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Local specialists' experience and skills in animal behaviour studies: insights from wild chimpanzee field assistants

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The study of wild animal behaviour and cognition has greatly benefited from the foundational work of local specialists (LSs), particularly field assistants. In primate research, long-term studies rely on accurate identification and tracking of individuals—a skill often honed by LSs and passed on to international specialists (ISs). Despite growing recognition in publications, LSs' scientific contributions often remain undervalued. Here, we show that LSs at the Budongo Conservation Field Station (Uganda) reliably extract acoustic information (caller identity, sex and age, call components and production context) from long-distance pant hoot calls produced by wild chimpanzees. Importantly, LSs significantly outperform ISs at identifying individuals (LS accuracy = 50% (95% confidence interval (CI): 45–56%); IS accuracy = 8% (95% CI: 5–11%)), an important skill for recognizing and locating individuals in dense forests. LSs' performance was positively associated with duration of working experience. Given the limited field time of ISs (typically 1–2 years), LSs' expertise and longer commitment (mean 16.75 years) represent an essential yet underacknowledged scientific resource. Our study highlights LSs' critical role in ethological research—not only enhancing skills and data quality, but also potentially helping address both ethical (e.g. community involvement) and environmental (e.g. travel carbon footprint) challenges linked to fieldwork in remote locations.

1. Introduction

In addition to the critical insights provided by work with captive animals [1,2], the study of animal cognition has benefited immensely from studies on free-ranging animals [3]. Over the past 50 years, field research with wild primates has helped researchers uncover and understand cognitive abilities central to human evolution by studying closely related non-human species, including motor cognition and tool use [4], social learning and culture [5], and language precursors [6]. Given its significance for unveiling evolutionary processes in species closely related to humans, comparative research involving wild apes has been, and remains, of high importance [7,8].

In addition to environmental, financial and logistical challenges associated with conducting field research on animals, including on wild apes, there is a growing dissatisfaction with 'helicopter' or 'parachute' research among local researchers, field assistants, governmental agencies, residents and more ethically concerned international researchers [9–14]. These terms describe situations in which researchers from the Global North—often from high-income countries or well-funded institutions—travel to collect data or samples in another region or community, which is often in low- or middle-income and remote areas, and leave with little or no involvement with local researchers, communities or stakeholders. 'Helicopter' practices can have other detrimental effects, such as importing diseases that can be dangerous or fatal to primates [15,16].

Hobaiter and colleagues [10] recently argued that local specialists (hereafter LSs) are critical to the future of primatology because of their knowledge and their geographical proximity to field sites. LSs is an umbrella term that encompasses a great variety of profiles. They have in common their geographical proximity to critical field sites. LSs include local field assistants that live on site and close by and conduct regular primate monitoring, which is crucial for the collection of long-term behavioural data as well as the conservation of wild populations (e.g. *PanAf* project [17]). For example, the continuous and standardized collection of data over several decades from wild chimpanzee communities, also made possible by LSs, allowed international specialists (ISs) to conduct large-scale research projects on topics including comprehensive behavioural repertoires, community cultural differences, longitudinal changes across multiple generations and the effects of climate change [18–20]. Additionally, LSs, and particularly those like field assistants who are very regularly on site, can provide seemingly anecdotal observations [21] that can be highly informative about significant but often rare behaviours, such as chimpanzee lethal gang attacks [22], cases of novel tool use [23] or responses to dead group members [24]. Such 'serendipitous' observations, albeit often occurring initially by chance, can provide the initial spark for transformative lines of research and are of high scientific value and interest [25,26]. Finally, ISs routinely rely on LSs (particularly local field assistants) when they start working with a population (e.g. to learn from LSs how to discriminate individuals) or to acquire long-term knowledge about populations and their habitat [3]. Despite the important and extensive knowledge that LSs accumulate during long-term projects, their scientific contributions are often invisible, hard to quantify and go unrecognized, which in turn reinforces their lack of formal acknowledgement [10,27,28]. This is particularly true of local field assistants.

An area of research that heavily relies on LSs given their detailed and extensive understanding of chimpanzee behaviour acquired over time is the study of their acoustic communication. When studying wild chimpanzees at the Budongo Conservation Field Station (BCFS; Uganda), ISs often start by relying on LSs to identify which individuals are signalling, particularly when they are out of sight. This type of information is also routinely used at several other field sites as primary data to identify the source of long-distance signals, like pant hoots and drumming, which are both signals characterized by strong individual signatures [29–31]. It is also not unusual that ISs greatly rely on LSs for entire studies, particularly because identification of acoustic information is probably driven by experience and familiarity [32,33].

