The Time Course of Angry Behavior in the Temper Tantrums of Young Children[a]

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There are great differences of opinion regarding the duration and time course of emotions, including anger. Investigators focusing primarily on emotions elicited in the laboratory by experimental manipulations (*e.g.*, viewing of emotion-eliciting slides), and often involving analysis of facial expression, have suggested that emotions in general last for only a few seconds.[1,2] Other investigators relying mostly on diary methods or retrospective accounts of real-life episodes have concluded that emotions last for considerably longer periods, generally on the order of minutes to hours.[3–5] In the case of anger, Frijda *et al.*[3] have suggested that successive angry expressions can succeed one another continuously for as long as the conflict provoking them lasts. These investigators further remark that "some emotions may have particular, built-in time courses . . . [that cannot] be stopped at will by the subject once overt expression has been allowed to go beyond a certain point. . . . Anger need not be very intense to have this sort of inertia. . ." (p. 200). Potegal[6] has presented a related discussion of a putative "neural flywheel" in the aggressive arousal of humans and other animals.

The variation found in empirical studies of anger duration mirrors that in theoretical disputes. The earliest of five surveys in the literature found a unimodal distribution of anger durations in American college women, with the mode being 10–20 min, but with almost as many subjects reporting durations of 5 minutes or less.[7] Subsequent surveys have generated bimodal distributions of anger. The shorter mode in Japanese and American surveys varies from "a few minutes" to "less than 10 minutes."[5,7–10] The longer mode in all surveys was a day or more. One possible source of variance in these surveys is differences in the intensity of the reported anger. In adults, higher intensities of self-reported anger are associated with longer durations (ref. 10, p. 267). Similarly, Gates' data (ref. 7, Table VI) suggests that modal duration increases systematically with intensity of anger. The inertial metaphors cited above imply that higher intensities of anger are associated with longer durations because it requires more time for the anger to dissipate (*cf* the counter arguments of ref. 10).

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The conclusion that substantial numbers of individuals typically experience episodes of anger with durations between 5 and 15 minutes is consistent with experimental demonstrations of the persistence of aggressive arousal over a delay imposed between provocation and test. Kornadt[11] and Konecni[12] found increases in projective and overt behavioral measures of aggressiveness, respectively, in subjects up to 13 minutes after they had been provoked by insult and/or frustration, whereas Doob and Climie[13] and Buvinic and Berkowitz[14] failed to find such effects after delays of 20 or 60 minutes. Note that all of the foregoing studies estimate overall durations of anger persistence; little effort has been expended to characterize the details of anger's trajectory over time. Although it is intuitive to assume that anger declines monotonically, Frijda *et al.*[3] indicate that some individuals report multiple peaks in their experience of anger. Detailed studies in other animals of the time course of aggressive behavior following a brief provocation have also suggested a more complex course with several phases.[15,16]

If little is known about the time course of anger in adulthood, even less is known about its development. This is rather surprising, because young children are less likely to mask their emotions and are therefore potentially good subjects for studies of emotional behavior. The laboratory allows for the controlled manipulation and observation of behavior, but the relevance of data so generated to the emotional behavior of children in the natural environment of the home remains a concern. At the other extreme are spontaneous agonistic interactions between individuals. Dawe[17] reported that the average duration of "quarrels" between preschool children was a quite brief 23 seconds; there was some tendency for quarrel duration to increase with age between 25 and 60 months. However, such agonistic interactions between individuals always involve strategies and negotiations that can profoundly alter the nature and time course of the individual experience.[18] Our approach to these issues begins with the observation that temper tantrums are an almost ubiquitous venue for anger in young children. Because many parents have discovered through trial and error that one way to deal with a child's tantrum is to let her/him "work it out" without interference, the time course and sequence of behaviors in tantrums may be less controlled by the behavior of others than is the course of events in other real world anger/aggressive interactions. Goodenough's[19] classic monograph, "Anger in Young Children" appears to be the sole extended treatment of this subject in English. She reported a range of tantrum durations from less than 1 minute to 75 minutes, with the modal duration estimated at 2 minutes.

As mentioned above, there is more to the time course of anger than its persistance. Parens *et al.*[20] have noted a temporal structure in tantrums consisting of ascending and descending phases of emotional intensity upon which secondary fluctuations are superimposed. Their report, and the accompany figure, are similar to the description by Frijda *et al.*[3] of the multipeaked time course of emotion in adults. Parens *et al.*[20] do not identify the behaviors upon which their estimates of emotional intensity are based.

