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Introduction

1.1 Interaction and behavior sequences

Birds courting, monkeys fighting, children playing, couples discussing, mothers and infants exchanging gleeful vocalizations all have this in common: Their interaction with others reveals itself unfolded in time. This statement should surprise no one, certainly not readers of this volume. What is surprising, however, is how often in the past few decades researchers interested in dynamic aspects of interactive behavior – in how behavior is sequenced moment to moment – have settled for static measures of interaction instead. This need not be. In fact, our aim in writing this book is to demonstrate just how simple it often is not just to record observation data in a way that preserves sequential information, but also to analyze that data in a way that makes use of – and illuminates – its sequential nature.

We assume that readers of this book may be interested in different species, observed at various ages and in diverse settings, but that most will be interested specifically in observing interactive social behavior. This is because we think sequential methods are tailor-made for the study of social interaction. As noted, a defining characteristic of interaction is that it unfolds in time. Indeed, it can hardly be thought of without reference to a time dimension. Sometimes we are concerned with actual time units – what happens in successive seconds, for example; at other times, we are just concerned with what events followed what. In either case, we think it is a sequential view that offers the best chance for illuminating dynamic processes of social interaction.

For example, we might ask a married couple to fill out a questionnaire, and from their responses we might assign them a "marital satisfaction" score. This would at least let us try to relate marital satisfaction to other aspects of the couple's life circumstances, like their own early experience or their current work commitments, but such a static measure would not tell us much about how the couple interacts with each other, or whether the way in which they interact relates in any way to how satisfied they report being with their relationship. In order to "unpack" the variable of marital

satisfaction, we would need to examine more closely just how the couple related to each other – and, in order to describe and ultimately attempt to understand the dynamics of how they relate to each other, a sequential view is essential. Our hope is that readers of this book not only take such a sequential view, but also will learn here how to describe effectively the sequential nature of whatever interaction they observe.

1.2 Alternatives to systematic observation

There is a second assumption we make about readers of this book. We assume that they have considered a variety of different methods of inquiry and have settled on systematic observation. For a moment, however, let us consider the alternatives. When studying humans, at least those able to read and write, researchers often use questionnaires, like the marital satisfaction inventory mentioned. These questionnaires, as well as tests of various sorts, certainly have their uses, although capturing the dynamic quality of behavior sequences is not one of their stronger points.

We do not mean to suggest, however, that investigators must choose between observational and other methods. In our own work, we usually employ a convergent measurement network that taps the constructs we are interested in studying. This network usually includes questionnaire, interview, and other measurement operations (e.g., sociometric measures). Still, we think there is something captured by observational procedures that eludes these other measurement procedures. Nonetheless, there are at least two time-honored alternatives to systematic observation for capturing something of the sequential aspect of interaction. These are (a) narrative descriptions, and (b) properly designed rating scales.

If we were forced to choose between the adjectives "humanistic" and "scientific" to describe narrative descriptions, we would have to choose humanistic. We do so, not to demean the writing of narrative reports – a process for which we have considerable respect – but simply to distinguish it from systematic observation. After all, not only have humanistic methods of inquiry been used far longer than the upstart methods we characterize as scientific, but also the preparation of narrative reports, or something akin to it, is an important part of code development, a process that must precede systematic observation.

Still, narrative reports depend mightily on the individual human doing them, and judgments about the worth of the reports are inextricably bound up with judgments about the personal qualities of their author. In fact, we would be surprised if two reports from different authors were identical. With systematic observation, on the other hand, the goal is for properly

trained observers to produce identical protocols, given that they observed the same stream of behavior. The personal qualities of the observers (assuming some talent and proper training) should not matter. It is primarily this drive for replicability that we think earns systematic observation the appellation "scientific" and that distinguishes it from the writing of narratives.

Rating scales, on the other hand, allow for every bit as much replicability as systematic observation does. In fact, if we defined systematic observation more broadly than we do (see next section), the use of rating scales could easily be regarded simply as another instance of systematic observation. For present purposes, however, we prefer to regard them separately and to point out some of the differences between them. (For a discussion of some of these differences, see Cairns & Green, 1979.) Imagine that we are interested in the responsivity of two individuals to each other, for example, a husband and wife or a mother and baby. We could define behavioral codes, code the stream of behavior, and then note how and how often each was "responsive" to the other (systematic observation), or we could train observers to rate the level of responsivity that characterized the interaction observed.