In this study, we sought to empirically evaluate and make LSs' expertise more explicit as a step towards increased and more visible recognition of their work and how this type of knowledge can serve and benefit ethological knowledge, while also improving public perception about all actors involved in research. Here, we focused on LSs' capacities to identify callers of pant hoots and their main characteristics solely from acoustic signals, by focusing on the performance of local field assistants of the BCFS, the most represented LSs at the site. Pant hoots are vocal sequences characterized by four phases (introduction, build-up, climax and let-down) and their acoustic structure varies depending on the caller's identity (ID; [31,34]), age [35], sex [36] and the context of production [30,37]. We compared their performance to that of ISs collecting data at BCFS and other online participants, in which both groups had varying levels of experience with the species, using a questionnaire after playback presentation of pant hoot recordings. Because humans are able to extract acoustic information from animal vocalizations even without prior experience or exposure to them [38,39], we included online participants naïve to chimpanzee vocalizations to provide an accurate baseline to gauge ISs' performance. To better capture the role of working experience on the performance of LSs, we also included local field assistants undergoing training (training LSs) by more senior LSs and who worked for a shorter period of time with wild chimpanzees.

First, we tested the ability of all participants to extract information about the caller (ID, sex, age), call structure (climax and drumming presence) and context of production. We predicted that more experienced participants (i.e. LSs as opposed to training LSs or ISs) and participants with more years of experience working in the field would perform better. More specifically, because recognizing the caller's ID is a critical skill during LSs' field data collection, we predicted LSs to perform better than the other groups of participants in this regard. Second, we tested the ability of online participants to extract information about the caller (sex, age), call structure (climax and drumming presence) and context of production. We predicted that participants who had some experience working with chimpanzees would perform better compared to those with no experience. Third, we tested whether the degree of sociality and the rate of call production of chimpanzee individuals affected the ability of participants to extract information about the caller (ID, sex, age), call structure (climax and drumming presence) and context of production. We predicted that participants would perform overall better when assessing the calls of more social and more vocal individuals, given that greater visual and auditive exposure to these individuals would facilitate associative learning (akin to [40]). Fourth, we tested whether vocalizations accompanied by drumming would affect the ability of LSs to extract information about the caller (ID, sex, age) and context of production. Because chimpanzees drum in specific contexts and show individual styles [29,41], we predicted that participants would perform better when extracting information from vocalizations combined with drumming.

2. Material and methods

(a) Audio recordings

We investigated the ability of different groups of participants to extract information from chimpanzee pant hoot vocalizations. Using high-quality audio recordings from wild individuals, we presented structured questionnaires in which participants identified caller characteristics, such as ID, sex, age and call context. We then analysed their performance using statistical models to assess the effects of role in research, experience (duration in months) and acoustic features on perceptual accuracy. Recordings of pant hoots were made using a Sennheiser MKH416 directional microphone with a Marantz PMD661 MkII solid-state recorder (sampling rate 44.1 kHz, resolution 32 bits, wav format) from wild chimpanzees living in the Budongo forest (Uganda), who are routinely followed and studied by BCFS's LSs and ISs. We selected recordings of high quality and with minimal background noise and where a pant hoot was clearly produced by one single individual (criteria and definition used are presented in [42]). We used focal animal sampling as the main method of data collection, following a different study subject each day from 7.00 to 16.30 h, approximately 5.5 days a week and recorded whenever the focal individual produced a pant hoot. Pant hoot signals consist of four acoustically distinct phases produced in an orderly manner as introduction, build-up, climax and let-down, often accompanied by buttress drumming [43]. While the introduction, build-up and let-down are typically low-amplitude acoustic signals, the climax and drumming are high-amplitude signals that travel over much longer distances than the other pant hoot phases (up to 1 km) [25,44]. Furthermore, both climax and drumming encode the ID of the caller [29,30,45], while the other pant hoot phases are associated with contextual and other caller information (e.g. age, dominance status [30]). Caller ID and production context were visually confirmed during data collection by A.S. and G. Muhumuza, an experienced local field assistant. The former received prior training on the communication of chimpanzees by P.F.—an expert in chimpanzee pant hoots—and had 13 months of prior field experience collecting chimpanzee observations in Budongo. The latter collected behavioural data on the Sonso chimpanzees for 29 years and assisted several researchers over the years with studies on their communication. During data collection, the observers were always within the visual range of the chimpanzee callers and at a minimum distance of 7 m (following BCFS data collection protocols) and typically within 15 m maximum. Information about the caller ID was only collected if the individual was visually detectable.

(b) Questionnaire

In the dataset used for the questionnaire, we included a maximum of two pant hoot calls for each individual chimpanzee. To prepare the stimuli for playbacks during the questionnaire, the loudness of each call was normalized by matching the total root mean square to that of a high-quality reference recording. We then added 4 s of soft ambient noise at the beginning and end of the recording. The order in which the stimuli appeared in the questionnaire was randomized and presented in the same order to each participant. To limit strain from the task, the questionnaire was divided into two parts with different stimuli presented on separate occasions. In the first part of the questionnaire, we presented 44 pant hoots to participants; and in the second part, we presented 46 pant hoots (electronic supplementary material, table S1).

