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RESEARCH ARTICLE

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Opportunities for respiratory disease transmission from people to chimpanzees at an East African tourism site

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Abstract

Respiratory illnesses, including COVID-19, present a serious threat to endangered wild chimpanzee (*Pan troglodytes*) populations. In some parts of sub-Saharan Africa, chimpanzee tracking is a popular tourism activity, offering visitors a chance to view apes in their natural habitats. Chimpanzee tourism is an important source of revenue and thus benefits conservation; however, chimpanzee tracking may also increase the risk of disease transmission from people to chimpanzees directly (e.g., via aerosol transmission) or indirectly (e.g., through the environment or via fomites). This study assessed how tourist behaviors might facilitate respiratory disease transmission at a chimpanzee tracking site in Kibale National Park, Uganda. We observed tourists, guides, and student interns from the time they entered the forest to view the chimpanzees until they left the forest and noted behaviors related to disease transmission. Common behaviors included coughing, sneezing, and urinating, which respectively occurred during 88.1%, 65.4%, and 36.6% of excursions. Per excursion, individuals touched their faces an average of 125.84 ± 34.45 times and touched large tree trunks or branches (which chimpanzees might subsequently touch) an average of 230.14 ± 108.66 times. These results show that many pathways exist by which pathogens might move from humans to chimpanzees in the context of tourism. Guidelines for minimizing the risk of such transmission should consider tourist behavior and the full range of modes by which pathogen transmission might occur between tourists and chimpanzees.

KEYWORDS
conservation, tourist behavior, zoonotic

1 | INTRODUCTION

Human respiratory illnesses have caused significant mortality in wild African great ape populations, all of which are endangered (Kaur et al., 2018; Negrey et al., 2019; Palacios et al., 2011; Spelman et al., 2013). In the Kanyawara community of chimpanzees in Kibale National Park, Uganda, for example, respiratory illness has been the leading cause of death for over 31 years (Emery Thompson et al., 2018). Human metapneumovirus (HMPV) in Tanzania (Kaur et al., 2018), HMPV and human respirovirus 3 virus (HRV3) in Uganda (Negrey et al., 2019), rhinovirus C in Uganda (Scully et al., 2018), and coronavirus OC43 (Patrono et al., 2018) have been implicated in at least 84 individual wild chimpanzee deaths from 1968 to 2013.

These examples show that chimpanzees are susceptible to most, if not all, human respiratory pathogens. Although SARS-CoV-2 has not yet been documented in wild primates, it is considered a serious threat to great ape populations nonetheless (Melin et al., 2020). Human angiotensin-converting enzyme-2 (ACE2) has twelve key amino acid residuals on its surface, critical to SARS-CoV-2 infection (Melin et al., 2020). Apes, including chimpanzees, share those same key amino acid residuals, suggesting a similar susceptibility (Melin et al., 2020). Furthermore, wild chimpanzees have been infected with another human-origin coronavirus, OC43, in Côte d'Ivoire in 2016 (Patrono et al., 2018). During this outbreak, samples of OC43 taken from infected chimpanzees proved genetically identical to samples taken from asymptomatic humans with access to the park, despite quarantine before and after the visit (Patrono et al., 2018).

Great ape tourism is a popular activity that offers tourists the opportunity for tourists to learn from and engage with nature (Williamson & Macfie, 2014). It also provides a source of income that can be used to further great ape conservation efforts (Litchfield, 2001). When properly regulated, great ape tourism can benefit visitors, local communities, and hosting governments, and apes. However, tourism can also have negative consequences, in particular, increased disease risk to the apes (Muehlenbein & Wallis, 2014), which could cause dramatic population declines (Leendertz et al., 2006). To mitigate these risks, rules for great ape tourism by government agencies and the International Union for Conservation of Nature (IUCN), include preventing sick tourists and researchers from going into the field, maintaining proper distance from apes, controlling the duration of ape viewing, and practicing good biosecurity and hygiene, but these rules can be difficult to enforce (Hanes et al., 2018; Nakamura & Nishida, 2009; Weber et al., 2020), and with the emergence of SARS-CoV-2, have already been reevaluated (Gillespie & Leendertz, 2020; IPS, 2020; Reid, 2020; Williamson & Macfie, 2014). For example, tourists visiting the chimpanzees at Mahale Mountains National Park, Tanzania were closer to chimpanzees than stipulated regulations and some tourists were seen coughing near the chimpanzees (Nakamura & Nishida, 2009).

Building on previous research, the objective of this study was to record human behavior during chimpanzee tracking that might affect the risk of reverse zoonotic disease transmission. In Uganda, the Kanyanchu community of chimpanzees is visited by approximately 10,000 tourists per year from locations around the world (Kibale National Park General Management Plan, 2015). During these 1-h excursions, tourists are assigned to groups of six to visit a subgroup from a community that contains over 120 individual chimpanzees. Although visitors and guides are usually conservation-minded (Bulbeck, 2005), we hypothesized that they might engage in behaviors that could inadvertently expose the chimpanzees to reverse zoonotic pathogens. We also examined the number of tourists per group, their distance from chimpanzees, and the overall time spent viewing chimpanzees to assess compliance with current regulations.

