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On Operationally Defining Reconciliation

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Post-conflict reconciliatory behavior has been reported to occur with variable frequencies in different primate groups and species. Because different investigators have used different criteria to operationalize reconciliation, however, it is possible that the variation reported merely reflects different methods of study. To compare different groups and species in a meaningful way, an accurate operationalization of reconciliation is necessary. This study explores the correlation between operationally defined reconciliation (what observers recognize, such as friendly reunion) and functional reconciliation (behavior that restores a dyadic social relationship) in a group of captive long-tailed macaques, using results from an experiment originally undertaken to demonstrate the function of friendly reunions in restoring dyadic tolerance after aggression. In dyads of unrelated animals, reunions were equally effective in restoring tolerance whether they involved body contact, overt friendly gestures, or mere proximity. Classification of post-conflict reunions as "reconciliations" depends on comparisons with control observations; these comparisons have been carried out in several ways. Comparisons using the "n-minute rule" missed functional reconciliations, whereas those based on the "post-conflict/matched-control rule" appeared to lead to more accurate classification of functional reconciliations. Post-conflict reunions were equally effective in restoring tolerance whether they were initiated by the original aggressor or by the victim. An accurate operational definition of reconciliation, not a conservative one, is prerequisite to comparisons of the frequency of this behavior, and depends on empirical verification. This study suggests specific guidelines for an operational definition based on such verification.

Key words: aggression, social behavior, macaque

INTRODUCTION

Research on a number of Catarrhine primates has demonstrated that soon after escalated aggressive encounters, former opponents tend to seek one another out for friendly interaction [captive groups, Aureli & van Schaik, 1991a; Aureli et al., 1989; Cords, 1988; Cords & Aureli, 1993; de Waal, 1984, 1987, 1989; de Waal & Ren, 1988; de Waal & van Roosmalen, 1979; de Waal & Yoshihara, 1983; Judge,

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1991; Ren et al., 1991; Thierry, 1986; York & Rowell, 1988; wild groups, Aureli, 1992; Cheney & Seyfarth, 1989]. These friendly reunions were first termed "reconciliations" by de Waal & van Roosmalen [1979], and their functions in restoring tolerance levels among social partners to baseline levels [Cords, 1992] and in reducing the performance of tension-related behavior in the victim [Aureli & van Schaik, 1991b; Aureli et al., 1989] have recently been explicitly demonstrated. Some aspects of reconciliation behavior remain puzzling, however. For example, the frequency of reconciled conflicts varies across studies from 7 to 56% [see Judge, 1991, for a review), leading one to ask what factors influence the occurrence of this behavior. One way to answer this question is to correlate the frequency of reconciliation with features of the preceding fight, the social relationship of the opponents, the environment, or species identity [Aureli et al., 1989; Cords, 1988; Cords & Aureli, 1993; de Waal, 1984; de Waal & Ren, 1988; de Waal & Yoshihara, 1983; Judge, 1991; Thierry, 1986]. Quite apart from the difficulty inherent in interpreting correlation as causation is the problem of accurately assessing whether reconciliation, from a functional perspective, has occurred or not in any given instance.

All determinations of the frequency of reconciliation have in fact been made using an operational definition of this behavior, despite the function implied by its name: that is, investigators have looked for specific patterns of affiliative behavior after conflicts (i.e., friendly reunions between former opponents, see below) which are easy to recognize, and which I will refer to as "operationally defined reconciliation." It has been assumed that behavior that fits the prescribed criteria of operationally defined reconciliation does actually function to restore, or at least improve, the relationship between former opponents after aggressive conflict (i.e., that it "functionally reconciles" the former opponents). In a statistical sense, this assumption appears to be justified, as shown by studies demonstrating the function of friendly reunions in restoring tolerance and reducing victims' tension [Aureli & van Schaik, 1991b; Aureli et al., 1989; Cords, 1992]. On a case by case basis, however, functional reconciliation cannot be easily confirmed, so assessments of the frequencies of functional reconciliation (which is of theoretical interest) must be made using an operational definition (which provides a study tool).