In an initial survey carried out in the United Kingdom, Einon and Potegal[21] identified stamping/jumping, pushing/pulling, hitting, kicking, and throwing things as behaviors common to tantrums. Behaviors of lower incidence and possibly more deliberate aggressiveness included biting, pinching, scratching, and hair pulling. We now report that these behaviors exhibit a common time course, different from crying and several other tantrum behaviors, and we propose that they collectively reflect anger. We address the following two questions: How does the time course of anger vary with tantrum duration? and Are different angry behaviors associated with different overall levels of anger?

METHOD

Subject Selection

We obtained the names of parents of children between 18 and 60 months old from newspaper announcements of Madison-area births collated by the Waisman Center for Human Development and Mental Retardation. Birth announcements are released by the hospitals to the newspaper automatically unless the parents object; hence these lists represent a large sample of Madison-area in-hospital births. In order to highlight changes in tantrum characteristics with age, we selected noncontiguous age groups of children; that is, children who were 18–24, 30–36, 42–48, and 54–60 months old. Data were gathered in two steps.

Step 1: Telephone Interview

A group of undergraduates were trained in asking a series of questions about the incidence, frequency, duration, and general behavioral characteristics of tantrums and their relation to mealtimes, sleeping and awakening, and illness. Almost all of the parents who were reached by telephone consented to be interviewed. In general, parents (especially mothers) were interested and cooperative in responding to our questions; many volunteered additional information, and some asked for a copy of the results. By the end of stage 1, we had interviewed the parents of 1219 children, of whom 991 were classed as "tantrumers."

Step 2: Descriptive Narratives and Questionnaires

At the end of the telephone interview, parents were asked to provide a written description of one of their child's tantrums. The narrative/questionnaire packet sent to them included two "representative" tantrum narratives, which we wrote to indicate to parents the level of detail we wished reported. An ordered checklist of tantrum behaviors on the back of the narrative form was included to clarify and confirm events described in the narrative. The returned narratives varied from one paragraph descriptions to three pages of detailed notes carefully numbered in order of events with the corresponding clock times recorded. In most cases, once the narrative had been received, the parent was called back to verify details. Eight returned packets included no narrative or were dropped from the study because the narratives were fragmentary, inconsistent, and/or could not be clarified by the follow-up call. One narrative described a 77 min tantrum, almost twice as long as any other, with a unique behavioral pattern. This tantrum was not included. The data base for this report was 330 tantrum narratives.

The age × sex distribution of the children represented in the narrative subsample was almost identical to that in the original telephone survey. The age-related distributions of mean tantrum frequency and duration in children represented in the narratives was also quite similar to those in the survey (details to be reported elsewhere). By these criteria, the children whose tantrums were reported in the narratives appeared representative of those in the preceding telephone survey. Review of job, education, and racial self-identification information provided by parents suggested that respondents were largely middle class (*e.g.*, mean educational level of both parents was college graduate) and, with the exception of two Asian families, white.

Defining Tantrums

Tantrums were defined as beginning with the first occurrence of a major tantrum element: arching back/stiffening limbs, getting down, shouting, screaming, crying, pushing/pulling, stamping, hitting, kicking, throwing, running away; or by an aggressive behavior: biting, pinching, scratching, pulling hair. Because of their low individual rates of occurrence, the four latter behaviors were collapsed into an "aggressive behavior" category. The tantrum was defined as over when the last of these behaviors had stopped. Verbal protests (without raising the voice) were noted and whining was scored, but neither were used as tantrum markers.

Forty of the narratives contained gaps of 0.5–7.0 min during which no tantrum behaviors were reported to have occurred. This presented the problem of distinguishing one tantrum with a pause from two tantrums with an interval between them. After detailed examination of these cases, the following rules were adopted: For tantrums of overall duration < 10 min, a pause of ≥ 2.5 min with no tantrum behaviors was interpreted as separating two distinct tantrums. For tantrums $>$ 10 minutes, the criterion pause was 3 minutes. In all cases with two tantrums, only the first was included in the present analysis. The data reported here consist of tantrums (one each) had by 152 girls and 178 boys 18-62 months old. Mean tantrum duration ($\pm$ SD) = 4.7 $\pm$ 5.9 minutes (range: 0.5–39.5 min).

Constructing "Tantrugrams"

An intermediate step in data processing was the conversion of each written narrative into a tantrugram, a time $\times$ behavior matrix in which time was partitioned into consecutive 0.5 min units, and behavior in each of 15 different categories was scored as occurring or not occurring within each unit. The following rules were used in this conversion: If a parent's estimate of a given behavior duration was a range, for example, 1-2 min, then the behavior was scored as occurring for the mean value of the range, for example, 1.5 minutes. In some cases a behavior was reported as occurring throughout a period but there was no indication whether it was continuous or intermittent. Based on our general experience, screaming and shouting were scored as continuous, whereas angry behaviors were scored in the first, last, and alternate units of the period in such cases. Hitting and kicking included both directed striking and vigorous flailing in the air with arms and legs, respectively. "Down" was scored for any substantial lowering of the body; in most cases the child dropped to the floor, but also included were instances of sitting, squatting, and kneeling. This work was carried out by pairs of trained undergraduate raters each of whom prepared a tantrugram for a given narrative. The two raters then resolved discrepancies by discussion or by referral to a supervisor. The supervisor subsequently reviewed and corrected the final tantrugram.