For many purposes, a rating-scale approach might be preferable. For example, imagine an intervention or training study in which an investigator hopes to change maternal responsivity to infant cues. In this case, what needs to be assessed is clearly known and is a relatively coherent concept which can be clearly defined for raters. Then the far less stringent time demands of a rating-scale approach would probably make it the methodology of choice. On the other hand, if a researcher wants to describe exactly how mothers are responsive to their infants and exactly how this responsivity changes with infant development, then the more detailed methods of systematic observation are required.

1.3 Systematic observation defined

For present purposes, we define systematic observation as a particular approach to quantifying behavior. This approach typically is concerned with naturally occurring behavior observed in naturalistic contexts. The aim is to define beforehand various forms of behavior – behavioral codes – and then ask observers to record whenever behavior corresponding to the predefined codes occurs. A major concern is to train observers so that all of them will produce an essentially similar protocol, given that they have observed the same stream of behavior.

The heart and foundation of any research using systematic observation is the catalog of behavior codes developed for a particular project (see chapter 2). As inventories of questions are to personality or marital satisfaction

research, as IQ tests are to cognitive development research, so are code catalogs (or coding schemes) to systematic observation. They are the measuring instruments of observational research; they specify which behavior is to be selected from the passing stream and recorded for subsequent study.

In many ways, systematic observation is not very different from other approaches to behavioral research. Here, too, investigators need to say what they hope to find out; they need to define what seems important conceptually, they need to find ways to measure those concepts, and they need to establish the reliability of their measuring instruments. However, because human observers are such an important part of the instrumentation, reliability issues loom especially large in observational research, a matter which we discuss further in chapter 4.

In sum, the twin hallmarks of systematic observation are (a) the use of predefined catalogs of behavioral codes, (b) by observers of demonstrated reliability. The entire process of defining and developing coding schemes followed by training observers to acceptable levels of agreement can be both time-consuming and demanding. But without such an effort, the investigator who goes no further than only telling others what he or she sees runs the risk of having skeptical colleagues dismiss such narrative reports as just one person's tale spinning.

1.4 A nonsequential example: Parten's study of children's play

An early and well-known example of systematic observation is Mildred Parten's (1932) study of social participation among preschool children, conducted at the University of Minnesota's Institute of Child Welfare in the late 1920s. There are in fact many excellent observational studies of children's behavior which were done in the 1920s and 1930s, and many of the basic techniques still in use were first articulated then. We discuss Parten's study here as an exemplar of that early work and as a way of defining by example what we mean by "systematic observation." At the same time, Parten's study was not sequential, as we use the term, and so describing both what she did and what she did not do should clarify what we mean by "sequential."

During the school year of 1926–1927, some 42 children whose ages ranged from not quite 2 to almost 5 years were observed during indoor free play. Parten was interested in the development of social behavior in young children, and to that end defined six levels or categories of social participation as follows:

1. *Unoccupied.* The child does not appear to be engaged with anything specific; rather, his behavior seems somewhat aimless. He

might watch something of momentary interest, play with his own body, just wander around, or perhaps stand or sit in one place.

2. *Onlooker.* The child watches other children play, but does not enter into their play. This differs from Unoccupied because the child is definitely watching particular children, not just anything that happens to be exciting.
3. *Solitary Independent Play.* The child plays alone and independently with whatever toys are of interest. The child's activity does not appear affected by what others are doing.
4. *Parallel Activity.* The child still plays independently, but his activity "naturally brings him among other children." He plays beside them, not with them, but with toys that are similar to those the children around him are using. There is no attempt to control the coming or going of children in the group.
5. *Associative Play.* The child plays with other children. There may be some sharing of play material and mild attempts to control which children are in the group. However, there is no division of labor or assigning of roles: Most children engage in essentially similar activity. Although each child acts pretty much as he or she wishes, the sense is that the child's interest lies more with the association with others than with the particular activity.
6. *Cooperative or Organized Supplementary Play.* The child plays in a group that is organized for some purpose. The purpose might be to dramatize a situation – for example, playing house – or to play a formal game, or to attain some competitive goal. There is a sense of belonging or not to the group. There is also a division of labor, a taking of roles, and an organization of activity so that the efforts of one child are supplemented by those of another. (The above definitions are paraphrased from Parten, 1932, pp. 250–251.)

