64		0.10
10 Disagrees	disagree with, ignore, hinder	-1.00	disagree with, ignore, look away from	-0.86	disagree with, ignore, hinder	-0.94
		0.35		-0.01		0.85
		0.45		-0.22		0.05
11 Shows tension	fear, cajole, evade	-0.89	cajole, leave, stammer at	-0.89	fear, cajole, leave	-0.76
		-0.16		0.19		0.40
		0.35		0.13		0.28
12 Shows antagonism	argue with, deride, defy	-0.82	argue with, deride, defy	-1.27	argue with, deride, defy	-0.77
		0.71		0.68		0.91
		1.32		0.93		0.26

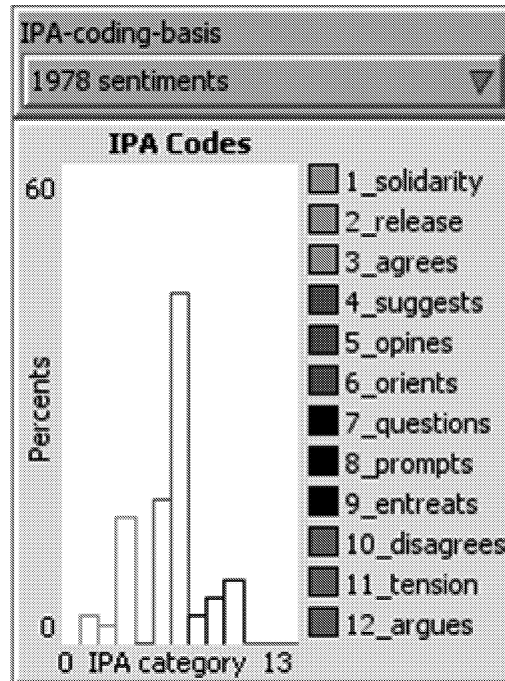


Figure 3.13. An example distribution of acts into IPA categories.

Table 3.3 shows the example behaviors and average EPA profiles for each category, for two U.S.A. dictionaries and one Canadian dictionary. The **IPA-coding-basis** drop-down menu at the top of Figure 3.13 allows selection of any one of these bases for coding behavior EPAs into IPA categories.

The example chart at the bottom of Figure 3.13 shows typical IPA results from analyzing a task-oriented group. The largest percentage of behaviors got coded into category 6, with large percents also in categories 3 and 5.

Count over from the first bar to identify the category number of a bar. The process of identification is facilitated by the bars' colors. The first three bars representing expressive-integrative positive reactions are colored green. The second three bars representing instrumental-adaptive attempted answers are colored blue. The third set of three bars representing instrumental-adaptive questions are colored black. And the final three bars representing expressive-integrative negative reactions are colored red.

Input-Output Information

GroupSimulator's **input-output** box, displayed in Figure 3.14, shows basic information about the analysis, and offers a rough verbal description of each action.

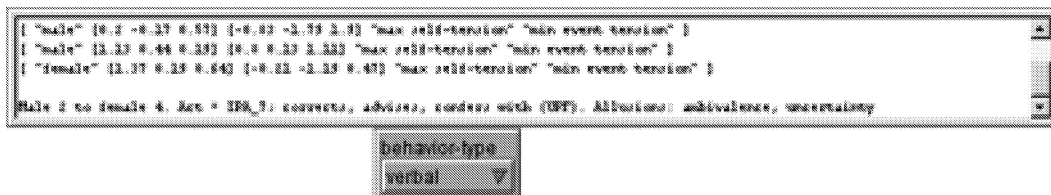


Figure 3.14. Description of inputs and actions.

Input information appears at the beginning of the scrolling display.

In Figure 3.14 some of the input information is not visible. Scrolling upward reveals the complete information on this four-person group, as follows.

```

4814386537254389
["whole-group" [1.15 0.94 0.33] [1.15 0.94 0.33] "0" "0" ]
["male" [1.89 3.3 -0.08] [2.21 2.88 0.37] "max self-tension" "min event tension" ]
["male" [0.2 -0.17 0.57] [-0.83 -1.79 1.9] "max self-tension" "min event tension" ]
["male" [1.13 0.44 0.19] [0.8 0.13 1.11] "max self-tension" "min event tension" ]
["female" [1.37 0.19 0.64] [-0.21 -1.19 0.47] "max self-tension" "min event tension" ]
  
```

The number on the first line is the random seed for the analysis which, along with the other information, allows you to reproduce the same analysis later if you want, as explained in the section below on "File Input."

