RESEARCH ARTICLE

Social Facilitation of Fur Rubbing Behavior in White-Faced Capuchins

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In their natural environment, capuchins select certain plants, containing secondary compounds with bactericide, insecticide or fungicide properties, to rub their pelage energetically (i.e. fur rubbing). Fur rubbing can be performed in solitary, or collectively in subgroups of variable size and composition, and most of the time fur rubbing happens in synchrony with other group members. The aim of this study is to understand the underlying mechanisms of this phenomenon, and, more particularly, to determine the processes involved in its synchronization. For this purpose, we designed a set of experiments where white-faced capuchins (Cebus capucinus) were presented with onions (Allium cepa) that they use to fur rub. We conducted a detailed kinetic study of fur rubbing behavior to determine if its synchronization is the consequence of simultaneous responses of different individuals to the same stimulus or if, on the contrary, there is a real collective phenomenon where individuals respond to conspecific behavior. Our results reveal that fur rubbing is a collective behavior with a mimetic underlying mechanism. If fur rubbing with onions (a plant with antifungal and repellent properties) allows capuchins to treat their fur against parasites or pathogens, its synchronization would optimize the treatment by acting as a group barrier to ectoparasite propagation. Am. J. Primatol. 70:161–168, 2008. © 2007 Wiley-Liss, Inc.

Key words: behavioral synchronization; Cebus capucinus; collective phenomenon; self-medication; social facilitation

INTRODUCTION

Fur rubbing has been reported in capuchin monkeys (Cebus spp.) [Baker, 1996, 1997, 2000; DeJoseph et al., 2002; Leca et al., in press; Valderrama et al., 2000], in owl monkeys (Aotus spp.) [Zito et al., 2003], and in black-handed spider monkeys (Ateles geoffroyi) [Campbell, 2000; Dare, 1974; Richard, 1970], but it has been particularly well studied in the white-faced capuchin (Cebus capucinus) [Baker, 1996, 1997, 2000; DeJoseph et al., 2002; Leca et al., in press]. In this species, items used for fur rubbing have pungent smells, are tactually stimulating, and contain secondary compounds that are known for their medical benefits or as insect repellents [Baker, 1997]. This behavior is labeled differently according to the type of items involved: (1) fur rubbing when items used are plant materials [Baker, 1996, 1998; Campbell, 2000; Quinn, 2004], (2) peat-bathing when peat is used [Ludes & Anderson, 1995], (3) self-anointing when millipedes are involved [Birkinshaw, 1999; Carroll et al., 2005; Valderrama et al., 2000; Zito et al., 2003] and (4) anting when ants are used [Falotico et al., 2004; Longino, 1984]. Although it may also be involved in scent marking [Campbell, 2000], the items used in fur rubbing are purportedly functional in repelling insects or removing ectoparasites [Baker, 1996], and thus this behavior has been mainly considered for its medicinal benefits [Baker, 1996; DeJoseph et al., 2002; Ludes & Anderson, 1995; Valderrama et al., 2000].

Surprisingly, even though the self-medication function of fur rubbing has attracted considerable attention, only a few studies have addressed the underlying mechanisms of this behavior. Some authors [Baker, 1997, 2000; Huffman, 2007] studied the identification and selection of fur rubbing items by white-faced capuchins and examined the cognitive components of plant selection. Recently, Leca et al. [in press] investigated the link between the form of

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fur rubbing and a number of social variables in two capuchin species (*Cebus capucinus* and *C. apella*). Synchronization of fur rubbing can be readily observed in capuchins, where it involves simultaneous fur rubbing by several individuals that may or may not be in physical contact [Baker, 1996; Quinn, 2004]. Accordingly, some authors proposed the existence of two forms of fur rubbing: (a) “social fur rubbing” when several individuals fur rub in body contact with each other [Baker, 1996; Ludes & Anderson, 1995; Quinn, 2004], and (b) “solitary fur rubbing” [Baker, 1996] when individuals fur rub simultaneously but not in physical contact with each other. Leca et al. [in press] recently examined the impact of social variables on the form of fur rubbing. These authors showed that in white-faced capuchins, individuals could fur rub together frequently, irrespective of their degree of kinship, affiliation, or dominance interval. However, no studies have addressed the underlying mechanisms of synchronization in fur-rubbing behavior.