Each child was observed for 1 minute each day. The order of observation was determined beforehand and was varied systematically so that the 1-minute samples for any one child would be distributed more or less evenly throughout the hour-long free-play period. On the average, children were observed about 70 different times, and each time they were observed, their degree of social participation was characterized using one of the six codes defined above.

Florence Goodenough (1928) called this the method of repeated short samples. Today it is often called "time sampling," but its purpose remains the same. A number of relatively brief, nonsuccessive time intervals are categorized, and the percentage of time intervals assigned a particular code is used to estimate the proportion of time an individual devotes to that kind of activity. For example, one 3-year-old child in Parten's study was

observed 100 times. None of the 1-minute time samples was coded Unoccupied, 18 were coded Solitary, 5 Onlooking, 51 Parallel, 18 Associative, and 8 Cooperative. It seems reasonable to assume that had Parten observed this child continuously hour after hour, day after day, that about 51% of that child's time would have been spent in parallel play.

The method of repeated short samples, or time sampling, is a way of recording data, but it is only one of several different ways that could be used in an observational study. What makes Parten's study an example of systematic observation is not the recording strategy she used but the coding scheme she developed, along with her concern that observers apply that scheme reliably.

Parten was primarily concerned with describing the level of social participation among children of different ages, and with how the level of social participation was affected by children's age, IQ, and family composition. For such purposes, her coding scheme and her method of data collection were completely satisfactory. After all, for each child she could compute six percentages representing amount of time devoted to each of her six levels of social participation. Further, she could have assigned, and did assign, weights to each code (−3 to Unoccupied, −2 to Solitary, −1 to Onlooker, 1 to Parallel, 2 to Associative, and 3 to Cooperative), multiplied a child's percent scores by the corresponding weights, and summed the resulting products, which yielded a single composite social participation score for each child – scores that were then correlated with the child's age and IQ.

Knowing that older children are likely to spend a greater amount of time in associative and cooperative play than younger ones, however, does not tell us much about moment-by-moment social process or how Parten's participation codes might be sequenced in the stream of behavior. This is not because her codes are inadequate to the task, but because her way of recording data did not capture behavior sequences. There is no reason, of course, why she should have collected sequential data – her research questions did not require examining how behavior is sequenced on a moment-by-moment basis. However, there are interesting questions to ask about the sort of children's behavior Parten observed that do require a sequential view. An example of such a question is presented below.

1.5 Social process and sequential analysis

The purpose of this book is to emphasize sequential analyses of sequentially recorded data, but we should not let this emphasis obscure how useful and interesting nonsequential data (or the nonsequential analysis of sequential data) can be. At the same time, we want to argue that sequential analyses

can provide an additional level of information about whatever behavior we are observing, a level that is not accessible to nonsequential analyses.

In many ways, Parten's study typifies the sort of "time-budget" information that nonsequential analyses of observational data can provide. Indeed, it is often very useful to know how children, or mothers with infants, or animals in the wild, or office workers distribute their time among various possible activities. Nor is time the only thing that can be "distributed." We could, for example, observe married couples in conversation, code each "utterance" made, and then report percent scores for each utterance code. Computing such percentages is a nonsequential use of the data, to be sure, but it does allow us to determine, for example, whether disagreements are more common among "distressed" as opposed to "nondistressed" couples.

There are, however, additional questions that can be asked. When utterances are recorded sequentially, we can go on to ask what happens after one spouse disagrees or after one spouse complains. Are there characteristic ways the other spouse responds? Are these ways different for husbands and wives? Are they different for distressed and nondistressed couples? (For answers to these questions, see Gottman, 1979a.) At this point, we are beginning to probe social process in a way that only sequential analyses make possible.

In general, when we want to know how behavior works, or functions, within an ongoing interaction, some form of sequential analysis is probably required. For example, a nonsequential analysis could tell us that distressed husbands and wives complain more than nondistressed ones do, but only a sequential analysis could tell us that distressed couples, but not nondistressed ones, tend to react to each other's complaints with additional complaints. Similarly, a nonsequential analysis can tell us that 3-year-olds engage in less parallel play than 2-year-olds, but only a sequential analysis can tell us if, in the moment-by-moment stream of activity, young children use parallel play as a bridge into group activity. An example of such a sequential analysis will be discussed later, but first we present a second nonsequential example.