The second line gives the sentiment toward the whole group, as an EPA profile within a pair of brackets. The whole-group sentiment is the average of the self-sentiments of all group members. The initial transient feeling toward the whole group equals the whole-group sentiment, and is displayed in a second pair of brackets. Two quoted entities at the end of the line relate to how actors and objects are chosen; these both are zero because the whole group never takes the role of actor, and never selects an object of action.

The third line gives information on a group member. The first EPA profile in brackets is the group member's self-sentiment. The second EPA profile in brackets is the group member's initial transient self-feeling. The first quoted entity identifies the group member's basis for choosing who will be the next actor. The second quoted entity identifies the group member's basis for choosing who will be the objects of actions.

Subsequent lines give information in the same format on other group members, males first and then females.

A blank line precedes action descriptions. Each action is specified in a number of different ways.

First, the action is specified in terms of the actor's sex and ID number, the sex and ID number of the group member who is the object of action, and the IPA category of the behavior.

Next are some examples of the kind of behavior the actor might perform, followed by the SYMLOG direction of the behaviors in parentheses (see Table 3.2). Think of an arrow starting at the middle of the EPA space and extending through the EPA position of the computed behavior. The bearing reported in parentheses is the SYMLOG region to which the arrow points.

The example behaviors come from the region of the EPA space where the arrow points. The examples are extreme instances of behaviors whose sentiments have the same pattern as the current behavior. The examples suggest the quality of the current behavior, even if the current behavior is not as extreme as the behaviors listed. Neutral acts are listed if the EPA profile for the current behavior is near zero on all three dimensions.

Two special characters might appear in the example behaviors, tilde and underline—for example, *~offers __ to*, *~apologizes to*, *~prays with*. The tilde indicates that

the behavior is not really in the target region, only close by. In this example all listed behaviors have tildes, signifying that no behaviors that have been measured on EPA represent this region (the *DP* direction). The underline stands for the word “something” – for example, *offers something to*.

The **behavior-type** drop-down menu, shown at the bottom of Figure 3.14, determines whether example behaviors are *verbal* in nature, or *physical* in that they are non-verbal and may involve some touching.

Finally, the description of action suggests some value areas that might be alluded to in the course of the current behavior. These are values corresponding to the actor’s current impression (transient EPA) when projected into a SYMLOG region.

Copying Input-Output

All of the information in the **input-output** box can be copied to a text document as follows. Click inside the box with the mouse. Press keys for *Select-all* (*Ctrl-A* in the case of Microsoft Windows), then keys for *Copy* (*Ctrl-C* on Windows). Click inside an open text document, and press keys for *Paste* (*Ctrl-V*). The entire contents of the **input-output** box will be transferred to the text document.

A text document created this way and saved as TXT can be used to input the same model at a later time, as discussed in the “File Input” sec

Files

Controls related to external files are shown in Figure 3.15. The **read-file** button is used to input specifications of a particular group that you want to analyze. The **save-IO** switch is used to make *GroupSimulator* write data files for external statistical analyses. The **fast** switch is used to speed up analyses when writing results to external data files.

You can read or write files only with the downloaded version of *GroupSimulator*. In the applet version clicking the **read-file** button or running analyses with the **save-IO** switch in the *on* position has no effect.

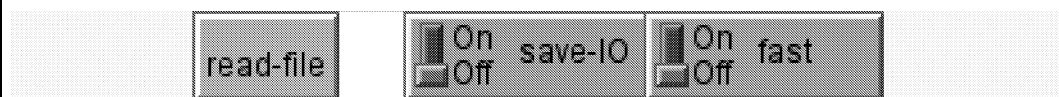


Figure 3.15. Elements related to files.

Output Files

Turning the **save-IO** switch to *on* automatically generates two output files.

```
Data_GroupSimulator_actions.txt
Data_GroupSimulator_runs.txt
```

Both files are created in the directory where *GroupSimulator* resides.