The synchronization of group members allows the coordination and cohesion of different individuals, thereby optimizing the benefits of group-living [Coussi-Korbel & Fragaszy, 1995; Elgar & Catterall, 1982; Krebs, 1974; Laland & Williams, 1997; Lazarus, 1979; Mason & Reidinger, 1981; Pitcher & Parrish, 1993]. The synchronization of individual behaviors is not necessarily the result of a collective phenomenon. Group members may respond simultaneously to a common stimulus independently of conspecific behavior. As with the starter’s gun at the start of a race, this kind of “false” collective phenomenon appears in several species [Krause & Ruxton, 2002]. Thus, the fact that some phenomena involve many individuals performing the same activity at the same time does not imply that such a phenomenon is collective, as no inter-individual dependence may exist. Although the study of such mechanisms on captive groups could permit to learn more about the behavior’s practice in the wild, such investigations are still scarce [Huffman & Hirata, 2003, 2004]. The main purpose of this study is to examine the mechanisms underlying synchronization during fur rubbing. Synchronization could be due to (1) an “independent simultaneous response” of monkeys to a common signal, i.e. the presence of stimulant items to fur rub or (2) to a “dependent response” of monkeys to conspecific behavior, i.e. inter-individual interactions could reinforce the response to the signal. Whenever individual behavior depends on conspecific behavior, mimetic processes may be involved [Meunier et al., 2006]. The underlying dynamics of this kind of phenomena are characterized by autocatalytic processes [Camazine et al., 2001]. To explore the underlying mechanisms of synchronization (i.e. how the monkeys influence each other), we studied the dynamics of fur rubbing, i.e. the temporal evolution of the number of capuchins fur rubbing simultaneously when the stimulus plant is available. By studying dynamic processes, we considered the temporal aspect of fur rubbing independently of its spatial aspect, i.e. social fur rubbing and solitary fur rubbing (see above for an explanation). Thus, we pooled these two forms of fur rubbing in our approach, which focused on collective fur-rubbing in terms of displaying the same behavior at the same moment. We used detailed kinetic analysis and mathematical modeling to explore the relation between individual behavior and collective phenomena.

**METHODS**

**Subjects and Environment**

The group of white-faced capuchins was established in 1989 at the Primate Centre of the Louis Pasteur University in Strasbourg, France. The group contains 15 individuals from three separate lineages. Our experimental subjects were four males (ages 1, 2, 6, and 12) and eight females (1, 2, 5, 6, 6, 11, 13 years-old, and one individual aged at least 20 years); three individuals of less than 1 year old were not studied. The group was kept in an 1-acre outdoor enclosure with natural vegetation and had free access to an indoor shelter. Commercial primate pellets and water were available ad libitum. Fresh fruits and vegetables were provided once a week, but not during testing.

**Observation Procedure**

The observation procedure complied with protocols approved by the “Certificat d’autorisation d’expérimenter sur animaux vivants no 67–99 (Direction des Services Vétérinaires, Préfecture du Bas-Rhin, France)” and adhered to the legal requirements of CNRS, France. Observations took place between 14:00 and 17:30 from July to October 2005. Two observers collected data with two camcorders (Sony DCR-PC110). This design allowed filming of up to four subgroups of animals because most of time, capuchins performed fur rubbing in two specific limited areas. Each observer filmed one of these areas. When individuals were out of shot, the first author recorded their behavior with an ad libitum behavior sampling method [Altmann, 1974] using a tape recorder. We conducted 30 experiments in which bulbs of onions (*Allium cepa*) were supplied as fur-rubbing items. *Allium cepa* is known for its antifungal effects [Pyun and Shin, 2006] and is used by humans for its repellent properties [Guarrera, 1999]. In each experiment, we supplied 11 onions that had been previously cut into four pieces. Only one experiment was conducted per day. Onions were deposited on the park ground in a 1 m² “deposit area” that was always the same. Pieces of onion were
still available in the deposit area at the end of observations: $13 \pm 9$ (mean $\pm$ SEM). We took resource deposition as a reference time for calculating latencies of recorded behaviors. Temperature and hygrometry were measured at the beginning of each experiment.