1.6 Another nonsequential example: Smith's study of parallel play

Parten believed that her study established a relationship between children's age and their degree of participation in social groups: As children became older, they participated more. Her cross-sectional study is often interpreted as suggesting a developmental progression; thus parallel play is seen as a "stage" through which children pass as they develop from solitary to social

group players. This idea found its way into textbooks but was not tested empirically until Peter Smith did so in the late 1970s (Smith, 1978). In the present context, Smith's study is interesting for at least three reasons: for what he found out, for the way he both made use of and modified Parten's coding scheme, and for his method, which only appears sequential, as we define the term.

For simplicity, Smith reduced Parten's six categories to three:

1. *Alone,* which lumped together Parten's Unoccupied, Onlooker, and Solitary
2. *Parallel,* as defined by Parten
3. *Group,* which lumped together Parten's Associative and Cooperative

After all, because he wanted to test the notion that Parallel play characterizes an intermediate stage of social development, finer distinctions within Alone and within Group play were not necessary. Smith then used these codes and a time-sampling recording strategy to develop time-budget information for each of the 48 children in his study. However, Smith did not compute percent scores for the entire period of the study, as Parten did, but instead computed them separately for each of six successive 5-week periods (the entire study took 9 months). These percent scores were then used to code the 5-week periods: Whichever of the three participation categories occurred most frequently became the category assigned to a time period.

Smith's method is interesting, in part because it forces us to define exactly what we mean by a sequential approach. Certainly his method has in common with sequential approaches that successive "units" (in his case, 5-week periods) are categorized, that is, are matched up with one of the codes from the coding scheme. However, what Smith did does not satisfy our sense of what we usually mean by "sequential." It is only a matter of definition, of course, but for the purpose of this book we would prefer to reserve the word "sequential" for those approaches that examine the way discrete sequences of behavior occur. Normally this means that sequential approaches are concerned with the way behavior unfolds in time, as a sequence of relatively discrete events, usually on a moment-by-moment or event-by-event basis. In contrast, Smith's 5-week periods are not at all discrete, and thus his approach is not sequential – as we use the term here – but is a reasonable data reduction technique, given the question he sought to answer.

1.7 A sequential example: Bakeman and Brownlee's study of parallel play

What Smith reported is that many children moved directly from a 5-week period in which Alone play predominated, to one in which Group play

Table 1.1. *Three coding schemes for participation in social groups*

Parten (1932)	Smith (1978)	Bakeman & Brownlee (1980)
Unoccupied	Alone	Together
Onlooker		Unoccupied
Solitary		Solitary
Parallel	Parallel	Parallel
Associative	Group	Group
Cooperative		

Note: A coding scheme is an investigator's attempt to cleave an often intractable world "at the joints." Given here are coding schemes used by the three studies discussed in this chapter. The dashed lines indicate that what Parten coded Unoccupied, Bakeman and Brownlee might have coded either Together or Unoccupied. Similarly, what Bakeman and Brownlee coded Unoccupied, Parten might have coded either Unoccupied or Onlooker. Smith would have coded all of these Alone, as well as what both Parten, and Bakeman and Brownlee, coded Solitary.

did, without an intervening period during which Parallel play was most frequent. He concluded that a period during development characterized by parallel play may be optional, a stage that children may or may not go through, instead of obligatory, as Parten seems to have suggested. Still, Smith's children engaged in parallel play about a quarter of the time, on the average, and therefore, although it was seldom the most frequent mode of play, it was nonetheless a common occurrence. This caused Bakeman and Brownlee (1980) to think that perhaps parallel play might be more fruitfully regarded, not as the hallmark of a developmental stage, but as a type of play important because of the way it is positioned in the stream of children's play behavior. Thus Bakeman and Brownlee raised a uniquely sequential question about parallel play, one quite different from the question Parten and Smith pursued.