Results from analyses are appended to the ends of these files, so you must delete old copies before beginning a new analysis in order to have the files contain data from your current analysis only.

Turning the **fast** switch *on* stops dynamic displays on *GroupSimulator's* interface, other than the *ticks* counter. This speeds up processing, so turn the switch to *on* if you are interested only in file output, and want to get it as fast as possible.

The format and information in each output file are discussed in separate sections below.

Data_GroupSimulator_actions.txt

The file named *Data_GroupSimulator_actions.txt* begins with specifications of the **Model** being analyzed. For example:

```
[MODEL:: Males: [0.8 1.6 -0.5] Females: [1.2 0.7 0] Actor choice=max self-
tension Object choice=min event tension Equations=US unisex N=6 female%=25
Individuality=1 Initial tension=1 Reciprocal action probability=0.8 Address
group probability=0.4 Group act to all=true IPA coding=2004 sentiments Run
size=1000 Next group changes sentiments Random seed=8367882153828732]
```

The three numbers in brackets following the word *Males* are the settings on the **male-goodness**, **male-dominance**, and **male-activation** sliders, respectively. Similarly, the three numbers in brackets following the word *Females* are the values set on the **female-goodness**, **female-dominance**, and **female-activation** sliders. Next is the option selected on the **actor-choice** menu, and that is followed by the choice on the **object-choice** menu. The selection on the **equations** menu is next. The value reported after *N* is the value on the **group-size** slider, and the value on the **percent-females** slider is given next. Then come the values on the **individuality** slider and on the **initial-tension** slider. "Reciprocal action probability=" reports the value on the **reciprocal-act-Pr** slider. "Address group probability=" reports the value on the **address-group-Pr** slider. "Group act to all=" is followed by *true* if the **grp-act-to-all** switch is *on*, otherwise by *false*. "IPA coding=" shows the selection on the **IPA-coding-basis** menu. "Run size=" gives the value on the **run-size** slider. "Next group changes" is followed by the selection on

the **change-next-group's** menu. "Random seed" is the initialization number for randomization.

The next line of the file identifies the **Output Variables** in the data.

```
OUTPUT VARIABLES:: RUN#, EVENT#, IPA#, BEHAVIOR-EPA, DEFLECTION, ACTOR-
RECIPROCATING, ACTOR, ACTOR-FUNDAMENTAL-EPA, ACTOR-TRANSIENT-EPA, ACTOR-
EMOTION-EPA, ACTOR-DEFLECTION, ACTS-ORIGINATED#, ACTS-RECEIVED#, OBJECT, OB-
JECT-FUNDAMENTAL-EPA, OBJECT-TRANSIENT-EPA, OBJECT-EMOTION-EPA, OBJECT-
DEFLECTION
```

This could be read as follows.

In event EVENT# of run number RUN#, the behavior was given an IPA coding of IPA# and had an EPA profile of BEHAVIOR-EPA (three numbers), producing an event deflection of DEFLECTION. ACTOR RECIPROCATING corresponds to the true or false answer to the question, Is this action part of a reciprocation sequence?

The actor was ACTOR (a gender and a number in parentheses). The actor's self-sentiment was ACTOR-FUNDAMENTAL-EPA (three numbers). The actor's self-impression after the event was ACTOR-TRANSIENT-EPA (three numbers), resulting in an emotion of ACTOR-EMOTION-EPA (three numbers), and a self-tension of ACTOR-DEFLECTION. During this run, the actor has initiated ACTS-ORIGINATED# actions, and has been the object of ACTS-RECEIVED# actions by others.

The object of the current action was OBJECT (a gender and a number in parentheses). The object's self-sentiment was OBJECT-FUNDAMENTAL-EPA (three numbers). The object's self-impression after the event was OBJECT-TRANSIENT-EPA (three numbers), resulting in an emotion of OBJECT-EMOTION-EPA (three numbers), and a self-tension of OBJECT-DEFLECTION.