**Video and Audio Processing**

Video and audio sequences were played back and analyzed by the first author. The occurrence of fur rubbing was recorded individually using 1 s instantaneous sampling [Altmann, 1974]. For each monkey, we obtained a number of sequences of variable duration corresponding to the different fur-rubbing episodes performed.

**Data and Statistical Analysis**

**Temperature and hygrometry**

We tested the differences of temperature and hygrometry between months using the Kruskal–Wallis test [Siegel & Castellan, 1988]. We pooled data of September and October because only two trials were conducted in October. We found no difference either for temperature ($\chi^2 = 4.269; N_{\text{July}} = 7; N_{\text{August}} = 12; N_{\text{September–October}} = 11; P = 0.118$) or for hygrometry ($\chi^2 = 4.186; N_{\text{July}} = 7; N_{\text{August}} = 12; N_{\text{September–October}} = 11; P = 0.123$) between months. Moreover, we tested the effect of variations of temperature and hygrometry on fur-rubbing duration using Pearson’s correlation test. Neither temperature ($r^2 = -0.086; P = 0.116$) nor hygrometry ($r^2 = 0.123; P = 0.068$) influences fur-rubbing duration.

**Fur-rubbing episodes**

To distinguish between two consecutive fur-rubbing episodes, we adopted Baker’s critical interval of 10 min [1996]. To analyze dynamics of fur rubbing, we focused on the time intervals between fruit deposit and the first fur-rubbing episode ($\Delta T_{01}$), between the first two individuals fur rubbing ($\Delta T_{12}$), and so on for each interval ($\Delta T_{i-1,i}$). We used the sign-test [Siegel & Castellan, 1988] to test which intervals ($\Delta T_{i-1,i}$) differed significantly from one another. Significance levels were set at 0.01.

**Kinetic Analysis**

The kinetics is characterized by the probability of starting fur rubbing and the probability of stopping fur rubbing.

**Probability of starting**

When the probability of beginning fur rubbing is independent of the time elapsed since the deposit of items, the time intervals between fruit deposit and the first fur-rubbing behavior ($\Delta T_{01}$) follow an exponential distribution:

$$P_0(t) = e^{-\Psi_0 t}$$  \hspace{1cm} (1)

where $\Psi_0$ corresponds to the probability of initiating the first fur-rubbing episode and $t$ corresponds to the time elapsed since the supply of onions.

The mean starting time of the first individual to fur rub ($\Delta T_{01}$) is the inverse of $\Psi_0$, which is the sum of the individual probabilities of beginning fur rubbing. In the case of $n$ individuals having the same probability of starting ($\lambda_i$), the probability of initiating the first fur-rubbing episode is:

$$\Psi_0 = n \lambda_1$$  \hspace{1cm} (2)

and the mean latency time $\Delta T_{01}$ is:

$$\Delta T_{01} = \frac{1}{\lambda_1 n}$$  \hspace{1cm} (3)

The other inter-rank latencies also follow an exponential distribution and the mean interval between $i-1$ and $i$ are:

$$\Delta T_{i-1,i} = \frac{1}{\lambda_i(n + 1 - i)} \hspace{1cm} i = 1, ..., n$$  \hspace{1cm} (4)

where $\lambda_i$ corresponds to the probability of the rank $i$.