Reconciliation was first recognized operationally in a study of captive chimpanzees, in which former opponents were observed to make eye contact and physical body contact (e.g., kiss) after fights [de Waal & van Roosmalen, 1979]. The affiliative nature of these interactions, the fact that they occurred between former opponents, and their timing shortly after aggressive conflicts were features that suggested their interpretation as reconciliatory. An operational definition was sharpened in a later paper on rhesus macaques [de Waal & Yoshihara, 1983] that introduced control observation periods for assessing baseline rates of social interaction when there was no prior aggression: reconciliation was said to have occurred when former opponents interacted (in friendly ways) sooner after a conflict than during controls, and when this decreased latency to friendly reunion was specific to the former opponents, again relative to controls. Most subsequent studies of reconciliation have used some version of this operational definition, comparing post-conflict behavior of former opponents with behavior during control periods, and looking for friendly, selective, and relatively high-rate interactions between former opponents.

Studies have nevertheless differed in some of the specifics of this operationalization, with differences apparently reflecting nothing more than the intuitions and judgments of the various investigators. Because results may be affected by different methods of analysis, it seems important that an empirical basis for evaluating methodological differences be established. This paper evaluates some of the

TABLE I. Age, Sex, and Ranks of Experimental Subjects

Dyad	Age (yr)[a]	Sex[a]	Matriline rank [a,b]	Individual rank[a,c]
Sr, St	3, 3	f, f	1, 4	11, 24
Dl, Jm	14, 9	f, f	1, 2	6, 15
Sn, Ms	10, 4	f, m	1, 2	9, (12)
Rt, Tn	2, 3	f, f	1, 3	8, 19
Sj, Uj	6, 5	f, f	1, 2	10, 16
Rc, Sp	9, 7	f, f	1, 4	7, 24
Tf, Dm	3, 2	m, f	1, 4	(1), 21
Up, Sk	14, 16	f, f	3, 4	14, 22
My, Tr	13, 6	f, f	2, 3	12, 18
Mn, Dj	6, 8	f, f	2, 4	13, 20

[a]Data given in same order as individual name-codes in Dyad column.
[b]There were 4 matrilines in the group.
[c]Individual ranks are given considering only females in the colony. The two male subjects, both juveniles, are represented by their mothers' ranks (in parentheses).

differences in operational definitions of reconciliation using data from an experiment whose main purpose was to demonstrate the function of this behavior in restoring dyadic tolerance. With a clear measure of whether functional reconciliation occurred or not, it is possible to see how varying parameters of the operational definition are associated with the functional outcome: an ideal operational definition should correlate perfectly with that outcome. In particular, I consider what types of post-conflict interactions should qualify as reconciliatory, how one should compare their timing to controls, and whether the identity of the animal that initiates the friendly reunion affects its functional success.

METHODS

Data discussed in this paper come from two sources. The primary source is an experiment originally undertaken to demonstrate the reconciliatory function of friendly post-conflict reunions between former opponents in long-tailed macaques (*Macaca fascicularis*). Details of this experiment have been published more extensively elsewhere [Cords, 1992], but it is described in an abbreviated form below to clarify the data analyzed in the present paper. The second source of data used in this paper is an observational study of the sequelae of spontaneous aggressive conflicts in the same group of monkeys.

Experimental Data

The original purpose of the experiment was to test the reconciliatory function of friendly post-conflict reunions by comparing aspects of the social relationship of dyads at baseline, after aggression and after aggression followed by friendly reunion. If friendly reunions function to reconcile the opponents, these reunions should restore the social relationship to (or toward) its original condition after it has been disturbed by aggression.

The experimental subjects were 10 pairs of long-tailed macaques, part of a larger group of about 37 monkeys, formed in 1981 by removing several matrilines from a long-established colony at the Basel Zoo. The group was housed in a 1,000 m^2 indoor-outdoor enclosure, and was fed a mixed diet. Members of each pair came from different matrilines. Their ages, sexes, and ranks are given in Table I. Only one of the adult females (Tr) had an infant, which accompanied her during tests,

and which spent most of its time very near or clinging to its mother. For each test, the two subjects were separated with minimal disturbance from the rest of the group by vocal and gestural commands. All experimental treatments (see below) were replicated 10 times per dyad with all treatments in one replicate preceding all treatments in the subsequent replicate: thus, treatments in each replicate were matched in time. Only one treatment per dyad was carried out per day. The treatments within one replicate were carried out within approximately 1 week. The same treatments in successive replicates were separated by at least 1 week.

