

THE EVOLUTIONARY ROOTS OF HUMAN COMMUNICATIVE REPAIR: THE CASE OF CHIMPANZEE GROOMING

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Human communication is characterized by several distinct aspects such as directionality, reference, and role reversal. If a communicative interaction fails, humans use distinct mechanisms to repair it. Surprisingly, relatively little is known about the evolution of repair and possible precursors in non-linguistic species. Thus, this paper introduces possible precursors of communicative repair in grooming interactions of one of our closest living relatives, the chimpanzees (*Pan troglodytes schweinfurthii*). In 1996, Dunbar had suggested that early humans engaged in complex grooming interactions, before grooming was replaced with a more efficient bonding system - language. Therefore, grooming offers a unique platform to investigate the evolutionary precursors of communicative repair.

1. Introduction

How humans perceive and interact with each other is predominantly through language. Why only humans developed this unique communicative system remains a mystery (Hauser et al., 2014; Knight, Studdert-Kennedy, & Hurford, 2000) and has led to considerable scientific debate (Christiansen & Kirby, 2003). Some researchers postulated that turn-taking is one of the most ancient mechanisms underpinning the layered language system (Levinson, 2016). This cooperative interaction during conversations was first systematically described by Sacks and colleagues (1974). It requires the combined effort of at least two participants, who alternate short, reciprocal, flexible, and non-overlapping turns to coordinate their interaction during conversations. Turn-taking involves distinct temporal relationships (~200 ms time windows, Stivers et al., 2009), the establishment of participation frameworks (who and when should they talk, move or act next), and the use of repair mechanisms (hereafter communicative repair) to counteract problems during communication.

Recently, comparative researchers started to investigate whether turn-taking is indeed an ancient mechanism that is already present in non-linguistic primate

species (e.g., Fröhlich et al., 2016; Pika, Wilkinson, Kendrick, & Vernes, 2018; Ravnani, Verga, & Greenfield, 2019; Rossano, 2018). Individuals alternating the production of signals can be found in several non-linguistic primate species, with the majority of research focusing on the temporal relationships characterizing turn-taking interactions and adjacency pair-like sequences (see Pika et al., 2018 for a recent review). However, relatively little is known about communicative repair in non-linguistic species.

Communicative repair in human conversations is defined as 'fixing' a misunderstanding or communicative problem (Schegloff, Jefferson, & Sacks, 1977), with researchers distinguishing between self-and-other-initiated repair. Self-initiated repair refers to an actor producing communicative means to counteract trouble in a conversation. It entails *repetition*, e.g., repeating the entire or part of the previously spoken turn, or *elaboration*, e.g., rephrasing the previously spoken turn (Kitzinger, 2012). Dingemanse and colleagues (2015) in a cross-linguistic study, showed that across twelve languages, 48% of communicative repair occurrences included individuals partially repeating their initial spoken turn during spontaneous conversations. In contrast, other-initiated repair refers to someone other than the speaker identifying the communicative trouble and using means to counteract it (Dingemanse & Enfield, 2015). Here individuals may locate the source of trouble in the prior communicative turn (e.g., repeating a certain word), use question words (e.g., "Who", "What", "Where?", "Huh?") or maintain silence and stare at the speaker, i.e., freeze looks (Dingemanse & Enfield, 2015; Manrique & Enfield, 2015).

In a study of native English speakers, communicative repair occurred at a delay (~700 ms) after the last spoken turn during face-to-face conversations (Kendrick, 2015). Compared to the average temporal gap of 0-500 ms between turns found across several human cultures (Stivers et al., 2019). Furthermore, Lerner and Raymond (2021) recently showed that communicative repair also occurs in non-verbal bodily actions. They reported troubles during exchanges of manual actions, such as premature (mis)recognition of an emerging action, that are repaired through adjustment of actions (e.g., retarding or reversing an action). Communicative repair, therefore, seems to be crucial for different modes of communication and was suggested as an essential element to facilitate the coordination and cooperation between interacting individuals (Levinson, 2006). However, relatively little is known about the evolution of repair and possible precursors that may be found in non-linguistic species.