Assuming that all individuals have the same probability of starting fur rubbing $\lambda_i = \lambda$ irrespective of their rank, the general equation of a mean interval $\Delta T_{i-1,i}$ is:

$$\Delta T_{i-1,i} = \frac{1}{\lambda(n + 1 - i)} \hspace{1cm} i = 1, ..., n$$  \hspace{1cm} (5)

The interval increases along ranks:

$$\Delta T_{01} < \Delta T_{12} < \ldots < \Delta T_{n-1,n}$$

This increase is expected whether the probabilities of starting fur rubbing are identical or different between individuals.

Assuming the existence of mimetic behavior, all but the first individual to fur rub have a new probability of starting fur rubbing $\lambda_i$ ($i = 2, \ldots, n$), which increases with the number of individuals already fur rubbing:

$$\lambda_1 \leq \lambda_2 \leq \ldots \leq \lambda_n$$

In short, the individual probability of starting fur rubbing ($\lambda_i$) increases with the number of capuchins already fur rubbing. When individual behavior is affected by conspecific behavior and is not time-dependent [see Reader, 2004 for details], intervals must not increase any further along ranks. Conversely, the $\Delta T_{i-1,i}$ distribution should exhibit a minimum. As numerous mimetic dependence processes may coexist, in the following section, we will aim to determine the underlying process of fur-rubbing dynamics.

**Mimetic process determining**

To determine the underlying mimetic process, we focused on the distribution of the intervals ($\Delta T_{i-1,i}$), which were multiplied by the number of individuals still “inactive,” i.e. individuals that could
participate in the probability of starting fur rubbing (Fig. 2b):

\[ IP_{t-1,i} = (\Delta T_{t-1,i})(n + 1 - i) = \frac{1}{\lambda_i} \quad i = 1, \ldots, n \]

\[ IP_{t-1,i} \] is the inverse of the probability of starting fur rubbing \( \lambda_i \).

**Probability of stopping**

The survival curve shows the fraction \( F \) of fur-rubbing sessions still running after \( t \) seconds as follows:

\[ F = e^{-\int_0^t k(\tau) d\tau} \]

\[ \ln F = -\int_0^t k(\tau) d\tau \]

where \( k(t) \) is the probability of stopping fur rubbing per unit of time.

We estimated the probability \( k(t) \) by fitting the fraction of sessions still running at time \( t \) with the polynomial equation (9):

\[ k(t) = \sum_{i=0}^{l} a_i t^i \]

\[ \ln F = -\sum_{i=0}^{l} \frac{a_i t^{i+1}}{i+1} \]

If \( a_0 > 0 \) and \( a_1 = a_2 = \ldots = a_j = 0 \), the probability of stopping \( k(t) \) is constant and independent of \( t \).

**Modeling: Monte Carlo Simulation**

We used Monte Carlo simulations to identify the main factors underlying the fluctuation of our experimental results. These kinds of simulations automatically incorporate the random aspects of the process. The steps can be summarized as follows:

- **Decision process:** At each time step (i.e. each second), the decisions of the \( n \) individuals are tested. To determine the choice of an individual (i.e. whether to stay in its behavioral state or not), the value of a random number is compared with \( \lambda_i \) or to \( k(t) \). For each monkey, the random number is drawn from a uniform distribution between 0 and 1. If its value is less than or equal to \( \lambda_i \) or \( k(t) \), the monkey begins fur rubbing or stops it. Simulations were run 1,000 times.