In each test, the dyadic social relationship was assayed for 15 min after the subjects were released into a 33 m^3 cage where two lab-animal bottles of diluted fruit syrup hung above a sitting perch. The distance between bottles was chosen after pilot tests as the smallest distance at which the monkeys would readily drink simultaneously: at shorter distances the dominant animal would not tolerate co-drinking by its partner, or the partner would not even approach the bottles. Dominance was assessed by bared-teeth displays [Angst, 1974; de Waal & Luttrell, 1985].

Each drinking test followed a treatment that occurred in an adjacent cage. In the baseline condition (treatment 1), the monkeys were kept for 5 min, with no aggressive interactions, before being admitted to the bottles. In treatment 2, the observer provoked aggressive conflict (threat by the dominant, submission by the subordinate) by giving the subordinate monkey a tidbit while the dominant watched. When agonistic signals ceased, the monkeys were admitted to the bottles. A comparison of treatments 1 and 2 revealed the effect of aggression on the dyadic relationship as measured in the drinking test. After aggression, subordinate monkeys showed an increased latency to drinking alongside their dominant partners, dominants showed increased rates of aggression to their partners, and the amount of time spent co-drinking decreased. These results were interpreted as showing that the behavioral assay successfully measures conflict-induced disturbances in the characteristic tolerance shown by the partners [Cords, 1992]. However, these data were not analyzed further in the present paper.

To test the role of friendly post-conflict reunions in restoring tolerance, two further treatments were compared. In treatment 3, conflict was again provoked, but the monkeys were allowed to "reconcile". Body contact, close proximity ($\leq$50 cm, $\geq$5 s), or exchange of friendly (but not merely submissive) signals were accepted as potential reconciliations if they occurred within 7.5 min (median = 1.12 min, and 93% of qualifying interactions occurred within the first 4 min) of the conflict. This time limit was selected partly for practical reasons (to ensure that at least 4 tests could be completed each day) and partly because it seemed that friendly reunions occurring much later were less obviously related to the conflict, as the former opponents were likely to be distracted by events outside the cage. If no friendly reunions occurred, the test was repeated; such repetitions were necessary for a total of 10 tests in 7 different dyads (in 8 of these 10 cases, only one repetition was required). When the friendly reunion ended, the monkeys were admitted to the bottles. Treatment 2 could be a control for treatment 3: greater tolerance in the latter case, however, might merely reflect the time that elapsed before reunion occurred, rather than the interaction per se. Therefore treatment 4 was introduced as a control: after provoked conflict, the observer distracted the dominant monkey to prevent friendly reunions for a period equal in length to that taken by the monkeys to make such a reunion in the previous treatment 3 test; they were then admitted to the bottles. Distraction was achieved by showing and occasionally offering tidbits. (Tidbits had to be offered occasionally to avoid the animals' losing interest in looking at them. The tidbits were tiny and did not

apparently alter the animals' eagerness to attend to them when they were presented.) After treatment 3, latencies to co-drinking decreased, aggression by the dominant partner decreased, and the time spent co-drinking increased relative to treatment 4, and did not differ from baseline. In conjunction with controls for the distraction manipulation, this result was interpreted as evidence that friendly reunions do function as reconciliations, restoring social relationships after they have been disturbed by conflict (Cords, 1992).

The analysis presented in the present paper uses data from treatments 3 and 4 in the experiment described above. The friendly reunions that occurred in treatment 3 were not under the control of the experimenter, and varied in several ways, including the type of affiliative behavior shown, the exact timing of the reunion after conflict, and the identity of the partner that initiated the reunion. Thus it is possible to analyze how each of these aspects of friendly reunion (or operationally defined reconciliation) is related to functional reconciliation. For such an analysis, however, it is necessary to recognize a functional reconciliation. I used as a measure the latency to the subordinate's co-drinking with the dominant for at least 2 sec (N.B.: the dominant could be drinking or merely sitting within 50 cm of a bottle, but the subordinate had to drink), and considered functional reconciliation to have occurred in treatment 3 only if the latency to co-drinking was shorter than in the matched treatment 4. For a quantitative measure of how effective the reconciliation was, the numerical difference of the treatment 4 and treatment 3 latencies was used: only positive differences were considered reconciliations, and the larger the difference, the more effective the reconciliation was. This difference in latencies could not be calculated if co-drinking did not occur in one or both treatments, and 12 such cases were omitted. The latency measure was chosen because it gave very clean results in the original analysis of experimental results [Cords, 1992]. Another functional measure used in that analysis, namely, the amount of time spent co-drinking (relative to a random expectation derived from each individual's total drinking time, and thus corrected for motivational variation), gave essentially the same results as those reported here; however, since this measure does not add substantially to the conclusions, and since it is probably not independent of latency, details of this analysis are not reported.