Statistical Analysis of Behavior Time Course

To provide an adequate statistical base for evaluating the time course of 13 tantrum behaviors (verbal protest and arch/stiff were excluded from this analysis) while allowing for the possibility that tantrums of different duration may have had different dynamics, tantrums were first partitioned into four duration groups: 0.5–2.0 min (n = 135), 2.5–4.0 min (n = 89), 4.5–10.5 min (n = 70), and 11–39.5

min (n = 36). Under the working assumption that processes within a duration group are roughly homogeneous, the momentary probability of each behavior within successive time epochs for each group was estimated by calculating a Poisson rate parameter, λ, for each epoch across the group from the expression

$$\lambda = \frac{-\log(1 - p)}{T},$$

where p, the probability of the behavior, is estimated by the fraction of corresponding epochs (*e.g.*, the first epoch in each tantrum) during which the behavior occurred. T = the duration of the epoch. Momentary Poisson rates (MPR) are used in our analysis as estimates of behavior magnitude or intensity rather than the directly derived probabilities, because λs derived from epochs of different durations are comparable, whereas probabilities are not. As seen in FIGURES 1 and 2, epochs for the first 3 minutes were set equal to the minimum 0.5 min units originally used to score behavior. To offset the reduction in the number of tantrums still occurring at longer durations, epochs on the right side of the graphs for the last two duration groups were made progressively longer to include a larger sample of data from each remaining tantrum. Standard errors and p values were obtained by bootstrap calculations from the MPR. (In the bootstrap procedure, original data sets are sampled with replacement multiple times to obtain new, random data sets of the same size as the original. Statistical quantities derived in this way from the new data sets are free of parametric assumptions and all approximations and are at least as accurate estimates of true population values as those obtained in the conventional way.[22])

RESULTS

Differences between the Time Courses of Angry Behaviors and Other Acts

FIGURE 1 shows a grouping of tantrum behaviors by two gross features of the time course. The behaviors in A, the upper part of the FIGURE, are all characterized by a peak MPR occurring somewhere in the middle of the tantrum. The behaviors in B, the lower part of the FIGURE, are all characterized by an MPR peak at the beginning of the tantrum. In most cases this peak is followed by a monotonic decline. Note that stamping, pushing/pulling, hitting, and throwing things, all behaviors that intuitively reflect anger most directly, appear in B. The only exception appears to be kicking, and its time course may be explained by its coupling to down: a large portion of kicking happens once the child has thrown her/himself to the floor. Thus, in general, angry behaviors have reached their most probable level within the first 30 seconds of tantrum onset and decline steadily thereafter.

In principal components and multidimensional scaling analyses of these data to be reported elsewhere, we have found that, in fact, the parameters of the angry behavior time courses cluster together in parameter space and that the parameters of other behaviors (*e.g.*, screaming, shouting, and down) are at considerable distances. It thus seems reasonable to suppose that a distinct process or set of processes influences or drives angry behaviors. We refer to these processes as anger and consider it a latent variable. What follows are analyses of some of the characteristics of this latent variable.