**RESULTS**

**Description of Fur Rubbing**

Typically, after the deposition of onions on the park ground, capuchins would approach them, grab one or two pieces, and then climb into trees or other elevated structures in their park. The minimum number of individuals fur rubbing in an experiment was six, of which four of them were recorded for fur rubbing simultaneously, and the whole group participated in fur rubbing in 10 experiments. The mean number of individuals fur rubbing per day was 10.5 ± 1.5 individuals, of which 8.7 ± 2.4 fur rubbed simultaneously. As illustrated in Figure 1 (●), fur rubbing exhibited the following dynamics: the mean number of individuals fur rubbing simultaneously increased quickly from the beginning of fur rubbing, reached a maximum, remained constant for a few minutes, and then decreased slowly. The latency to the first fur-rubbing event was of 139 ± 88 sec. The number of individuals fur rubbing simultaneously reached a peak at 541 ± 260 sec from resource deposit. The mean individual duration of a fur rubbing episode was of 805 ± 580 sec (pooled for all individuals). We recorded a total of 316 episodes for all individuals.

![Fig. 1. Mean number of individuals fur rubbing simultaneously in relation to the time elapsed since onion deposition. (●) Experimental data (with standard deviation in grey); (○) simulated data of "dependent individuals"; (Δ) simulated data of "independent individuals."](image-url)
Fur-Rubbing Dynamics

Probability of initiating fur rubbing

After the supply of onions (t = 0), two different types of dynamics are theoretically possible. Capuchins may either react to the stimuli provided by the supply of onions independently to conspecific behavior or, alternatively, their initiation of fur rubbing could be influenced by conspecific behavior. We analyzed the first latencies of fur rubbing, i.e., the time spent between fruit deposit and the first fur-rubbing behavior for each experiment. These latencies follow an exponential distribution \((r^2 = 0.9436)\) [see equation (1)] and, therefore, the probability of beginning fur rubbing is independent of the time elapsed since the supply of onions.

Are individuals independent? The distribution of intervals \((\Delta T_{i-1,i})\)

Mean experimental intervals are presented in Figure 2a. The first interval is significantly higher than the second one (Sign Test: \(N_{\text{Negative Differences}} = 28, N_{\text{Positive Differences}} = 2, N_{\text{Ties}} = 0; P < 0.001\)), which reflects an increase in the probabilities of initiating fur rubbing as a consequence of fur-rubbing initiation by a conspecific.

We tested which intervals \((IP_{i+1,i})\) differed significantly from one another. We analyzed 12 x 11/2 possible combinations. As illustrated in Figure 2b, \(IP\) of the first rank \(IP_{0,1}\) is significantly higher than those of intervals 2–11 (Sign Test: \(N = 17–30; P < 0.004\)). \(IP_{1,2}\) to \(IP_{1,12}\) (rank 2–12) are not different to some of the others (Sign Test: \(N = 10–30; P > 0.01\)), which suggests that subsequent participants have the same starting probability \(\lambda^\prime\)\).

\[\lambda_2 = \lambda_3 = \ldots = \lambda_n = \lambda^\prime\] higher than the one of the first individual \(\lambda_1\) \((= \lambda = 6 \times 10^{-4} \text{ in our experiments})\). The mimetic process between individuals is an “all-or-nothing” one: the probability to start fur rubbing is very low until the initiation of fur rubbing by the first capuchin, which triggers a quick response from all the others. After the initiation of fur rubbing, all “inactive” individuals have a new probability of starting fur rubbing \(\lambda^\prime = 27.10^{-4} \text{ sec}^{-1}\).

Probability to stop fur rubbing

A good fit is obtained with a second-order polynomial equation \((r^2 = 0.996, \text{Fig. 3})\) corresponding to

\[k(t) = a_0 + a_1 t\]

with \(a_0 = 6 \times 10^{-4} \text{ sec}^{-1}\) and \(a_1 = 10^{-6} \text{ sec}^{-2}\).

The fitting curve shows that the probability of stopping \([k(t)]\) increases with the duration \(t\) of fur rubbing.