Participants were n = 4 LSs (all local field assistants), n = 2 training LSs (all local training field assistants) and n = 4 ISs (hereafter, BFCS participants) working in the Sonso community at BCFS (electronic supplementary material, table S2). Our sample of LSs has been employed by the BCFS to work as field assistants and conduct daily focal follows to collect behavioural data on all chimpanzee individuals in a community, which has been ongoing for almost 30 years and constitutes the long-term dataset. There, LSs record social information such as which individuals spend time in proximity and in the same group as well as behaviours used to determine the dominance hierarchy, contextual data such as activity changes, ecological data such as the type of food consumed and feeding spots visited, territorial data by recording where individuals travel to, and more opportunistic information such as when females immigrate into the community, when a mother appears with a newborn, or when more rare but critical events take place (e.g. inter-community encounters, death of an individual). In addition to the initial training of new ISs and the tracking of chimpanzees in the forest when working in pairs, LSs support data collection and can have specific roles during data collection, such as assisting during playback experiments (e.g. [46,47]). All ISs conducting studies in the Sonso community at the time of data collection were recruited as participants. One IS was conducting a study on social cognition while the other three were conducting studies on vocal communication; however, none of the researchers were collecting data or studying pant hoot acoustic information (e.g. vocal signatures, sex differences, etc.). We are aware that BCFS local field assistants are but one group of LSs conducting research on animal behaviour, and that each person is characterized by a unique set of skills, personal as well as professional ambitions, and is affected by specific situations and experiences [11,48]. Ideally, all these should be considered as much as possible when assessing ones' performance and when improving scientific practices. Here, we focused on the reality of the collaboration between LSs and ISs at the BCFS in Uganda, generally marked by the involvement and interaction of local field assistants (constituting our sample of LSs) with Global North PhD candidates, Master's students and research assistants (constituting our sample of ISs). Given the small number of LSs (a situation shared with many field sites), we were limited in our ability to consider the role of individuals' factors in addition to their working experience. However, differences between individuals' backgrounds as well as opportunities and challenges should be kept in mind when contextualizing this study and its findings.

We also recruited n = 121 adult (>18 years old) international participants online through social media and email communication. Written informed consent was obtained from all participants after explanation of the procedure (in person or via online form). Participation was voluntary, anonymous and without time constraints. We first provided a brief written explanation of pant hoots (i.e. definition, features, structure), including the components that may accompany it (i.e. climax and drumming) to all participants in the same way, and then informed them that pant hoots could be from any number of individuals in the community. The climax and drumming were described based on the literature and were accompanied by an example recording which included both components that participants could listen to any number of times. LSs and ISs completed the questionnaire in a quiet room, while online participants used a custom-built platform provided by Qualtrics (https://ufrpsycho.eu.qualtrics.com/jfe/form/SV_080w4FzkEx4SCZn). At the beginning of the procedure, a stimulus (i.e. pant hoot recording) was played as an example of how to fill in the questionnaire and to allow participants to adjust the volume. During the completion of the questionnaire, each recording was played once to simulate natural occurrences. We asked LSs and ISs about the last time they worked in the Sonso community and the overall duration of all the periods they worked in Budongo following the Sonso chimpanzees (in months), which we used as a measure of 'experience with the Sonso community'. We asked online participants their education level, sex, age, and if they had any experience working with chimpanzees. Each participant was assigned a unique identifier code. The questionnaire data were anonymized, stored safely, kept private and participants were asked not to share any information about the questionnaire. Note that LSs were remunerated 6000 UGX per hour for their additional working time to participate in this study (determined in accordance with the BCFS management).

In the first part of the questionnaire, we asked participants to extract the ID and sex of the caller (male/female), the presence of the climax phase (yes/no), and the presence of drumming (yes/no). In the second part, we asked participants to extract the ID, sex and age of the caller (adult, sub-adult, juvenile, infant) and the context of call production (feeding, travelling, resting). Online participants were not asked to extract the ID of callers, as they did not have this knowledge. One training LS only participated in the first part (interruption owing to COVID-19).

(c) Statistical analyses

All statistical analyses were conducted using R (version 4.3.0; [49]). First, we tested whether LSs performed better than chance by using a binomial test. Chance levels were p = 0.014 for the ID of the caller (73 possible identities), p = 0.500 for sex, climax and drumming, p = 0.250 for age (four possible categories) and 0.330 for context (three possible contexts). We then ran a series of generalized linear mixed models with a binomial error structure (correct response: yes/no) using the R package *lme4* (version 1.1–23; [50]) to explore the determinants of performance in the questionnaire. Each model tests performance on a different type of information that can be extracted from acoustic features. While some types of information are not independent, for instance, recognizing the ID of the caller probably means that their sex and age are also known, they each vary in difficulty, and assigning the ID of a caller is arguably the most challenging task. However, when a participant was not certain or incorrect about the caller's ID, they were nevertheless able to assign their sex or age correctly, which we evaluated using a series of models. First, we ran six models to investigate the ability of all participants to extract information about the caller's ID (model 1—BCFS participants only), sex (model 2), climax presence (model 3), drumming presence (model 4), caller's age (model 5) and call context (model 6). Second, we investigated the effect of working experience with the Sonso community on the ability of LSs to extract information about the caller's ID (model 7), sex (model 8), climax presence (model 9), drumming presence (model 10), caller's age (model 11) and call context (model 12). Third, we explored the effect of working experience with chimpanzees on the ability of online participants to extract information about the caller's sex (model 13), climax presence (model 14), drumming presence (model 15), caller's age (model 16) and call context (model 17). We included the education level, sex and age (years) of participants as control variables. Fourth, we ran six models to test the effect of the gregariousness of chimpanzees and their pant hoot rate production (i.e. the number of calls produced per hour during focal follows) on the ability of BCFS participants to extract information about the caller's ID (model 18), caller's sex (model 19), climax presence (model 20), drumming presence (model 21), caller's age (model 22), and call context (model 23). We considered 'gregariousness' as the probability of finding an individual in a party with other chimpanzees [40,51]. To calculate gregariousness, we used the field site's long-term data on party composition collected every 15-min intervals by BCFS LSs while conducting focal animal sampling (for a detailed explanation see [40]). Fifth and finally, we ran four models to test whether the presence of drumming would facilitate the LSs' extraction of information about the caller's ID (model 24), the caller's sex (model 25), the caller's age (model 26) and the call context (model 27).