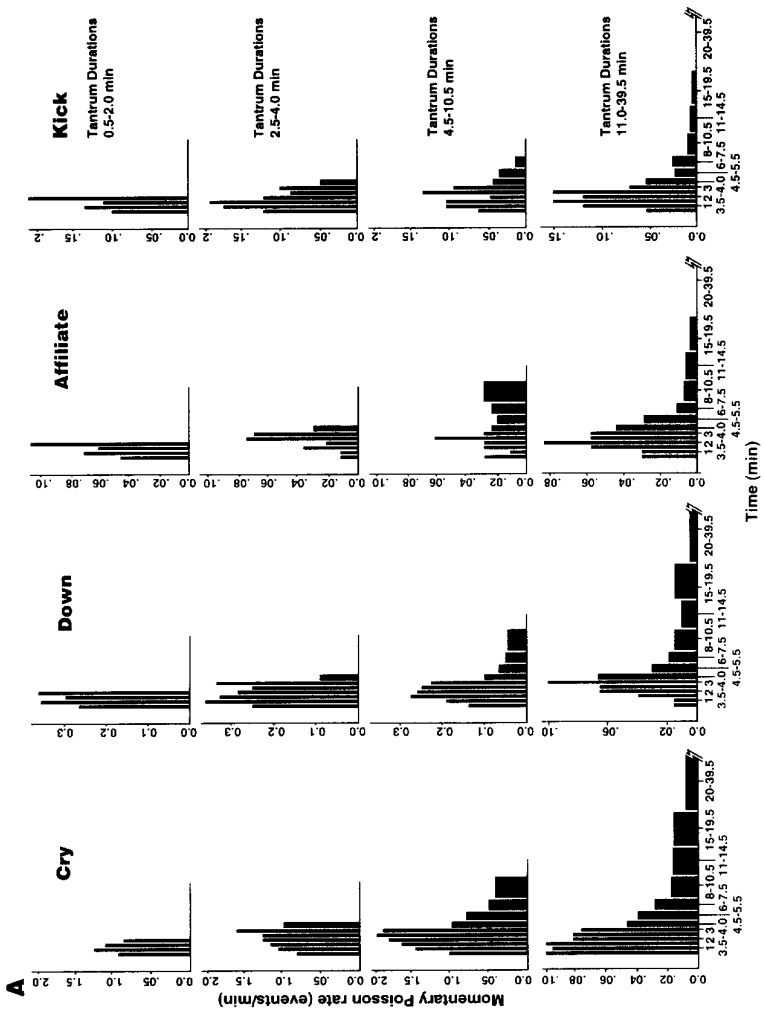

FIGURE 1A. Momentary Poisson rates (MPR) of behaviors whose peak rates occur somewhere in the middle of the tantrum. Tantrums have been collapsed into four groups according to duration.

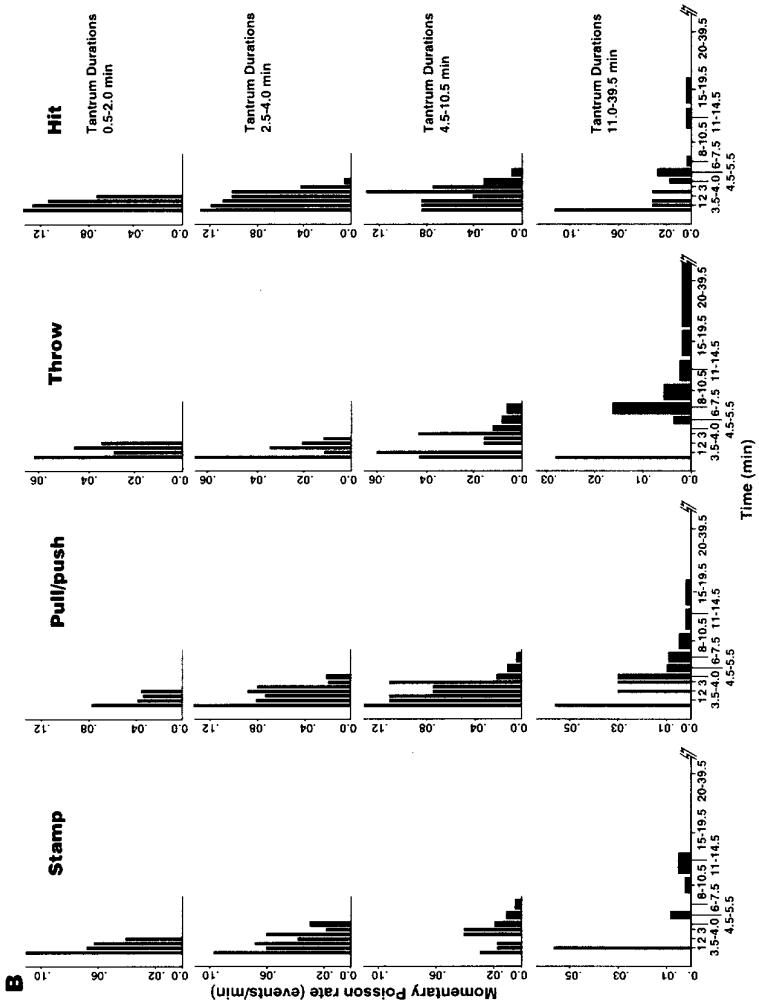

FIGURE 1B. MPR of behaviors whose peak rates occur at the beginning of the tantrum.