Simulation Results and Predictions

Using this mathematical model, we simulated different situations. First, we simulated “independent individuals,” i.e., individuals who respond to the deposition of onions independently of conspecific behavior [see equation (5), Fig. 1: \(\Delta\)]. Second, we simulated “dependent individuals,” i.e., individuals whose response to the deposit of onions is affected by conspecific behavior, assuming an all-or-nothing mimetic process [see equation (4), Fig. 1: \(\oplus\)]. Finally, we compared these results with our experimental data (Fig. 1: \(\bullet\)). As illustrated by Figure 4, only the simulation assuming “dependent individuals” fits well with our experimental data.

The dynamics of fur rubbing is governed by four parameters, \(\lambda, \lambda^\prime, a_1, a_2\), and by the total number of

\[\text{Fig. 2. Interval duration (inter-rank latencies } \Delta T_{i-1,i} \text{). (a) The mean duration of intervals and (b) the same durations but multiplied by the number of individuals still inactive.}\]

\[\text{Fig. 3. Survival curve of the fraction } F \text{ of fur-rubbing sessions still running according to time (}\circ\text{). The equation corresponds to the second-order polynomial equation fitting our experimental data (black line).}\]
individuals $n$. Here, we tested the influence of these parameters on group synchronization. As a measure of group synchronization, we used the mean of the maximum fraction of the number of individuals performing fur rubbing simultaneously (i.e., maximum mean of the number of individuals fur rubbing/the total number of individuals in the group). In particular, we focused on the initiation of fur rubbing (involving a mimetic process) and on the influence of $\lambda$, $\lambda'$, and $n$ on group synchronization.

Not surprisingly, we found that group synchronization increases with increasing $\lambda'$, but we also found that synchronization values quickly reach a plateau, which is much less evident (Fig. 4). We also tested the impact of large individual probabilities of spontaneously starting fur rubbing by implementing a probability $10$ times higher than our experimental one ($\lambda = 6 \times 10^{-3} \text{sec}^{-1}$). We found an important fraction of individuals fur rubbing simultaneously (high synchronization of 0.835, Fig. 4). This means that mimetic behavior is not required to reach a high synchronization when individuals have a high spontaneous probability of initiating fur rubbing.

Concerning the influence of $n$, increasing $n$ values decrease group synchronization under both the “independent individuals” and the all-or-nothing model (Fig. 5: $\Delta$ and $\bigcirc$). However, in a mimetic process involving a linear increase of $\lambda_i$ relative to the number of individuals fur rubbing ($\lambda_i = \theta (i-1)$ ($i = 2, \ldots, n$), where $\theta$ measures the influence of all other group members already performing fur rubbing), synchronization does not decrease monotonously but increases after reaching a minimum value (Fig. 5: $\square$). The number of individuals corresponding to this minimum changes according to the value of $\theta$.

**DISCUSSION**

Our study strongly suggests that fur-rubbing initiation is influenced by conspecific behavior in white-faced capuchins. We found that the individual probability of initiating fur rubbing does not depend on the time elapsed since the resource is made available, but increases when one or several conspecifics engage in fur-rubbing activity. Thus, our results demonstrate the existence of a mimetic synchronized phenomenon in this context and thereby, in white-faced capuchins, we can conclude that fur rubbing is a real collective behavior in the sense that individuals respond to their group members. The mimetic process demonstrated here refers clearly to social facilitation, which is defined by Byrne [1994, p 237] as when “the presence of a conspecific performing an act (often resulting in reward) increases the probability of an animal which sees it doing the same”. In the present study, the initiation of fur rubbing by one or several capuchins would draw the attention of other group members and trigger their own initiation of fur rubbing.