The data used in the present analysis consist of multiple replicates on independent dyads. When there were enough data, statistical analysis was carried out at the level of individual dyads; otherwise, the data were pooled, but patterns in the data from each dyad were evaluated by eye to see if they conformed to the results from the pooled sample. To test for homogeneity within each dyad, a preliminary analysis was made on post-conflict behavior as a function of replicate number. In neither treatment 3 nor treatment 4 was the latency to co-drinking related to replicate number (Page tests, one-tailed $P > .05$): in other words, the monkeys did not become generally more tolerant of one another with time (N.B.: latencies did not decrease in treatment 1 either, Page test, one-tailed $P > .05$). In treatment 3, there was also no tendency for functional reconciliations to occur more often in some replicates than others (Cochran Q test, two-tailed $P > .05$). Thus it seemed justified to combine the 10 tests for each dyad.

The first analysis concerns how variation in the type of behavior exhibited in post-conflict reunions (treatment 3) relates to functional reconciliation. The behavior shown in reunions varied in friendliness, and interactions were ranked from most to least friendly as follows: (1) *Contacts* involved actual physical contact between former opponents, including grooming, mounting, sitting-in-contact, and brushing against one other (either while passing along a beam or shelf, or while changing position when the two sat in proximity). (2) *Friendly proximity* involved

TABLE II. Frequency With Which Reunions of Different Types Actually Functioned to Reconcile Opponents

Type of reunion	Proportion reconciled (%)
Contact[a]	46/57 (81)
Friendly proximity	12/12 (100)
Friendly distance	14/15 (93)
Mere proximity	13/16 (81)

[a]"Contact" included grooming and mounting (14 of 15 such reunions were functionally reconciled) and other forms of contact such as sitting-in-contact and brief touches (32 of 42 such reunions were functionally reconciled). Splitting the "contact" category into these two components does not change the result that functional reconciliation is independent of the type of reunion.

the two animals sitting <50 cm for >2 sec, without any physical contact, but with some friendly signal by one or both individuals. Such signals included eyebrow-raising, lipsmacking, and grunting and one case of close visual inspection. Merely submissive signals by the subordinate victim (e.g., bared teeth) were not included. (3) *Friendly signals over a distance* included the same signals as friendly proximity, as well as show-looking [van Hooff & de Waal, 1975] if it elicited a response from the opponent. However, the monkeys did not approach one another closer than 50 cm for more than 2 sec. (4) Finally, *mere proximity* involved the partners coming within 50 cm for >2 sec without the exchange of any overt friendly signals, and without physical contact. 11 of the 16 cases of mere proximity were timed, and averaged 13.3 sec (range 3–40 sec).

Observational Data

Observations were made of the sequelae of spontaneous aggressive conflicts in the entire group of macaques when it occupied its large outdoor quarters. Most of these observations were made during 15 months before the experiment described above began: there was a one-month period when experimental and observational data were both collected, but observations were made in the mornings and experiments were carried out in the afternoons. The methods used in collecting the observational data have been detailed in Cords and Aureli [1993, Z group]. Briefly, one of the opponents in an aggressive conflict was monitored for 15 min after the conflict had ended, and its behaviour was compared to that observed during a control period with no preceding aggression that occurred one or a few days later. Data were collected on 244 dyads in the group, none of which comprised the same two individuals. Only one conflict per dyad was included in the analysis, so that there were 244 matched pairs of observations in the sample.