Output lines look like the following examples. (Each block of text is printed on a single line in the file.)

```
[1 14 7 -0.3 1.54 0.4 6.84 false (male 5) -0.98 1.33 -0.46 -0.42 0.64 -0.03
0.71 0.26 0.73 0.97 1 0 (whole-group 0) 0.7 1.43 -0.22 0.61 -0.95 -0.29 -0.47
-2.59 0.32 5.69]
```

```
[1 15 6 1.38 1.55 0.39 7 false (male 3) 0.81 1.08 0.61 0.61 0.05 0.22 0.49
-0.53 0.06 1.27 1 0 (male 2) 0.73 1.23 -0.14 0.77 -0.94 0.04 -0.14 -2.31 0.82
4.74]
```

The file identifies self-sentiments of group members only if they are active participants in interaction. The self-sentiments of all group members can be obtained from the other output file.

Data_GroupSimulator_runs.txt

The file named *Data_GroupSimulator_runs.txt* reports statistics from an entire run, so a line of data is added to this file only when a run is completed. For example, if the run size is set to 300 on the **run-size** slider, then 300 actions occur before a line of data is printed into *Data_GroupSimulator_runs.txt*.

The file begins with specifications of the **Model** being analyzed, the same as the **Model** specification on the first line of *Data_GroupSimulator_actions.txt*. The description of the contents of the line provided in the last section apply here as well.

The second line of *Data_GroupSimulator_runs.txt* identifies the **Variables** in the data.

```
[VARIABLES:: percents in IPA categories; for each agent: gender, ID#, fundamentals, # of acts-initiated, # of acts-received; % of possible ties implemented; network from-to matrix ]
```

The phrase “percents in IPA categories” designates a list of twelve percentages in square brackets. Count from the left bracket to assign a sequence# to each percentage. Then any particular percentage is the percent of behaviors in the run that were in IPA category sequence#.

The phrase “for each agent: gender, ID#, fundamentals, # of acts-initiated, # of acts-received” means the following. A second list in brackets identifies each group member by giving gender and ID# in parentheses, then that member’s EPA self-sentiment (three numbers), number of acts initiated, and number of acts received. The whole group entity (if there is one) is listed as member 0, and its number-of-acts-initiated always is zero.

“% of possible ties implemented” refers to a number following the closing bracket of the second list and preceding the opening bracket of the final list. This number is the percentage of implemented ties between group members, relative to the maximum number of ties. Links to the whole-group entity (if one is in the analysis) are not counted in this statistic.

The phrase “network from-to matrix” designates the final list, which partitions into N+1 rows, each with N+1 column entries, where N is the number of group members (not counting the whole-group entity, if there is one). The rows and columns correspond to a who-to-whom matrix in which you begin counting

rows or columns from zero. The zero-row represents actions from the whole-group entity, and this row always contains only zeros, even if the entity is in the analysis, because the whole group never performs actions in *GroupSimulator*. The second row shows how often group member number one acted toward the whole group and toward each of the other group members. The third row indicates how often group member two acted toward the whole group and toward each of the other group members. And so on.

The following is an example line of data from a 300-action run of a six-person group that included the whole-group as an agent. The very first opening bracket and the very last closing brackets have no useful meaning as far as data are concerned, so ignore them.

```
[[5 0 0.33 3 26.33 53 0 12 0.33 0 0 0] [(whole-group 0) 0.85 1.84 -0.15 0 5
(male 1) 2.38 1.9 0.61 19 10 (male 2) -0.02 3.94 0.47 47 37 (male 3) 1.07
2.46 -1.55 25 19 (male 4) 0.93 1.59 -0.92 70 72 (male 5) 0.97 1.37 0.49 101
112 (female 6) -0.22 -0.21 -0.02 38 45] 66.67 [0 0 0 0 0 0 0 0 0 0 4 14 1 4
0 0 0 0 43 0 0 0 0 21 2 2 1 1 0 17 0 33 18 0 8 37 0 32 0 24 0 1 0 2 15 20
0]]
```

The first list in brackets indicates that 5% of all behaviors were in IPA category 1, 0.33% were in category three, 3% in category four, 26.33% in category five, 53% in category six, 12% in category eight, and 0.33% in category nine; no behaviors were recorded in the other IPA categories.