The Time Course of Total Anger

The total level of anger in a time epoch is best estimated by combining individual angry behaviors. Unlike probabilities, individual MPRs are additive; we therefore estimate total anger levels by summing the latter. As might be expected from the plots of the individual behaviors, FIGURE 2 shows that the general shape of the time course for each duration group is an initial peak followed by a more-or-less monotonic decline. From the viewpoint of acute tantrum dynamics, one might expect that greater initial anger would be associated with longer tantrums inasmuch as a higher level of initial anger might take longer to dissipate. The plots in FIGURE 2 suggest instead that the longer the tantrum, the lower the initial MPR. That is,

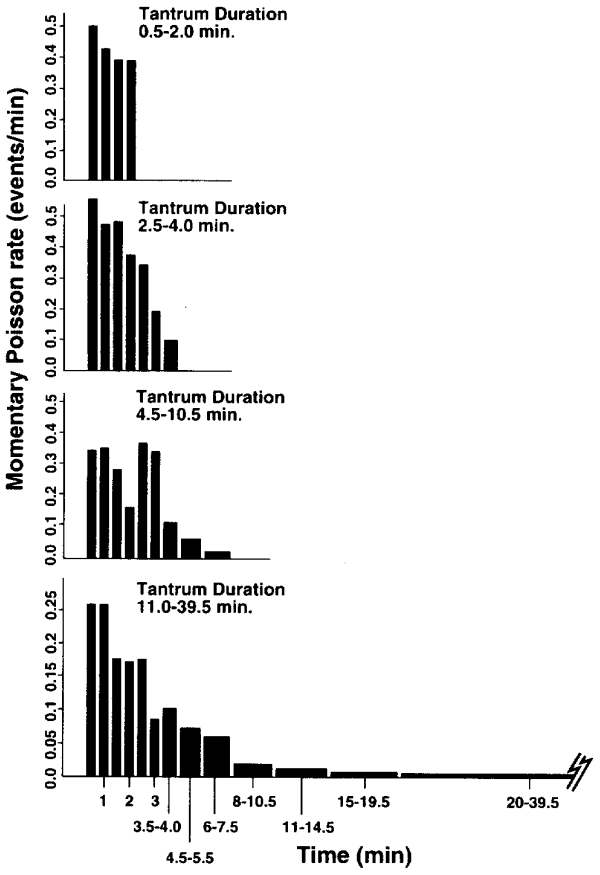

FIGURE 2. Total angry behavior. Summed MPR of stamping, throwing, hitting, kicking, pulling/pushing, and (collectively) scratching, biting, pinching, and hair pulling in four duration groups.

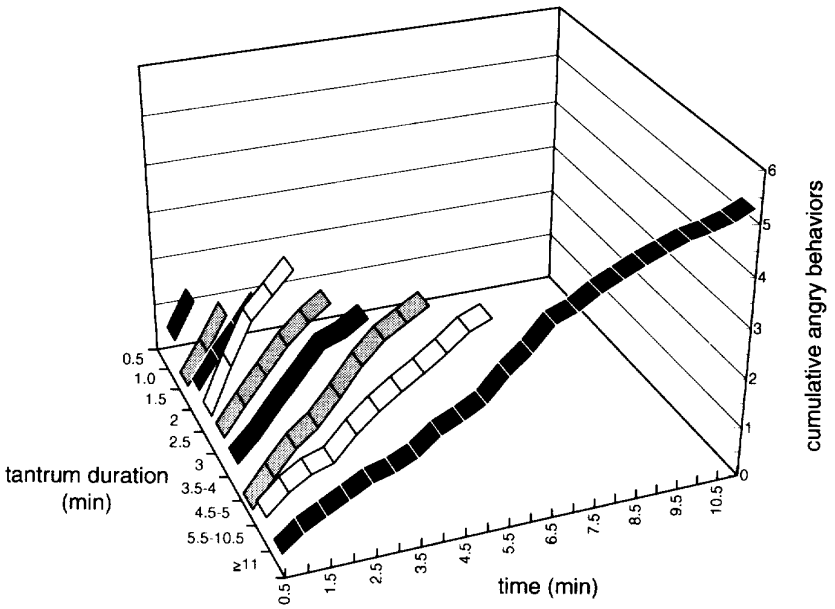

FIGURE 3. Cumulative mean number of angry behaviors in tantrums of nine different durations. The shortest tantrums, 0.5 min long, are not shown. Note that some of the data at the ends of grouped tantrums are truncated (*e.g.*, for tantrums 4.5 to 5.0 min long, the last 30 s of anger in the 5.0 minute tantrums are not shown).

less initial anger is associated with longer tantrum duration. This impression was confirmed by a low but significantly negative Pearson product moment correlation of the number of angry behaviors in the first 0.5 min of the tantrum with the overall tantrum duration across all subjects ($r = -.13$, $p < .02$). Similarly, when tantrums are grouped by duration into 10 groups with durations from 0.5 to ≥ 11.0 min (Ns, the number of subjects, ranges between 25 and 35 for each group), an ANOVA with age as a factor shows that mean rates of anger over the whole tantrum decline systematically with duration [$F(9, 289) = 4.95$, $p < .0001$]. As noted in the DISCUSSION section below, we interpret this finding as showing temperament differences, with children prone to greater distress having longer tantrums with more crying and less anger.