RESULTS

Types of Friendly Reunions That Function as Reconciliation

Table II shows the proportion of different types of post-conflict reunion, graded according to friendliness as described above, that satisfied the functional definition of reconciliation. The different types of interaction did not differ in their effects on the social relationship as measured in the drinking test (Kolmogorov-Smirnov test, two-tailed $P > .10$): all were highly successful in reducing the latency to co-drinking. Although the data in Table II are combined for all 10 dyads, the same homogeneous pattern is apparent when each dyad is inspected separately; there are too few data, however, for individual statistical analyses.

Of particular interest are those reunions characterized by mere proximity, since many investigators have excluded such reunions from their operational definitions of reconciliation [Aureli & van Schaik, 1991a; Aureli et al., 1989; Cheney & Seyfarth, 1989; de Waal, 1984, 1987; de Waal & Ren, 1988; de Waal & van Roosmalen, 1979; de Waal & Yoshihara, 1983; Judge, 1991; Ren et al., 1991]. Table II shows, however, that among the dyads tested, such reunions were as effective in functionally reconciling former opponents as other reunions that involve exchange of more overt friendly signals. Indeed, if the results of the original experiment [Cords, 1992] are limited to cases of reunion with mere proximity, one would still conclude that reunions do effectively reconcile former opponents (Sign test, one-tailed $P = .011$, for all dyads combined; 7/8 dyads with 1–3 scores each for mere proximity showed functional reconciliations more often than not).

Results are similar if the effectiveness of reconciliation is considered. The type of reconciliatory interaction did not significantly influence the difference in latencies to co-drinking by the subordinate in treatments 3 and 4 (Kruskal-Wallis test, $H_{corr} = 1.35$, two-tailed $P = .717$, 3 df, for all data combined). All individual dyads showed the same homogeneous pattern.

The Timing of Reunions

Time criteria in operational definitions of reconciliation rely on comparisons of post-conflict behavior with controls. Two methods have been used. First, since control observations are usually matched to post-conflict periods in that both occur within a few minutes or days of one another, some investigators have compared each post-conflict session to its matched control, and have judged reconciliation to occur when friendly reunion between former opponents occurs earlier in the former than in the latter, or only in the former and not in the latter [the PC/MC rule; Cords, 1988; de Waal & Ren, 1988; de Waal & Yoshihara, 1983; Ren et al., 1991; York & Rowell, 1988]. The advantage of this method is that it is specific to a particular dyad at a particular time in its social relationship: since different dyads may have different baseline rates of interaction, and these rates may fluctuate as a function of recent social events within the dyad or in the group, controls that allow for this variation are valuable. Nonetheless this method has been criticized for allowing too many errors of classification, since a particular post-conflict reunion is compared to only a single control observation, not to a sample of such observations [Aureli et al., 1989].

For this reason, a second method has been used, in which the rate of post-conflict reunions for the group as a whole is compared to the baseline rate of similar friendly interactions in the absence of immediately preceding aggression: most studies have found that the rate of post-conflict reunions exceeds the baseline rate for only a few minutes after the conflict [Aureli et al., 1989; Cords, 1988; de Waal & Ren, 1988; de Waal & Yoshihara, 1983; Ren et al., 1991; York & Rowell, 1988]. A reconciliation is then defined operationally when post-conflict reunion occurs within the period for which group post-conflict interaction rates are higher than group control interaction rates [Aureli et al., 1989]. Friendly post-conflict reunions occurring after this period are not classified as reconciliatory. This method (the n-minute rule) has the advantage of basing classification decisions on a larger sample of control observations, but, as used so far, it ignores variation in interaction rates among different dyads in the group and over time. In principle these problems could be avoided if one established a baseline interaction rate for a particular dyad at a particular time, but this would require a density of data exceeding that of any study to date. Other advantages of this method are given by Aureli et al. [1989].