1.1 Brief overview of communicative repair in non-human primates

To date, relatively little research attention has been focused on communicative trouble and repair in non-human primates. For instance, Haimoff (1988) examined duets songs (organized bouts comprised of three distinct sequences of vocal behavior between pairs: the introductory, interlude, and great calls) of wild and captive gibbon species (*Hylobates* spp.). On about sixty occasions, gibbons were found to counteract ‘errors’ (production of sounds not being produced normally by an individual at a point in the bout) by abruptly terminating the duet bout and re-initiating a new sequence. Hence, two clear cases were found where Siamang (*Symphalangus syndactylus*) individuals repaired ‘troubles’ (not producing the expected call at the appropriate time of a sequence) by ultimately initiating the anticipated call and restarting the sequence. Additionally, Heesen and colleagues (2022) presented two cases on captive bonobos (*Pan paniscus*) and wild chimpanzees (*Pan troglodytes*), where individuals may engage in communicative repair during the context of grooming and respectively joint-travel. They described that self-initiated repair could be found beyond modern humans through signal persistence, repetition, and elaboration, e.g., gesture repetition by a chimpanzee mother to initiate joint-travel. Nonetheless, communicative repair across non-human primates in their natural environment still remains unknown.

Hence, this paper aims to pinpoint possible precursors of communicative repair and to propose a systematic framework to enable cross-comparison between primates. We focused on the interactions of one of our closest living relatives, the chimpanzees (*Pan troglodytes schweinfurthii*) in the wild. Chimpanzees are an ideal species to investigate communicative repair due to their rich vocal and gestural repertoires and high collaboration degrees (Goodall, 1986; Mitani, 2009). Similar structures or traits found between chimpanzees and modern humans may either be homologous relating to shared ancestry (Wrangham, 1987) or convergent evolution of the Pan and Hominin ancestors in encountering similar evolutionary pressures (Tooby, DeVore, & Kinzey, 1987). At the end of the last century, Dunbar (1996) suggested that due to a considerable increase in group size, grooming was replaced in modern humans by the more efficient bonding system of language. Communicative interactions involving repair may therefore have characterized grooming interactions before the dawn of human language. Thus, we centered on interactions in the context of grooming, a frequent behavior in chimpanzee societies and has been suggested as a crucial platform for learning and exchanging communicative signals (Pika, 2009, 2014).

2. Communicative repair in wild chimpanzees: Employed signals and temporal relationships

Here we introduce six grooming interactions that involve the production of three distinct gestures, the DIRECTED SCRATCH¹, PRESENT BODY PART, and TOUCH (see Fig. 1). These gestures are commonly produced during grooming interactions (either uni-directional - Fig. 1/A, or bi-directional grooming) by chimpanzees of the Ngogo community, Kibale National Park in Uganda, to request, negotiate and maintain grooming (Pika, 2009, 2014). The interactions involve hallmarks of human communicative interactions, including first-order intentionality, flexibility, directionality, reference, role negotiation, and role reversal (Pika, 2014).



Figure 1. (A) Uni-directional grooming interaction of an adult male (left) grooming another adult male (right). (B) An adolescent male SCRATCHING the back of their head (front) after grooming an adult male (back). (C) An adult male PRESENTING their side (front) and the adult male (back) that was previously grooming him. (D) An adult male (right) TOUCHING the rump of the adult male (left) that he was grooming. All illustrated gestures are depicted in red circles.

The DIRECTED SCRATCH is an auditory and visual signal defined as an individual making a relatively loud and exaggerated scratching movement on the part of their body (Pika, 2014). When an actor (individual grooming the other) signals with a DIRECTED SCRATCH during a grooming interaction (see supplementary materials Fig. S1), the recipient (individual being groomed) could either (i) ignore, (ii) respond by repositioning themselves (see supplementary materials Fig. S2 - role negotiation), (iii) groom the actor or (iii) groom the actor at the allocated scratch area (see supplementary materials Fig. S1/C - role reversal) (Pika, 2014). A DIRECTED SCRATCH by an actor stops the ongoing interaction (breaks the temporal relationship). It presents a request to the recipient to give a certain response to potentially ‘fix’ the interaction. For instance, role reversal, where the recipient becomes the actor (see supplementary materials Fig. S1). Or negotiation of the actor’s role where the recipient repositions themselves to allow the actor to continue their interaction (see supplementary materials Fig. S2). The potential illustrated repair is initiated by the gestural request of an actor while in parallel disturbing the natural flow and temporal relationship of the grooming interaction (possible self-initiated repair). This forces the recipient to respond and

¹ Gestures are depicted from here in SMALL CAPITALS.

act, to continue their interaction, and possibly return to the initial situation (see supplementary materials Fig. S1, where the initial actor after the possible repair ends up being the actor again).