Regardless of the explanation of the inverse relationship, it is still reasonable to ask if the time courses of anger in tantrums of different duration are systematically related. For this analysis we again partitioned tantrum duration more finely into 10 duration groups, but this time we excluded tantrums in which no anger was expressed (Ns ranges from 17 to 30). FIGURE 3 displays the time courses of total anger in these groups as cumulative functions. (Because of the smaller N in each group, the anger versus time plots for these groups were more variable than the plots in FIGURES 1 or 2; the patterns in these more finely partitioned data are better displayed by cumulative plots.) FIGURE 3 clearly shows that growth rates decline systematically with increasing tantrum duration, forming a fan of time

courses. Although not shown as clearly, there is also a strong trend for the starting point of the plots to decline with increasing tantrum duration. Based on the assumption that the number of tantrums in each time interval and each duration group are Poisson distributed, a χ^2-test comparing the mean anger rate in corresponding time units across the plots demonstrated a highly significant difference among these plots ($p < .0001$). Having demonstrated that the plots differ, we then tested whether they are systematically related. Using a nonparametric, rank-based procedure, we compared the observed ordering of mean anger rate in corresponding time units across the plots to the order generated by a 1000 random permutations of these anger rates; the null hypothesis of a random ordering of rates as a function of duration was rejected ($p < 0.01$). The decline in the cumulative growth rate of anger in tantrums of progressively longer duration shown in FIGURE 3 is thus significantly systematic.

Occurrence of Individual Angry Behaviors as a Function of Total Anger MPR

Inspection of FIGURE 1B suggests that there may be some differences among the time courses of individual angry behaviors. Similarly, although all these behaviors clustered in the same locus within the time course parameter space, their individual 95% confidence regions did not overlap. One possible explanation for these differences is that angry behaviors are differentially coupled to or gated by total anger levels. In other words, some angry behaviors may become more probable and others less probable at different levels of total anger. This hypothesis was examined by collapsing all time epochs with the same total anger MPR and computing the proportion of total MPR (the MPRP) accounted for by individual behaviors for each level of total anger. As FIGURE 4 shows, the MPRP of stamping clearly declines as total anger MPR increases. The MPRP of throwing remains constant, whereas hitting, kicking, and pulling/pushing all increase with increasing total anger MPR (see slopes in TABLE 1). The null hypothesis, that there is no systematic relationship between individual and total behavior MPR can be rejected for all behaviors except throwing. Because the MPR of the individual behaviors sum to the total MPR, these plots are not fully independent. However, the bootstrap procedures for estimating statistical significance take this non independence into account; the relative relationship among the slopes is displayed veridically.

The graphs in FIGURE 4 also contain several points that appear to be statistical "outliers." Reanalyses following removal of these outliers did not significantly change any of the reported results. Changes with total MPR account for 20–25% of the variance in stamping, kicking, and pulling/pushing and considerably less in throwing and hitting (TABLE 1). This indicates that much of the variation in the time course of the angry behaviors comes from sources other than the link with overall levels.

Scaling the Angriness of Behavior

The analyses associated with FIGURE 3 further suggest an approach to scaling the angriness of each angry behavior according to its relative contribution to different overall levels of anger (*i.e.*, stamping reflects less anger, because it is most common at the lowest overall levels of anger). We formed an index of angriness for each behavior by calculating the value of the total MPR at each point on the graph weighted by the individual behavior MPRP at that point [*e.g.*,