The second list in brackets conveys the following information:

The whole group's fundamental EPA sentiment was 0.85 1.84 -0.15, and the whole group initiated no actions but was the target of five actions; member one, a male, had a self-sentiment of 2.38 1.9 0.61, and he initiated 19 actions while being the object of 10 actions; etc.

Following the second list is a single number: 66.67. This is the percentage of realized ties among members relative to the maximum possible number of ties (which would be 30 in a group of six).

The final list in brackets shows which group members acted on which other group members. The implied squared matrix is displayed in Table 3.4.

As noted above, the first row of the who-to-whom matrix always is zero because it represents the actions of the whole group, and the whole group never acts in *GroupSimulator*. The diagonal of this matrix also always is zero, because *GroupSimulator* does not implement self-actions.

Table 3.4. An illustrative who-to-whom matrix.
Note: 0 is Whole-group; other numbers represent group members.

From	To						
	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
<u>0</u>	0	0	0	0	0	0	0
<u>1</u>	0	0	0	0	4	14	1
<u>2</u>	4	0	0	0	0	43	0
<u>3</u>	0	0	0	0	21	2	2
<u>4</u>	1	1	0	17	0	33	18
<u>5</u>	0	8	37	0	32	0	24
<u>6</u>	0	1	0	2	15	20	0

Using the Data

Many of the analyses you might want to conduct on *GroupSimulator* data can be accomplished with a spreadsheet.

The free *OpenOffice* spreadsheet named *Calc* makes the importation of *GroupSimulator*'s data files easy.

In a text-processing program, remove the **Model** and **Variables** lines from the *GroupSimulator* data files and save just the data as a text file—named, say, *temp.txt*. Invoke Open File from inside *OpenOffice Calc*, and select the file *temp.txt*. *OpenOffice Calc* recognizes the file as text, and pops up a window asking for instructions on how to convert the text to columns. Under “Separator Options” check *Space* and *Merge delimiters*. In the *Other* space for additional delimiters type the four characters `]]()`. Click *OK*, and the data will be neatly distributed into columns and ready for your analyses.

The process is a bit more involved with Microsoft's *Excel* because *Excel* doesn't allow a group of *Other* delimiters.

In a text-processing program, remove the **Model** and **Variables** lines from the *GroupSimulator* data files. Additionally, Search and Replace all instances of the four characters `]]()`, replacing with nothing at all. Save the results as a text file—say, *temp.txt*. Invoke Open File from inside *Excel*, and select the file *temp.txt*. *Excel* recognizes the file as text, and pops up a series

of windows. On the first window, check the *Delimited* option and click the **Next** button. On the second pop-up window check *Space*, and click the **Finish** button. The data will be neatly distributed into columns and ready for your analyses.

File Input

You can set up a group from a file. This feature has two benefits.

First, you can create a group in which members have specific self-sentiments. For example, you could give group members the sentiments of family identities, like mother, father, daughter, and son, in order to analyze quintessential family interactions.

Second, you can re-install a group that interested you in an earlier session, providing that you saved the group specifications that were printed in the **input-output** box before leaving the earlier session.

Inputting a Group

Clicking the **read-file** button opens a file directory window so that you can load a file that you have prepared in a text processing program. Selecting a file from the file directory window works the same as with any other program on your computer.

The file must have the following format.

- Each line must begin with an opening square bracket.
- Next comes either "*male*" or "*female*" followed by a space.
- Next comes another opening square bracket.
- Next are three numbers between -4.5 and +4.5, separated by spaces, specifying the EPA self-sentiment of this agent.
- Next come a closing square bracket, a space, and an opening square bracket.
- Next are three numbers specifying the EPA values for the initial impression of this agent.
- Next is a closing square bracket and space.
- Optional: You can specify the group member's actor-choice criterion by entering it next in quotes— e.g. "max self-tension". If you specify one, you must specify

the same criterion for all group members. If you specify a SYMLOG direction—e.g. “UPF”—you must specify a SYMLOG direction for all members, but they do not need to be the same. If not present, or if you enter an empty entry, “”, the option on the **actor-choice** menu is assigned to the group member as the actor-choice criterion.