TABLE III. Frequency With Which Reunions Occurring at Different Times Post-Conflict Actually Functioned to Reconcile Opponents

Time after conflict (min)	Proportion reconciled (%)
0–1	38/41 (93)
1–2	19/26 (73)
2–3	16/19 (84)
3–4	6/7 (86)
5–7.5	6/7 (86)

The experiment demonstrating functional reconciliation allows one to evaluate the suitability of the n-minute rule for the group of macaques tested. In the experiment, any friendly reunion occurring within 7.5 min of the conflict was accepted as potentially reconciliatory. According to the observational data, however, only those interactions occurring within 2 min post-conflict would be classified as reconciliatory using the method of Aureli et al. [1989]. Table III shows that friendly reunions occurring within 2 minutes of a conflict and those occurring more than 2 min after a conflict are equally likely to reconcile the partners in a functional sense (Fisher Exact test, two-tailed $P > .05$). The table shows data pooled for all dyads, but when each is examined separately the same results hold in every case (Fisher Exact test, two-tailed $P > .05$ for each dyad, $N = 8$ dyads in which both reconciliatory and non-reconciliatory reunions occurred earlier and later than 2 min). Thus the 2-min rule would appear to underestimate the frequency of functional reconciliation.

It is not possible, with the present data, to evaluate directly whether classification by the PC/MC rule would give a better fit to the functional results than classification with the 2-min rule; this is because the experiment on functional reconciliation did not include controls for baseline levels of friendly interactions, which would be needed for the PC/MC comparisons. There is indirect evidence, however, that classifying with the PC/MC rule would fit the functional results more closely. Summarizing observational data from the entire group, Table IV shows how the two operational definitions of reconciliation agree with one another: although there is high agreement overall (87%), it is clear that the 2-min rule identifies only a subset of those post-conflict interactions classified as reconciliations by the PC/MC rule. In fact, the only disagreement in classification between these two rules concerns cases of friendly reunion that occurred later than 2 min post-conflict, but still earlier in the post-conflict period than in the control period (or only in the PC period). These cases are classified as reconciliation by the PC/MC rule, and most of them (23/31) occurred within 2–8 min post-conflict. The results of Table III show that friendly post-conflict reunions occurring within this time span are equally effective in functionally reconciling opponents as those that occur in the first 2 min only. Thus it appears that the PC/MC rule includes as reconciliations some interactions that are excluded by the 2-min rule, but which nonetheless satisfy the functional definition equally well as those interactions included by both rules. (To judge whether the remaining 8 cases also satisfied the functional criterion, it would be necessary to extend the experiment by including in treatment 3 cases of friendly reunion occurring more than 7.5 min after the conflict.)

Furthermore, there is no indication that the 2-min rule separates reconciliations that are more or less effective. Friendly reunions occurring within 2 min of conflict were equally effective in reducing the latency to the subordinate's co-

TABLE IV. Classification of Post-Conflict Friendly Reunions as Reconciliations by the PC/MC and 2-Minute Rules

	PC/MC rule	
2-min rule	Reconciliation	No reconciliation
Reconciliation	51	0
No reconciliation	31	162

drinking with the dominant as those that occurred from 2–7.5 min (Mann Whitney U test, $Z = -.799$, two-tailed $P = .424$). The same result holds when each of the 9 dyads that showed variation in the timing of the reunion is analyzed separately.

Initiation of Friendly Reunions

Although no investigators have limited their operational definitions of reconciliation to friendly reunions initiated only by the original aggressor or only by the victim, the question of which opponent acts as initiator has been considered in several publications [Aureli et al., 1989; Cords, 1988; de Waal & Ren, 1988; Judge, 1991; York & Rowell, 1988]. With the present data, it is possible to consider whether friendly reunions initiated by either partner are differentially likely to function as reconciliations, or whether they differ in their effectiveness.

In the experiment, the dominant animal was always the aggressor in the provoked conflict of treatment 3. The initiator of the friendly reunion was defined as the individual that first approached or gave a friendly signal to its partner. In 93 of the 100 friendly reunions it was possible to clearly assign the role of initiator. Of 53 reunions initiated by aggressors, 45 (85%) satisfied the criterion of functional reconciliation. This fraction is not significantly different from the 35 of 40 reunions (88%) initiated by victims that were functionally reconciled. The same results are found when individual dyads are analyzed separately (Fisher Exact test, two-tailed $P > .05$ in every case, $N = 8$ dyads in which the identity of the initiator varied), and when initiations involving an exchange of signals are examined separately from those involving only approaches (Fisher Exact tests, two-tailed $P > .05$ for all dyads pooled; there were too few data to analyze dyads separately).