In each model, the part of the questionnaire, identifier code of each participant, and recording number were included as random effects to control for replicated observations [52]. To keep the type I error rate at the 5% nominal level, we included all random slopes that were theoretically identifiable [53] (see the electronic supplementary material for model structures). To assess the significance of the test predictors, we used a likelihood-ratio test (LRT) to compare each model with a 'null' model comprising only the intercept, control variables, random slopes, and effects [54] (see the electronic supplementary material). We controlled for the false discovery rate (FDR) of running multiple models by adjusting the p-values of each LRT using the Benjamini and Hochberg correction (P*). FDR correction is preferred in exploratory analyses and when dealing with multiple hypothesis tests because it balances Type I and Type II error risks better than more conservative methods [55]. The data and code used in the analyses are available using the following link: https://osf.io/4f8xr/overview?view_only=f8c7eacde3d24321bbf3af76b0c01a3e

3. Results

Binomial tests confirmed that LSs performed better than expected by chance at extracting information correctly about the caller's ID ($p < 0.0001$), sex ($p < 0.0001$), age ($p < 0.0001$), presence of climax ($p < 0.0001$), presence of drumming ($p < 0.0001$) and call context ($p < 0.0001$). We found that, for 13 of 27 models, the model incorporating the independent variables was significantly different from the reduced model without the independent variables (table 1). We report significance tests and p-values for all models, including the 14 non-significant models, in the electronic supplementary material. More specifically, we found that LSs were more likely than ISs and training LSs to correctly assign the ID of the caller (table 1; figure 1a; LSs accuracy = 50% (95% confidence interval (CI): 45%–56%); ISs accuracy = 8% (95% CI: 5%–11%)). Compared to online participants, LSs were also more likely to correctly assign the sex of the caller (table 1; figure 1b), the presence of the climax phase (table 1; figure 1c), the presence of drumming (table 1; figure 1d), the age of the caller (table 1; figure 1e), and the context of the call (table 1; figure 1f). We found that the longer the LS worked with the chimpanzee community, the more likely they were to correctly assign the ID (table 1; figure 1g) and sex (table 1; figure 1h) of the caller. Online participants who previously worked with chimpanzees were more likely to correctly assign the age of the caller than those without work experience with chimpanzees (table 1; figure 1i). LSs were more likely to correctly assign the ID (table 1; figure 1j) and age (table 1; figure 1l) from more gregarious callers, and more likely to correctly assign the sex (table 1; figure 1k) and the age (table 1; figure 1m) of chimpanzees who called at higher rates. Finally, LSs were more likely to correctly assign the context of call production (table 1; figure 1n) when drumming was combined with the pant hoot.

4. Discussion

LSs have historically played an important role in studying wild animal behaviour (with significant contributors such as Ali Wallace among others [56]) and continue to do so [57–61]. They provide training and insights into wild animal behaviour and ecology, often forming the backbone of long-term projects and sparking new discoveries. However, their scientific contributions have traditionally been undervalued. To quantitatively evaluate LSs' knowledge in a research context, we empirically assessed their ability to identify and characterize wild chimpanzees from long-distance calls alone, focusing on local field assistants at BCFS. We compared it to the performance of ISs at BCFS and naïve online participants.

Overall, we found that when listening to recordings of chimpanzee pant hoots, the LSs recognized climax or drumming components, the age of the caller, and the context of production more often than online participants and above chance levels. We also found that the LSs were more likely to identify the caller than the ISs and above chance levels, which is arguably the most challenging information to extract from a call. Our findings suggest BCFS LSs acquire this knowledge through experience, as those with more time working with chimpanzees performed better. Indeed, the duration of experience working with and being exposed to chimpanzees is probably the main factor shaping their abilities. This idea is reinforced by the finding that more gregarious chimpanzees—who spend more time in groups and are more frequently observed by LSs and ISs—were also identified more accurately. Direct observations of chimpanzees vocalizing probably provide the opportunity to learn by association the acoustic features that distinguish individual callers. Chimpanzees recognize individuals from pant hoots alone and match callers' faces with their vocalizations [62,63], and acoustic analyses confirm strong individual differences and contextual information in call structure [30,31,34,43,64]. Our study further supports the idea that pant hoots convey rich acoustic information, and humans can learn to extract meaningful information from them too.