Like Smith, Bakeman and Brownlee modified Parten's coding scheme somewhat (see Table 1.1). They defined five codes as follows:

1. *Unoccupied,* which lumped together Parten's Unoccupied and Onlooker.
2. *Solitary.* Unlike Smith, Bakeman and Brownlee chose to keep Unoccupied and Solitary separate. Because they were interested in how these "play states" are sequenced, and because both Solitary and Parallel play involve objects, whereas Unoccupied does not, they thought the distinction worth preserving.
3. *Together.* As far as we know, this code has not been used in other published studies. It appears to be a particularly social way of being unoccupied and is characterized by children clearly being with others – there seems to be an awareness of their association – but without the kind of focus on objects or activities required for Parallel or Group play.
4. *Parallel,* as defined by Parten.
5. *Group.* Like Smith, Bakeman and Brownlee lumped together Parten's Associative and Cooperative.

The source material for this study consisted of videotapes, made during indoor free play. Forty-one 3-year-olds were taped for about 100 minutes each. Observers then viewed these tapes and decided which of the five codes best characterized each successive 15-second interval. This method of recording data represents something of a compromise. It would have been more accurate if observers had simply noted when a different "play state" started. That way, not only would an accurate sequencing of states have been preserved, but accurate time-budget information (percentage of time spent in the various play states) would have been available as well.

This raises an interesting question. Is continuous recording (noting times when different codable events begin and end) better than interval recording (assigning codes to successive time intervals)? We shall have considerably more to say about this matter later. For now, let us simply say that Bakeman and Brownlee were able to extract from their data a reasonably accurate sequence of events, that is, a record of the way different play states followed each other in time.

Viewing their data as a sequence of play states, Bakeman and Brownlee first counted how often each code followed the other codes (for example, they determined how often Group followed Parallel, followed Together, etc.). Then, using methods described in chapter 7, they compared observed counts to their expected values. This was done separately for each possible transition for each child, which means, for example, that if the Parallel to Group transition occurred at greater than expected levels for a particular child, the expected levels were based on how often that child engaged in Group play.

Among other things, Bakeman and Brownlee wanted to know if certain transitions were especially characteristic of the children they observed. Of particular interest was the Parallel to Group transition, one they thought should be frequent if parallel play functions as a bridge into group play. Now just by chance alone, observed values for this transition should exceed expected values for about half of the children. In fact, observed values for the Parallel to Group transition exceeded chance for 32 of the 41 children observed, a deviation from chance that was significant at better than the .01 level (determined by a two-tailed sign test). Thus, Bakeman and Brownlee concluded, the movement from parallel to group play may be more a matter of moments than of months, and parallel play may often serve as a brief interlude during which young children have both an increased opportunity to socialize as well as a chance to "size up" those to whom they are proximal, before plunging into more involved group activity.

The point of this example is that, given a sequential view, coupled with what are really quite simple statistics, Bakeman and Brownlee were able to learn a fair amount about young children's experience in free-play groups. For one thing, it appears that children changed the focus of their activity in quite systematic ways, "one step" at a time. Some transitions were "probable," meaning that observed exceeded expected values for significantly more than half of the children. Other transitions were "improbable," meaning that observed exceeded expected values for significantly less than half of the children (for example, observed exceeded expected values for the Unoccupied to Parallel transition for only 2 of the 41 children). The remaining transitions were neither probable nor improbable; Bakeman and Brownlee called them "possible" or "chance" transitions.

The probable transitions all involved either remaining alone (moving between Unoccupied and Solitary) or else remaining with others (moving between Together, Parallel, and Group). What is interesting, however, is how any movement at all occurred between being Alone and being Together. Thus transitions from Unoccupied to Together (adding a social focus to no focus) and from Solitary to Parallel (adding a combined object and social focus to an existing object focus) were possible, whereas transitions from Unoccupied to Parallel (which would require simultaneously adding both an object and a social focus) or from Solitary to Together (which would require simultaneously dropping an object focus and adding a social one) were improbable. Theoreticians can now argue about what this "one step at a time" model means, but for present purposes, we would just like to emphasize again that without a sequential view and some simple sequential techniques, this bit of social process would have remained undescribed.