When the effectiveness of reconciliation is considered, and when data from all dyads are pooled, a difference does emerge depending on which party initiated the reunion. Considering only those cases in which a functional reconciliation occurred, those initiated by aggressors ($N = 39$) show a latency to codrinking in treatment 4 decreased by an average of 96 sec relative to treatment 3, whereas those initiated by victims ($N = 33$) showed a mean decrease of 166 sec (Mann Whitney U test, $Z_{\text{corr for 7 ties}} = -2.11$, two-tailed $P = .035$). An analysis of results from individual dyads, however, reveals that in 6 of 7 for whom there was variation in the initiator of the reunion, there is no significant difference in the effectiveness of the reunion depending on its initiator. The trend observed in the pooled data seems to be due to one single dyad, which, when removed from the combined data set, leaves no significant difference in the effectiveness of reunion as a function of which opponent was the initiator.

DISCUSSION

The results presented here suggest empirically derived guidelines for operationalizing the concept of reconciliation. At least in this group of captive long-tailed macaques and after conflicts about priority of access to food, reconciliation

can be recognized operationally as (i) first post-conflict non-aggressive encounters between former opponents, including mere proximity, (ii) occurring after a conflict sooner than expectations based on baseline interaction rate measured (once) for the same dyad at about the same time, (iii) regardless of which opponent initiates the encounter. This operational definition agrees most closely with a functional measure of reconciliation, namely the restoration of baseline tolerance levels in a co-feeding situation.

The fact that mere proximity functions as reconciliation may surprise those most familiar with demonstrative primate species, like macaques and chimpanzees. In fact, most studies of reconciliation in such species have excluded post-conflict reunions involving mere proximity as reconciliations [Aureli & van Schaik, 1991a; Aureli et al., 1989; Cheney & Seyfarth 1989; de Waal, 1984, 1987; de Waal & Ren, 1988; de Waal & van Roosmalen, 1979; de Waal & Yoshihara, 1983; Judge, 1991]. Other monkeys, like guenons, however, generally exchange few overt specialized signals [Rowell, 1988], and their lack of appeasement signals has been particularly noted [Rowell, 1971]. Nonetheless, guenons like patas monkeys are attracted to one another after fights, and their post-conflict behavior has been interpreted as reconciliatory, even though it mostly involves adjustments in spatial position rather than more obviously affiliative displays [York & Rowell, 1988]. Rowell and Olson [1983] have suggested that an absence of discrete displays characterizes a separate behavioral mechanism underlying group cohesion, in which the emphasis is on monitoring others' movements and adjusting one's own position accordingly; they suggest that such a mechanism may be fundamental in gregarious species, complementary to more specialized communication systems based on discrete displays. The results of the present study agree with this hypothesis, inasmuch as a simple change in spatial position seems to communicate to the partner a change in the social relationship separately from, but in much the same way as, more discrete and obviously friendly signals, such as body contact or facial expression. Long-tailed macaques can evidently achieve reconciliation in both ways. These results do not imply that proximity after conflict occurs only to reconcile former opponents, however: subordinates may also approach dominants to monitor their disposition to renew aggression, and dominants may approach subordinates to continue aggression if the situation is appropriate.

De Waal and Yoshihara [1983] noted previously among rhesus monkeys that former opponents tend to spend more time in proximity after aggressive conflicts than during controls, but they did not count encounters involving mere proximity as reconciliations. In a later publication, de Waal [1989, p. 115] describes similar encounters as "tension breakers" rather than as reconciliations. The experiment on the function of post-conflict reunions described here, however, makes it clear that these encounters do restore a functional aspect of a social relationship, namely, dyadic tolerance: they do more than merely break the ice. Their significance may derive both from the fact that the partners show interest in one another by approaching or not leaving respectively, and from the fact that aggression is neither continued nor renewed.

The analysis presented here does not fully answer the question of what proper controls are for analyzing post-conflict behavior. The n-minute rule and PC/MC rules lead to largely concordant results [see also Aureli & van Schaik, 1989]. The preceding results suggest, however, that the n-minute rule is perhaps unnecessarily conservative when used to classify post-conflict reunions as reconciliations, and that the PC/MC rule gives a better fit to the functional results. Aureli et al. [1989] also found the n-minute rule to be more conservative than the PC/MC rule. As they point out, however, the n-minute rule has practical advantages over the PC/MC

rule: classification is independent of the length of the post-conflict observation period, and control observation periods can be omitted once the rule is established for a given situation. Furthermore, the n-minute rule allowed them to test the function of friendly reunions in reducing the victim's rate of tension-related behavior with an observational study. For evaluating the frequency of reconciliation in any particular situation, however, the PC/MC rule may still be the method of choice because of its apparently greater accuracy with respect to functional reconciliation.