We also found that our samples of LSs and ISs more often recognized the sex and age of individuals who produced pant hoots at higher rates. This knowledge probably improves with accumulating experience, as exemplified by the difference in performance between training and trained LSs, who mainly differed in the time they spent working with chimpanzees. Experience in the field is a key factor, and ISs' shorter time in the field may limit their ability to acquire this knowledge, though they may still extract other call features such as climax. The relatively weak performance of online participants suggests that extracting most of this information requires prior chimpanzee knowledge, whether theoretical or experience-based. Even though all participants received an identical definition and example of a climax, LSs and ISs—owing to direct experience—were probably more attuned and knowledgeable about its characteristics (e.g. age differences [35]; sex differences [36]). The weaker performance of online participants in identifying climax and drumming remains puzzling but may reflect the challenge of simultaneously tracking vocal and drumming components for the untrained ear. Recent studies have shown that human participants can identify the affective content of chimpanzee vocalizations [38], their behavioural context of production [65], their emotional content [66] and the meaning of chimpanzee gestures [67]. Familiarity with the species improves performance [66,68], and we similarly find that more experienced LSs performed better. These findings suggest that modern apes (humans included) could be responsive to shared visual and acoustic communicative features. To further clarify what may allow humans exposed to or working with chimpanzees to varying degrees to learn to extract information from chimpanzee calls would require more detailed and comprehensive data about individual experiences. Specifically, because of the sample limitations, we could not explore whether LSs with prior direct or indirect experiences or knowledge about the BCFS chimpanzees may have also affected their ability to extract information. Investigating whether ISs with comparable experience may perform similarly was also limited owing to the fact that ISs tend to spend less time than LSs observing chimpanzees, because of the very fact that they are not spending as much time on site. One way to overcome these would be to test LSs' abilities by combining data from multiple field sites, making it possible to take into consideration further individual factors and their effects, as well as including ISs who may have had the opportunity to study chimpanzees for extraordinarily long periods.

Individual recognition through communicative signals is widespread in animals, particularly in species with dynamic social groups that rely on long-distance calls to stay in contact [69]. While in many species, lower-frequency calls are associated

Table 1. Summary output of the fixed effects from the significant models. (In models 1–6, the reference of the variable 'participant type' is local specialists (LSs). Results of the significant models are shown. Significant effects are in bold. Potentially problematic confidence intervals are in italics.)

independent variable and model no. (LRT)	estimate	s.e.	lower CI	upper CI	X^2	*p*
model 1 ($p^* = 1.495 \times 10^{-6}$): ID						
intercept	0.138	0.419	−0.698	0.986		
ISs	−3.444	0.431	−4.556	−2.481	−7.985	**<0.001**
training LSs	−7.940	2.184	−8.027	−3.296	−3.636	**<0.001**
questionnaire no.	−0.485	0.421	−1.362	0.377	−1.152	0.249
model 2 ($p^* = 5.940 \times 10^{-15}$): sex						
intercept	3.662	0.422	−0.044	4.667		
online participants	−4.268	0.440	−5.330	−0.567	−9.708	**<0.001**
ISs	−2.364	0.390	*−3.384*	*1.347*	−6.055	**<0.001**
training LSs	−1.471	0.458	*−8.069*	*2.194*	−3.21	**0.001**
questionnaire no.	0.441	0.275	−0.118	0.986	1.603	0.109
model 3 ($p^* = 8.899 \times 10^{-6}$): climax						
intercept	1.230	0.352	0.328	1.901		
online participants	−2.466	0.629	−3.719	−1.094	−0.919	**<0.001**
ISs	2.458	0.554	*−1.895*	*3.733*	4.438	**<0.001**
training LSs	−0.405	0.531	−1.761	0.749	−0.762	0.446
model 4 ($p^* = 6.197 \times 10^{-10}$): drumming						
intercept	6.210	1.208	0.156	5.331		
online participants	−7.250	1.299	−6.044	−0.766	−5.583	**<0.001**
ISs	−1.106	1.384	−4.874	0.848	−0.799	0.424
training LSs	3.249	1.349	*−11.908*	*10.501*	2.408	**0.016**
model 5 ($p^* = 2.725 \times 10^{-8}$): age						
intercept	0.424	0.247	0.354	2.823		
online participants	−0.787	0.222	−3.456	−0.985	−3.541	**<0.001**
ISs	−0.315	0.251	−1.799	1.294	−1.257	0.209
model 6 ($p^* = 0.010$): context						
intercept	1.872	0.447	−0.129	0.902		
online participants	−2.495	0.444	−1.214	−0.285	−5.617	**<0.001**
ISs	−0.291	0.563	−0.908	0.195	−0.516	0.606
model 7 ($p^* = 0.014$): ID						
intercept	−1.626	0.343	−2.349	−0.810		
experience	0.11	0.021	0.061	0.153	5.382	**<0.001**
questionnaire no.	−0.625	0.404	−1.462	0.265	−1.545	0.122
model 8 ($p^* = 0.014$): sex						
intercept	2.196	0.361	−1.507	2.979		
experience	0.136	0.027	−0.029	0.229	5.062	**<0.001**
questionnaire no.	−0.754	0.495	−1.710	0.374	−1.525	0.127
model 16 ($p^* = 2.485 \times 10^{4}$): age						
intercept	−0.508	0.358	−1.209	0.218		
experience working with chimpanzees	0.879	0.193	0.480	1.237	4.554	**<0.001**
education level	−0.038	0.216	−0.382	0.318	−0.176	0.86
sex	−0.4	0.212	−0.826	0.126	−1.889	0.059
age	−0.011	0.009	−0.029	0.008	−1.148	0.251
model 18 ($p^* = 0.003$): ID						
intercept	−4.63	0.795	−6.129	−2.411		