- **Optional:** An individualized object-choice criterion can be next. The specified option controls how that interactant chooses objects of action. The selection on the interface **object-choice** drop-down determines the object choices of group members whose object basis is unspecified in the file.
- The line must end with another closing square bracket.

The following example shows file contents to run a four-person interaction among daughter, father, mother, and son (using Indiana, 2004, sentiments averaged across gender). Selection of actors and objects will be determined by selections on the **actor-choice** and **object-choice** menus when the file is loaded.

```
["female" [2.10 0.55 1.20] [2.10 0.55 1.20]]
["male" [2.71 2.71 1.15] [2.71 2.71 1.15]]
["female" [2.80 2.47 1.30] [2.80 2.47 1.30]]
["male" [1.95 1.66 1.89] [1.95 1.66 1.89]]
```

Here is the same group with SYMLOG value directions specified for actor choice and object choice.

```
["female" [2.10 0.55 1.20] [2.10 0.55 1.20] "DPB" "DPB"]
["male" [2.71 2.71 1.15] [2.71 2.71 1.15] "UPF" "UPF"]
["female" [2.80 2.47 1.30] [2.80 2.47 1.30] "PF" "PF"]
["male" [1.95 1.66 1.89] [1.95 1.66 1.89] "DP" "DP"]
```

Group members are listed in the following order: Da, Fa, Mo, So.

As the last line indicates, notes can be included in the input file as long as a blank line separates them from the data.

Model Definition on Output Files

Inputting a group from a file produces a somewhat different **Model** line in output files than was described previously. With file input, the first line of an output file gives the name of the file that was used to define the group. The values on the male and female goodness, dominance, and activation sliders are not reported since they were not used to define group members. Selections on the **actor-choice** and **object-choice** menus are tagged with the word “generic” to indi-

cate that the actual bases for actor and object choice might have been input from the file.

The following is an example.

```
[MODEL From file:: E:\!Current\SmallGroups\inputFamily.txt Generic actor-
choice=max self-tension, Generic object-choice=min event tension Equations=US
unisex N=4 female%=50 StartingStress=1 ReciprocalActionPr=0.8 Addres-
sGroupPr=0 GroupActToAll= true IPAcoding=2004 sentiments RunSize=300 change-
next-group's sentiments RandomSeed=7998695543932719]
```

Re-Installing a Group

Suppose you are analyzing a group, and you decide that you would like to come back and analyze the same group at a later date. Here is how you can do that.

- While you still are working with the group of interest, save the contents of the **input-output** box, as described above in the section titled “Copying Input-Output.”
- When you are ready to work with the group again, run *GroupSimulator*, click the **read-file** button, and load the TXT file that you saved.

The restored group will have the same self-sentiments and initial self-impressions. Randomization sequences will be the same, too, beginning at the point that the group first was created with the **setup** button in the original session.

Future Developments

GroupSimulator permits a huge variety of group definitions. Research on social interaction in groups still is too thin to clarify which ones of the multitude of group definitions are realistic. In fact, a primary function of *GroupSimulator* is to provide model-generated data that can be compared with empirical data from experiments or observational studies in order to evaluate different ideas about how interaction is produced in groups.

Some guidance on what kind of model to start with is provided by a studyⁱ that indicated that actors are not selected on the basis of *Min event tension* or *Min self-tension*. However, *Max self-tension* provided a basis for actor selection that successfully reproduced four empirically observed phenomena: 1. distributions of actions in IPA categories; 2. male-female differences in IPA distributions; 3. rank-frequency distributions of acts initiated by different group members, and 4. male-female differences in numbers of acts initiated. Other analyses indicate that

actor selections on the basis of value directions also can reproduce empirical phenomena, if male and females are assigned different value directions.

GroupSimulator's current incarnation does not deal with conflicting definitions of the situation or with different group members having diverging sentiments regarding the same stimulus, because dealing with these matters in group contexts would require processing large matrices. Until the matter is incorporated into *GroupSimulator*, you must turn to program *Interact* in order to analyze such problems.

ⁱ D. Heise. 2011. "A Theoretical Model of Small Group Interaction, Applied to Jury Deliberations." Department of Sociology, Indiana University.