To validate our hypothesis that fur rubbing involves a mimetic process, we constructed a model [Camazine et al., 2001; Deneubourg & Goss, 1989; Sumpter, 2006]. The comparison between our experimental distribution and distributions obtained from Monte Carlo simulations allowed us to confirm that fur rubbing is a collective phenomenon driven by mutual dependence on conspecific behavior. Simulations that assumed independent individuals, with a probability of fur rubbing that was estimated from experimental data, did not reproduce the observed collective dynamics. A synchronization pattern with an elevated number of individuals fur rubbing simultaneously only appeared when we assumed “mimetic capuchins.” We are aware that,
by considering all individuals to be identical, our model does not apparently take into account the existence of potential individualities; for example, different individuals could exhibit differences in their motivation to begin fur rubbing or in their probability to mimic conspecific behavior. However, our simplified formulation is an important first step. It is a traditional approach in modeling as it allows evaluating the role of anonymous processes in the phenomenon under study [Camazine et al., 2001]. Moreover, our model included quantifiable parameters \( \alpha \) and \( \alpha' \) to take into account interindividual differences, which will be expressed in spontaneous individual probabilities: individual motivation to begin fur rubbing is represented by \( \lambda \) and the mimetic factor, which could also vary individually, is represented by \( \lambda' \). Different individual values would only contribute to create more ranks (i.e., individuals would initiate fur rubbing more frequently in the first, second, or any other given position) but global dynamics would remain the same.

Moreover, in our model, the probability to first begin fur rubbing depends on the sum of all individual’s probabilities, irrespective of their values (identical or different). Much in the same way, the characteristics of our interval distribution will remain the same irrespective of the actual values of individual mimetic probabilities, whether they are identical or differences exist between them. Thus, individual characteristics do not influence the general dynamics of the phenomenon and would not have changed our results qualitatively.

Not surprisingly, the probability of ending fur rubbing is time-dependent, i.e., the longer a capuchin rubs its fur, the greater the probability of ending fur rubbing. In contrast with the beginning of the collective phenomenon, the ending of fur rubbing by one or several group members does not seem to influence an individual’s probability to continue fur rubbing. This coupling between mimetic behavior and the time dependence of the probability of ending fur rubbing \( k(t) \) is enough to synchronize individuals.

Demonstrating that capuchins perform fur rubbing collectively raises the question of the functional significance of collective medication. Indeed, if fur rubbing serves to reduce or control ectoparasites, as proposed in the literature [Baker, 1996; DeJoseph et al., 2002; Ludes & Anderson, 1995; Valderrama et al., 2000], synchronizing fur rubbing may increase its efficiency by acting as a collective barrier to ectoparasite propagation in the group. By mimicking other conspecifics, individuals could also benefit from the experience of other group members. Animals often face decisions where different choices have different fitness outcomes and, in these situations, any piece of extra information about the various alternatives would be useful [Danchin et al., 2004]. There are two ways to acquire additional information that cannot be assessed directly, by individual trial-and-error or by using social information. Social information is usually less costly than trial-and-error learning and may provide information that can lead to more accurate estimates of the environment [Doligez et al., 2003]. Mimetic fur rubbing by capuchins may be similar to the use of public information in a foraging context [Galloway et al., 2005; see also Galef & Giraldeau, 2001; Heyes & Galef, 1996 for reviews]. It could thus be interpreted as an efficient way to gather information about the appropriate items for fur rubbing.

To conclude, we are fully aware that our results are limited to one social group and that supplementary data on other plants, medicinal or not, and from additional groups are required to generalize our conclusions. Nevertheless, the characteristics of the dynamics highlighted here are very similar to those described for the same species during collective moves in the particular context of “provoked departure” [Meunier, 2007]. Moreover, the existence of a mimetic process underlying this kind of dynamics seems widespread in several collective contexts in capuchins, as in the collective choice of direction during group movements [Meunier et al., 2006]. Our results argue against some generally accepted ideas on primate societies and the mechanisms underlying collective phenomena in these groups. Perhaps due to the complex cognitive capacities and social systems of primates, collective phenomena are generally perceived as being based on complex multimodal processes, and therefore difficult to model [Meunier et al., 2006]. However, white-faced capuchins are certainly not the only species, where collective phenomena may be explained by these types of processes and dynamics, and our methodology could be applied to numerous other species performing similar group activities.

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