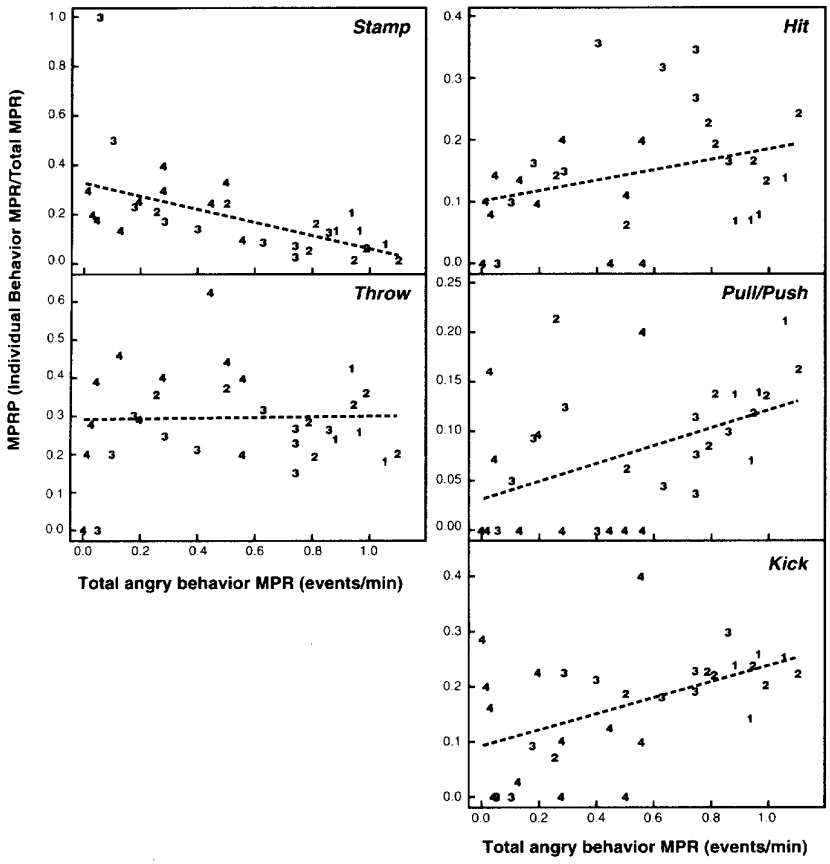

FIGURE 4. MPR of individual angry behaviors as a function of summed MPR of all angry behaviors. Tantrums are grouped into four durations groups, as in FIGS. 1 and 2. Numeric symbols indicate the duration group from which each data point was drawn: 1 = 0.5–2.0 min; 2 = 2.5–4.0 min; 3 = 4.5–10.5 min; 4 = 11–39.5 min.

for stamping: weight = $\Sigma(\text{total}_{mpr} \cdot \text{stamp}_{mprp})/\Sigma\text{stamp}_{mprp}]$. Weights for each behavior are shown in TABLE 1.

DISCUSSION

These results extend the conclusions of Einon and Potegal[21] that there are at least two emotional/behavioral processes with different trajectories at work in temper tantrums (*cf* ref. 23). With the exception of kicking, angry behaviors are characterized by an initial peak in MPR followed by a more or less monotonic

TABLE 1. Characteristics of Angry Behavior MPRs

Angry Behavior	MPRP Slope	Percent Variance Explained	Anger Weight
Stamp	$-.26^a$	25	0.35
Throw	.01	0.1	0.52
Hit	$.08^a$	9.1	0.58
Kick	$.14^a$	26	0.61
Pull/push	$.09^a$	21	0.65

[a] Significantly different from 0.0, $p < .05$.

decline. Although the various angry behaviors appear to differ somewhat in their time courses, multidimensional scaling analysis indicates that they cluster together in a time course parameter space. It is thus plausible to suppose that each of these is a reflection of a common underlying process (or processes) identifiable as anger.

As expected from its constituents, total MPR, the measure of overall anger level, exhibits an initial peak followed by a decline. We have heard anecedotally from some parents that they can see their child becoming visibly more angry at the beginning of a tantrum. Our finding that peak MPR occurs in our first sampling unit suggests that this rising phase of anger must generally happen within 30 seconds. In the future it would be of great interest to chart the rise using observation techniques with a finer time resolution than that provided by narrative reports. For the present, we note that in the preface to their edited volume, The Dynamics of Aggression,[18] Potegal and Knutson remark that there seem to be two temporal patterns of agonistic encounters. Those in which the intensity/riskiness/effortfulness of the behaviors of the antagonists escalate relatively slowly are characteristic of confrontations between strangers in which the outcome of the encounter is in doubt. Those in which the combatants know each other and in which there is a clear asymmetry in dominance/force show a rapid escalation and slower de-escalation (*e.g.*, ref. 24). Tantrums clearly fall in the latter category.

As noted above, it is plausible to suppose that more intense outbursts of emotion should persist for longer times. In our data, parents' judgments of tantrum intensity are significantly correlated with the overall duration of the tantrum. It is thus difficult to explain the observed negative correlation between the initial MPR of angry behaviors and the ultimate duration of the tantrum in terms of acute tantrum dynamics. It also seems implausible that children plan the duration of their tantrum at its outset and adjust their initial anger levels accordingly. These data may be more plausibly interpreted in terms of temperament. Einon and Potegal[21] found that longer tantrums were characteristic of distress-prone children who were less likely than the average child to act aggressively within the tantrum or towards other children outside the tantrum. They were almost twice as likely to be picked on by other children. Thus, longer tantrums may have a lower initial anger because they are had by children more disposed to distress then to anger.