In the experimental dyads, aggressors and victims of aggression were equally likely to initiate post-conflict reunions, and reunions were equally successful at reconciling the former opponents when initiated by either partner. The question of which partner *should* initiate reconciliation is beyond the scope of this paper, but the results presented here do suggest that this expectation should not be based on the effectiveness of reconciliation when initiated by one partner or the other. It seems that the aggressor and the victim, by initiating a friendly post-conflict reunion, can expect equal success in restoring mutual tolerance to baseline levels.

The present analysis suggests that some previous operationalizations of reconciliation are overly conservative, excluding certain types of encounters or excluding encounters occurring at certain times that nonetheless function to reconcile former opponents. Such conservatism is not a problem for studies whose aim is to document the existence of post-conflict reunion or its reconciliatory function, for it tends to favor the null hypothesis. To compare the frequency of reconciliation behavior between species, groups, or different types of dyads, however, an accurate operational definition of reconciliation is a necessity, especially since there may be systematic differences between these units in terms of when or how they reconcile. Excessive conservatism could lead to false conclusions.

It is important, however, to remember that the results reported here are of a statistical nature: the guidelines suggested by the analysis do not guarantee correct classification of an individual post-conflict reunion as a functional reconciliation. Comparisons of the frequency of reconciliation across dyads, sub-groups or species must be made with a reasonably large sample of reunions: real differences in the reconciliation frequency (the signal) should then be apparent despite occasional misclassifications (the noise).

A natural follow-up question concerns the generality of the results presented here. Two aspects of the study are of special concern. First the members of the dyads tested were unrelated. It is conceivable that friendly reunions involving mere proximity could have a different, and probably greater, reconciliatory significance for non-kin than for kin, who spend more time together generally: that is, related opponents might have to be more explicit. Data from the observational study, however, suggest that kin and non-kin do not differ in the types of friendly reunions made after conflicts: considering only those cases in which reconciliation occurred (by the PC/MC rule), 6/12 reconciliations by close kin (mother-offspring and maternal sibling pairs) and 20/70 reconciliations of unrelated (or less closely related) animals involved mere proximity ($G = 2.05$, two-tailed $P > .10$).

Second, the experiment was carried out on dyads, isolated from the rest of the group, and the results obtained in this context might be specific to it. In particular, mere proximity after conflict could be of greater significance in this socially limited context than when other animals are present and interaction of former opponents with third parties brings them together in "accidental" ways. (On the other hand, it is also possible that former opponents take advantage of interactions with third parties to bring about subtle post-conflict reunions.) Unfortunately, the group context would make experiments demonstrating the reconciliatory function

of single post-conflict encounters, and hence the sort of analysis presented here, very difficult, if not impossible. As a general argument against the context-specificity of results, however, we may note that in another study, patterns of the distribution of reconciliation were robust despite variation in group size (from 6 to 37 individuals) and the fact that some conflicts were spontaneous and some were provoked [Cords & Aureli, 1993]. The only way to be absolutely sure that operational definitions developed for one situation can be generalized, however, is to conduct further empirical tests of the correspondence between functional and operationally defined reconciliations.

CONCLUSIONS

1. In a group of captive long-tailed macaques, post-conflict reunions were equally effective in restoring dyadic tolerance levels to baseline values whether they involved body contact, overt friendly gestures, or mere proximity. All types of reunions could thus be classified as "reconciliations."

2. Classification of post-conflict reunions as "reconciliations" depends on comparisons with control observations: comparisons using the n-minute rule missed functional reconciliations, whereas those based on the post-conflict/matched-control rule appeared to lead to more accurate classification of functional reconciliations.

3. Post-conflict reunions were equally effective in restoring dyadic tolerance levels to baseline values whether they were initiated by the original aggressor or by the victim.

4. An accurate operational definition of reconciliation, not a conservative one, is prerequisite to comparisons of the frequency of this behavior, and depends on empirical verification.

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