(*Continued.*)

Table 1. (*Continued.*)

independent variable and model no. (LRT)	estimate	s.e.	lower CI	upper CI	X^2	*p*
gregariousness	0.143	0.033	0.064	0.212	4.406	**<0.001**
call rate	0.634	0.5	−0.539	1.718	1.267	0.205
questionnaire no.	−0.27	0.37	−1.073	0.486	−0.729	0.466
model 19 ($p^* = 7.537 \times 10^5$): sex						
intercept	0.621	0.568	−0.692	1.779		
gregariousness	0.047	0.036	−0.034	0.124	1.286	0.198
call rate	2.288	0.594	0.959	3.374	3.851	**<0.001**
questionnaire no.	−0.624	0.363	−1.387	0.185	−0.719	0.086
model 22 (p* = 2.485e-04): age						
intercept	−1.968	0.704	−3.388	−0.265		
gregariousness	0.147	0.045	0.032	0.237	3.277	**0.001**
call rate	1.474	0.712	−0.231	2.782	2.071	**0.038**
model 27 ($p^* = 0.006$): context						
intercept	−0.108	0.241	−0.618	0.388		
drum presence	1.808	0.461	0.318	2.613	3.92	**<0.001**

with larger individuals [70,71], chimpanzee pant hoots are unusual in that males produce both very high-pitched (climax) and very low-pitched (build-up) components within them [72]. Given the species' sexual dimorphism [73], untrained listeners may have mistakenly associated high-pitched calls with the smaller female individuals in our study. Instead, trained participants were able to distinguish male and female pant hoots, supporting previous findings that these calls differ acoustically (eastern chimpanzees [36]; but see [74] for western chimpanzees). Young chimpanzees pant hoot less often than adults [35,40], and because they spend time exclusively with their more solitary mothers [75], their calls may be harder to learn or recognize. Pant hoots also show acoustic and temporal differences across behavioural contexts [30,37,64], and our findings suggest that humans can distinguish these subtle context-related variations too. Drumming, which often accompanies pant hoots during travel and carries individual signatures [29], may further help field assistants narrow down the context. Pant hoots and drumming, when perceived together from long distances by receivers, may function as a redundant signal [76], reinforcing the signaller's ID and other acoustic information. Being able to know 'who is where and doing what' is remarkably useful when following chimpanzees to study their behaviour and is probably how chimpanzees navigate fission–fusion events and maintain contact.

Scientifically valuable knowledge of chimpanzee communication accumulates and is refined through long-term experience, underscoring the importance of LSs' involvement, particularly field assistants here. Some LSs in this study were among the first to assist Vernon Reynolds in founding the BCFS [77]. The close collaboration between LSs and ISs at BCFS may be unique among chimpanzee field sites, and including data from other sites could clarify the generalizability of these skills—especially where LS positions are held for shorter durations or where vocal communication is not a research focus. We acknowledge that this study is based on a small group of participants (although we included all available LSs and ISs at the time), similarly to most field sites, and that therefore future studies should explore LSs' knowledge across sites and research areas to improve the robustness and generalizability of our findings. Nevertheless, LSs' expertise at Budongo serves as one of the many examples of how LS skills can help reduce 'helicopter' research practices. Knowledgeable LSs can independently collect long-term but also observational data for specific shorter-term studies, by either complementing ISs' research projects or allowing for novel projects studying aspects of chimpanzee behaviour not possible or more challenging without their long-term knowledge and skills. As an example, researchers trained by local specialists in identifying pant hoots when hearing distant calls without visual information studied how different acoustic information affects behavioural responses during chimpanzee vocal ontogeny [40]. Over the last thirty-five years since the foundation of the field site, many more BCFS studies have immensely benefitted from the close collaboration between ISs and LSs and have contributed extensively to our understanding of the evolution of chimpanzee and human communication [37,47,78–80].