The demonstrated ordering in the plots of cumulative anger suggests that they form a family of related functions. A conventional approach to such an observation is to assume that the differences in the time course of anger observed in tantrums of different durations can be accounted for by variations in the parameter(s) of a single general process of anger operating in all tantrums regardless of duration. A simple example would be an exponential decay of anger; children with high time constants of decay would express anger only briefly, whereas children with

low time constants would express anger persistently. The conventional approach involves transformations of the axes to fit the various plots; the challenge under this approach is to identify transformations that preserve the function and that are orderly (*i.e.*, the transformations accounting for plots of successively longer tantrums form a reasonable sequence). A novel alternative to this standard parametric approach is the hypothesis of a single general anger trajectory. Under this hypothesis, the angry behavior in tantrums of different durations would fall along successive, partially overlapping segments of a single trajectory. The challenge under this interpretation is to reconstruct the trajectory and to specify the respective starting points along the trajectory for the angry behavior of tantrums of each duration. Although these approaches are mathematically isomorphic, they have different emphases. The general trajectory approach emphasizes the commonality of the anger process across tantrums; it implies that if a shorter tantrum were to become protracted, the time course of anger expressed toward its end would resemble that in a longer tantrum. Modeling that contrasts these two approaches is currently underway.

In the shortest duration tantrums shown in FIGURES 1B and 2, anger does not appear to taper off but ends abruptly. The general trajectory model stipulates that the shortest tantrums begin at the highest levels of anger, thus implying that they must involve an abrupt drop in anger. If the termination of anger in shorter tantrums is indeed relatively abrupt, it may be that anger is somehow actively inhibited or suppressed, that is, the emotion is regulated. Three- and four-year-olds have been experimentally shown to suppress mild negative responses in the presence of strangers.[25] In tantrums, distress mounts as anger decreases; perhaps sadness somehow displaces anger in some cases. As Miller and Sperry[26] noted of displays of anger by two-year-olds, an entire tantrum often ends abruptly with the resumption of some other activity (parents commonly report that the aftermath of tantrums is "as if nothing happened.") Thus, anger may be transformed or dissolved as a secondary consequence of a switch in the child's attention. If anger in short tantrums routinely ends abruptly, it brings into question the limits if not the adequacy of inertial metaphors for anger. However, it is also possible that the apparently abrupt endings are artifacts of partitioning time into units that are long relative to total tantrum duration. Tantrum observations with greater temporal resolution are needed to definitively establish the existence of abrupt terminations of anger.

There may also be emotion regulatory processes in which anger is actively prolonged by children (*e.g.*, ref. 27). Parental reports suggest that some children intensify their anger reactions in order to prolong the conflict, make sure that parents have noticed their anger, and get what they want. There are other children who refuse to be jollied out of their negative mood and "hold onto" their anger even when it serves no extrinsic purpose. The influence of such emotion regulatory processes on the trajectory of anger remains to be determined.

There was some agreement between the calculated anger weights and a scale included in the narrative/questionnaire packet on which parents rated the "angriness" of various tantrum behaviors. We foresee the anger weights being used in comparing the angriness of tantrums among different children and across different tantrums of the same child. They will also be useful in other situations in which a quantitative estimate of anger magnitude is desired. However, there remain questions about the extent to which the change in individual behavior probability with increasing overall anger MPR represents different degrees of anger *per se* or reflects factors such as the effortfulness/energy expenditure of various responses, the willingness to flout parental rules against the display of certain behaviors (*e.g.*,

when asked about biting, parents sometimes replied "We don't allow that"), and/or still other mechanisms.

As indicated above, some psychophysiological investigators believe that emotions in general last for only a few seconds.[1,2] Robinson and Pennebaker[28] note the caveat that estimates of emotion duration are constrained by the behavioral/biological systems being measured and that in the psychophysiological domain events typically last a few seconds. Continuous episodes of angry behaviors (*e.g.*, a flurry of hitting) within individual tantrums are usually quite brief and rarely last more than a minute or two. On the other hand, the probability envelope of these behaviors can persist for many minutes. Do these envelopes represent the repeated elicitation or the continuous activation of emotion? The apparently continuous decline in angry behavior in grouped data can be accounted for by an underlying continuous process that controls the probability of this behavior; as the probability drops the behavior appears more and more intermittent. A scheme of this sort has been shown to account for the temporal pattern of aggressive behavior in other animals.[29] The hypothesis of a continuous process is more parsimonious than the alternative account in which anger is reignited *de novo* at progressively longer intervals. A different aspect of the trajectory of anger that is completely unrepresented in our data is the (presumptive) decline in the intensity of acts, for example, the force of blows or the speed of grabbing things. Other observational techniques will be required to develop such data and determine whether they share a time course with behavior probabilities.

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