1.8 Hypothesis-generating research

Although we have defined systematic observation in terms of the use of predetermined categories of behavioral codes, we do not think that an investigator need have a coding system before collecting data of interest. For example, Gottman began his research on acquaintanceship in children (1983) by collecting tape recordings of children becoming acquainted. He had no idea at first which situations and experimental arrangements were best for collecting the data. Although the literature suggested some social processes to study, such as communication clarity, conflict resolution, and self-disclosure, he had little idea how to operationalize these constructs. A great deal of work was necessary before a useful coding system was devised. He also found that several different coding systems were necessary to capture different aspects of the children's interaction.

Furthermore, we have found in our own research that as an investigator engages in programmatic research in an area, across a series of studies much is learned about how the initial coding system operates. This leads to revisions of the coding system, and, in some cases, to simplifications. For example, consider conflict resolution in preschool children. An example of a disagreement chain is as follows (Gottman, 1983):

Host (H): This is stretchy.
Guest (G): No, it's not.
H: Uh huh.
G: Yes.
H: Uh huh.
G: It's dirty.
H: Uh uh.
G: Uh huh.
H: Uh uh.
G: Uh huh.
H: Uh uh.
G: Uh huh.
H: Uh uh. It's not dirty. (p. 27)

These disagreement chains can have fairly neutral affect. An escalated form of conflict involves negative affect (e.g., anger, crying) and is called "squabbling." Preschoolers getting acquainted at home do not squabble very much. Instead, they manage conflict so that it does not escalate. One of the ways that they do this is by giving a reason for disagreeing. This is a sequence in which a child disagrees and then gives a reason. For example: "No, I don't wanna play house. 'Cause I'm not finished coloring." It turns out that this sequence is very powerful in keeping conflict from escalating, compared to interactions in which the disagreement is not as likely to be followed by a reason for disagreeing. This fact was discovered in an initial study on acquaintanceship; this sequence (disagreement is followed by

giving a reason for disagreeing) then became an operational definition of a salient social process.

It is perfectly legitimate, in our view, to begin the process of systematic observation with the simple goal of description. As we gain experience with the phenomena we are investigating, we learn which variables are important to us. We can begin our investigation with a search for order. Usually we have some hypotheses about what we might expect to find. The wonderful thing about observational research is that it maximizes the possibility of being surprised.

There is a danger in this hypothesis-generating approach, and this has to do with the temptation of not thinking very much about what one might expect, and instead looking at everything. Our experience in consulting leads us to recognize the danger in this approach. Usually investigators who do not generate hypotheses at all will be overwhelmed by their data. A delicate balance must be worked out that is consistent with the researcher's style.

A basic requirement of this kind of exploratory research is that it is essential to replicate and search for consistency across studies. Our experience with this approach is positive: We typically find that confusing results do not replicate, and that interesting, interpretable results do replicate.

To summarize, hypothesis-generating research can play a vital role in the process of description and in the identification of phenomena. This kind of observational research is essential in new areas of investigation. However, it needs to be carefully done by incorporating it in programmatic research that builds in replication.

1.9 Summary: Systematic is not always sequential

We make two assumptions about readers of this book. First, we assume that they are already convinced that systematic observation is an important method for measuring behavior. Second, we assume that they want to explore dynamic, process-oriented aspects of the behavior they observe. This requires that sequential techniques be added to systematic observation.

Systematic observation has two major defining characteristics: the use of predefined behavior codes and a concern with observer reliability. The method is time consuming but offers a degree of certainty and replicability that narrative reports cannot. Even when systematic observation is not sequential, much can be learned, as the work of Parten and of Smith described above demonstrates. In particular, nonsequential systematic observation can be used to answer questions about how individuals distribute their time among various activities, or distribute their utterances among

different utterance categories. The data derived from such studies can then be used to ask the usual questions regard-ing how different groups of individuals vary, or how individuals change with age.

Sequential techniques, added to systematic observation, allow a whole new set of questions to be addressed. In particular, sequential techniques can be used to answer questions as to how behavior is sequenced in time, which in turn should help us understand how behavior functions moment to moment. In fact, for purposes of this book, we use the word "sequential" to refer to relatively momentary phenomena, not for developmental phenomena, which are expressed over months or years.

The purpose of this introductory chapter has been to suggest, both in words and by example, what sequential analysis is, why it is useful, and what it can do. In the following chapters, we discuss the various components required of a study invoking sequential analysis.