Here we focused on one piece of knowledge that field assistants (as LSs) can acquire and transmit to new researchers but, just as chimpanzee pant hoots are only one part of a rich and sophisticated range of social behaviours, so are the skills and benefits of further involving LSs in field research. Although LSs can equally collect high-quality animal behaviour and conservation data [59,81,82], their input is underappreciated despite its proven efficacy [60,83]. Furthermore, LSs are often only acknowledged in publications rather than included as authors even if increasing their involvement could benefit research across disciplines [57,58,84]. Despite an overall lack of recognition and more formal involvement that was traditionally present in both chimpanzee studies, primatology and field studies in general, recently BCFS field assistants have been increasingly included as co-authors in publications, with various roles in projects on chimpanzee communication, self-medication, and thanatology, for example [24,35,40,46,85–90]. How best to implement LSs' knowledge depends on the research project, team, field site and ethical considerations [91] as well as the needs and benefits of LSs and their ambitions within and outside

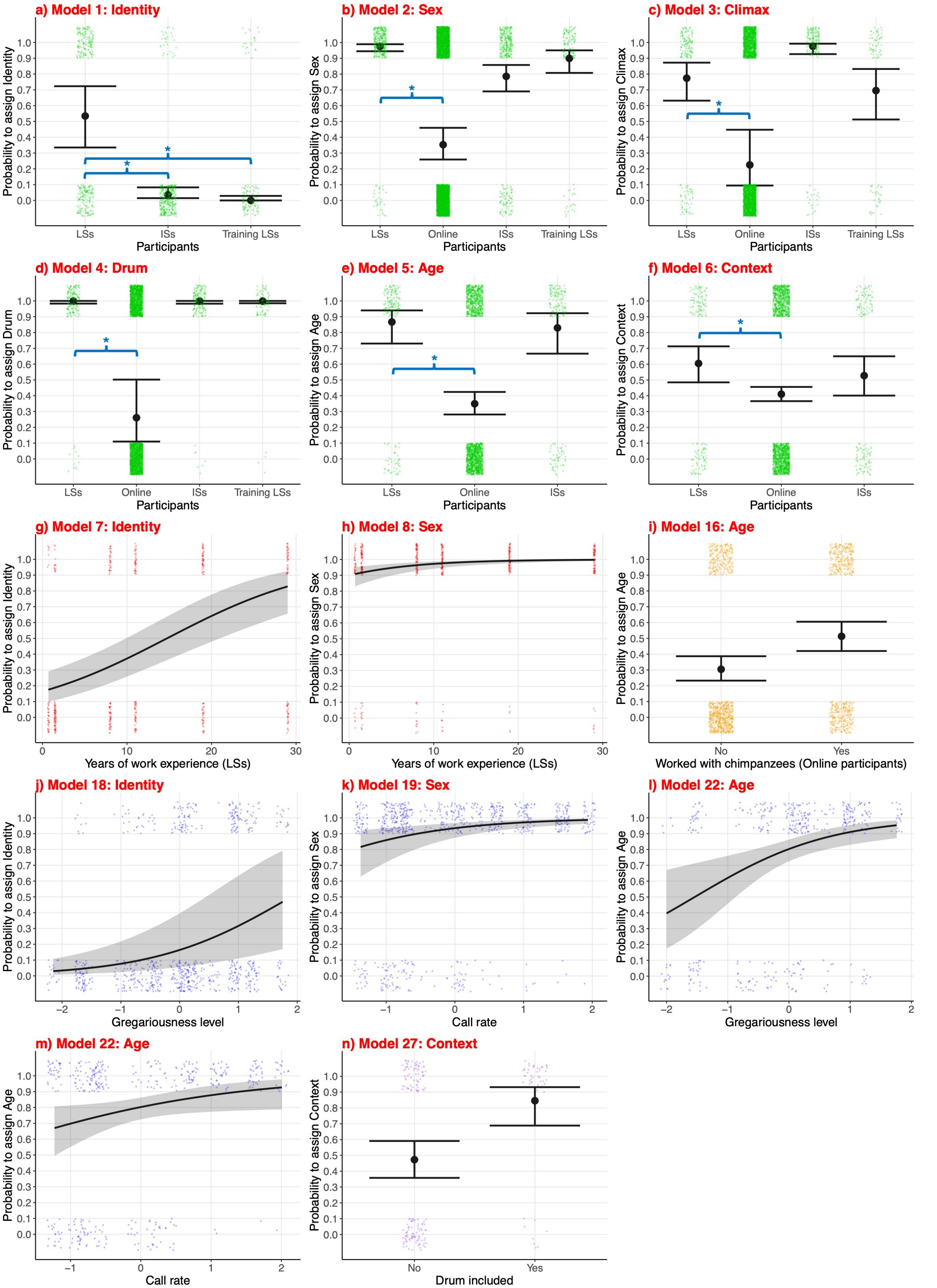

Figure 1. Plots of significant effects from significant models. On the *y*-axis, the probability of correctly assigning or extracting a specific type of acoustic information from listening to pant hoots. On the *x*-axis title, we indicated in brackets which participants (LSs, local specialists; ISs, international specialists) were considered in the model. The blue brackets with asterisks represent significant group comparisons. The dots represent raw datapoints and are grouped around 1/0 values, which represent correct/wrong answers. Bands and whiskers represent 95% confidence intervals.