PRESENT BODY PART is a gesture that involves an individual offering a body area such as their arm, back, or rump at a recipient (Pika, 2014). PRESENTING BODY PART is a referential gesture (Hobaiter & Byrne, 2014) because it draws the attention of another individual to a certain location. A PRESENT BODY PART by an actor draws the recipient's attention to request that it is their turn to groom the actor at the presented location. However, the recipient may still want the actor to continue grooming them and can negotiate this by PRESENTING BODY PART to the actor (see supplementary materials Fig. S3/G). The recipient could also ignore the request by the actor, potentially ending the interaction (see supplementary materials Fig. S4). The recipient negotiating the actor's role may represent a potential other-initiated repair since the recipient communicates that it is still the actor's turn to groom them. Ultimately, the use of PRESENT BODY PART by either an actor or recipient interrupts the natural flow of the grooming interaction.

The TOUCH is a tactile gesture defined as an individual gently putting their hand (<2 seconds) on any body part of the recipient (Pika, 2014) and may accordingly pause (see supplementary materials Fig. S5/B). Simultaneously, the grooming interaction stops, and the involved temporal relationship changes (the flow of grooming interaction is interrupted). This is a directed gesture from an actor to a recipient, where a recipient may respond by orientating themselves, giving access to the body area that the actor touched (i.e., intentional reference request, see supplementary materials Fig. S6/C). The performed request achieves a mutual understanding between the actor and recipient of where to groom next, allowing for the continuation of the interaction. In the scenario where the recipient does not entirely orient themselves after a given TOUCH, the actor can orientate themselves towards another body area (see supplementary materials Fig. S5/D). Here, the actor does not receive the adequate 'desired' response and counteracts this by performing the wanted request themselves (repositioning themselves towards a non-groomed body area of the recipient). Similar to the DIRECTED SCRATCH, the TOUCH depicts a possible repair during a grooming interaction. The actor initiates a potential repair, and the recipient can respond by repositioning themselves (see supplementary materials Fig. S6). Alternatively, if the recipient's response is inadequate, the actor may pause and reposition themselves (see supplementary materials Fig. S5), both cases illustrating possible self-initiated repair.

The gestures DIRECTED SCRATCH, PRESENT BODY PART, and TOUCH produced by chimpanzees changed the temporal relationship of their grooming interaction.

They, therefore, may represent means to ‘fix’ and eventually prolong the respective interactions, which can be understood as requests “Okay, what now? Here? Your turn or still mine? Didn’t I groom you enough”. After a given request, the interaction can change towards (1) role reversal (recipient becomes actor, e.g., producing a DIRECTED SCRATCH) or (2) role negotiation (the actor remains the actor, e.g., PRESENTING A BODY PART), or (3) during an actor’s turn they can reposition themselves following a failed reference of a PRESENTED BODY PART after a given TOUCH. The above scenarios demonstrate how both individuals interact and communicate with each other to continue their grooming interaction and communicate their intentions. In doing so, the actor or recipient can be responsible for employing certain signals to ‘fix’ and prolong their grooming interaction, which may characterize potential self- and other-initiated repair.

3. Conclusion and future trajectory

Despite the growing evidence of distinct elements characterizing human conversational turn-taking also being present in other primates, studies on communicative repair are still minimal. Here, we introduced possible precursors of human communicative repair by focusing on three commonly produced gestures by chimpanzees during grooming interactions to request, negotiate or reverse roles to maintain grooming. Future studies should therefore investigate communicative signals employed by non-human primates during grooming interactions and the outcome of these signals. This will aid in understanding the presence of communicative repair in non-linguistic species and how it relates to modern human communicative repair and the hallmarks of human communication. We, therefore, propose a four-aspect framework (see supplementary materials for further details) within the grooming context: (1) What does the signal entail? (2) Who initiates a signal? (3) What is the outcome after the signal? (4) What is the time window between the signal and outcome?. This framework may offer a systematic approach for future research to compare the evolutionary roots of communicative repair across primates.

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