academia. While some acoustic information in studies of animal communication is typically only extracted during later *post-hoc* analyses and from short-distance recordings [92], 'real-time' and reliable information extraction during data collection from short- and long-distance calls is currently possible only with the help of experienced LSs or ISs, but is rarely implemented. Such data is also equally important to pair with recordings for coding at a later stage, when individual information is relevant for multi-variate analyses but often too challenging to collect simultaneously in real-time depending on the project complexity (e.g. when studying both signallers and recipients). Unlike most acoustic analysis tools or automated algorithms, LSs are not narrowly focused or specialized on single tasks (e.g. ID recognition) but are true generalists. Experienced LSs such as local field assistants probably hold mental maps of the animal range territory, feeding ecology, behaviours, paired with knowledge of their social structure, dominance hierarchy, kin relationships, past and recent interactions, individual personalities, and more [57]. Comprehensively and continuously studying chimpanzees (and other animals) at the species, community and individual levels is particularly important when the goal is understanding their communication and its meanings, which are unlikely to be reducible to a list of acoustic parameters or entirely solved by a 'silver bullet' like artificial intelligence [93,94].

Beyond their scientific merits, the contributions of LSs, particularly local field assistants, can help address logistical challenges associated with field research—such as carbon footprint and the financial costs associated with travel—as well as ethical considerations inherent in wildlife research and conservation practices [95]. The continuous presence of LSs helps deter illegal activities like poaching that threaten wildlife, including chimpanzees, playing a crucial role in their conservation [61,96]. Growing concerns within the research community have focused on 'helicopter' or 'parachute' research [10] and with potential risks such as the spread of anthropogenic diseases that may threaten wildlife [97]. Equitable fieldwork with LSs requires ongoing collaboration, fair compensation and shared decision-making, with attention to power imbalances caused by funding disparities, language barriers and study authorship norms. Careful measures are needed to avoid introducing or perpetuating counterproductive practices—even inadvertently—by ensuring mutual exchange and communication between LSs and ISs. Furthermore, ISs should not only take immediate action but also create more opportunities for knowledge and technology transfer and establish longer-term educational initiatives (e.g. Master's programmes, internships, or training programmes to promote independent scholars empowered not only to support but lead research projects, with benefits for both current and future local specialists and communities (for a review, see [93]). Our study endorses extending collaborations, improving, and recognizing the involvement of LSs in wildlife research as a key step towards facilitating the transition from 'helicopter' to 'global' scientific practices [98,99]. Future work should also engage in critical discussion on the very concept of LSs—a concept we borrow from Hobaiter and colleagues [10] and on which we explicitly built our research. Local specialists encompass a great variety of profiles, with a diversity of backgrounds and professional and personal aspirations. Recognizing this will hopefully pave the way for fairer research practices and ultimately, transformative practices.

Ethics. The project followed the ASAB guidelines for the treatment of animals in behavioural studies and was approved by the Uganda Wildlife Authority (UWA/COD/96/5), the Uganda National Council for Science and Technology (NS 637), and the Research Ethics Committees of the Universities of Neuchâtel (38/2019-B) and St Andrews (chimpanzee research: no. 171; human research: PS14304). The UNCST also approved the amendment that concerned human data collection during the questionnaire. Data collection was stopped on 17 March 2020 because of the COVID-19 pandemic (UWA ref: EDO/73/01). Following recommended practices, the LSs who participated in the study are included as co-authors to recognize their contribution to the study [57], although they were not informed about our hypotheses and did not play a role in the interpretation or discussion after the data were collected. Furthermore, LSs were not employees of the researchers and the results of the questionnaires were not shared with their employers.

Data accessibility. The data and code used in the analyses are available using the following link: https://osf.io/4f8xr/?view_only=f8c7eacde3d24321bbf3af76b0c01a3e.

Supplementary material is available online [100].

Declaration of AI use. We have not used AI-assisted technologies in creating this article.

Authors' contributions. A.S.: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, validation, visualization, writing—original draft, writing—review and editing; P.F.: methodology, writing—review and editing; V.E.: formal analysis, methodology, writing—review and editing; K.Z.: funding acquisition, resources, supervision, writing—review and editing; J.C.: funding acquisition, resources, supervision, writing—review and editing; G. Muhumuza: methodology, resources; M.M.: methodology, resources; S.A.: methodology, resources; C.B.: methodology, resources; J.A.: methodology, resources; D.L.: methodology, resources; G. Muhanguzi: methodology, resources; G.D.: conceptualization, data curation, investigation, methodology, software, supervision, writing—original draft, writing—review and editing.

All authors gave final approval for publication and agreed to be held accountable for the work performed therein.

Conflict of interest declaration. We declare we have no competing interests.

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