2 | METHODS

2.1 | Ethical statement

Our research adhered to the legal requirements of Uganda, as well as the Principles for Ethical Treatment of Nonhuman Primates formulated by the American Society of Primatologists. The Institutional Review Board at Hunter College reviewed this study and they determined that it was exempt from review because the research involved observation of public behavior. The tourists were informed that a researcher was present during their visit. The identities of tourists were not recorded.

2.2 | Study site

Kibale National Park, Uganda is a mid-altitude forested park approximately 795 km^2 (Chapman et al., 2005). The park is managed by the Uganda Wildlife Authority. We collected observational data on visitors during tourist excursions to the Kanyanchu chimpanzee community. The community's home range is approximately 50 km^2. This community is visited by tourists, whereas other habituated chimpanzee communities in the park are the subjects of long-term research (Wrangham & Ross, 2008).

2.3 | Behavioral observations

We collected data from June 14th to August 12th, 2018, for a total of 101 excursions over 52 days during the high tourist season (when the majority of tourist excursions occur). Excursions were led by staff of the Uganda Wildlife Authority and occurred three times daily: 8 am (morning), 11 am (mid-morning), and 2 pm (afternoon), each lasting 2-5 h, with 1 h for viewing the chimpanzees. Our sampling effort was distributed evenly among these different viewing times.

Before excursions began, tourists presented their permits or payments and listened to a short safety briefing. This briefing included the following information: basic park information (history, species present, etc.), rules and regulations (no eating, flash photography, littering, etc.), chimpanzee specific information (community composition, typical behaviors, habituation process, etc.), and activity information (length of activity, what to wear or carry, etc.). Tourist groups were then divided and mandated to have no more than six people per group, including their guide and any interns, students, or researchers. Groups departed simultaneously, often from different trail entrances and remained in contact via radio. When chimpanzees were spotted, guides communicated through radios to ensure all tourists were able to view chimpanzees, occasionally leading to group "merges."

Behavioral data on visitors including park guides ($n = 15$), interns ($n = 10$), and tourists ($n = 459$), were collected using a prescribed ethogram as well as additional relevant behaviors (Table 1) continuously during the track and ad libitum; in addition,

TABLE 1 Total instances of recorded human behaviors during 101 visitor excursions, grouped by six behavioral categories

Category	# Instances	# Excursions	% Excursions
Self-grooming	12,654	101	100.0
Aerosol sunscreen/ bug spray	2	10	9.9
Biting/cleaning fingernails	32	32	31.7
Chapstick/lipstick	2	2	2.0
Eye drops	1	1	1
Hand-to-face contact	12,584	94	94.1
Face wipes	1	1	1.0
Hand sanitizer	5	5	5.0
Q-tip (twig)	1	1	1.0
Toothpick (twig)	25	25	24.8
Wash hands	1	1	1.0
Bodily functions	965	95	94.1
Bleeding	4	4	4.0
Coughing	733	89	88.1
Defecating	1	1	1.0
Sneezing	154	66	65.4
Spitting	16	13	12.9
Urinating	57	37	36.6
Eating	42	17	16.8
Breakfast foods (bread, eggs, millet)	5	7	6.9
Leaves	1	1	1.0
Lunch items (sandwiches, potatoes)	20	11	10.9
Snack Foods (protein bars, crackers, g-nuts, gum)	16	25	24.8
Miscellaneous potential concerns	398	70	69.3
Age/12-year old	1	1	1.0
Approaching chimps	30	21	20.8
Dehydration	1	1	1.0
Dropped gun	1	1	1.0
Earphones while walking	1	1	1.0
Falling	21	18	17.8
Flash camera	21	21	20.8
Gloves	15	15	14.9
Guide safety warnings	279	30	29.7
Handle feces	1	1	1.0
Ill/sick	4	4	4.0
Imitating chimp calls	20	20	19.8
Lighter	1	1	1.0
Phone call	1	1	1.0
Tourist lost	1	1	1.0
Direct forest interactions	23,669	100	99.0
Drop forest object after touching (fruit, leaves, feathers, snake skins)	83	60	59.4
Kiss tree	1	1	1.0
Littering	7	6	5.9
Removed fruit	1	1	1.0
Sitting on forest floor	561	79	78.2
Touching large tree trunks or branches	23,014	98	97.0
Using a branch as a walking stick	1	1	1.0
Wiping hands on leaves	1	1	1.0
Interpersonal interactions	170	54	53.5
Hand holding	160	53	52.5
Kissing	10	7	6.9

any miscellaneous behaviors deemed relevant to disease transmission were recorded. Human behaviors were grouped into six categories: self-grooming, bodily functions, eating, forest interactions, interpersonal interactions, and miscellaneous potential concerns. Guide safety warnings to tourists during excursions were recorded under miscellaneous potential concerns to account for tourist behaviors that guides actively tried to end. All occurrences of a behavior in the ethogram by any individual were recorded during the excursion. The following visitor group metrics were also recorded: initial group size, group size if merged with other visitors, distance while viewing arboreal and terrestrial chimpanzees, and time spent viewing chimpanzees. Merging was defined as when two excursion groups met in the forest and remained together for longer than 5 min.

2.4 | Data analysis

Human behaviors were displayed as frequency distributions and standardized as a proportion by dividing by the number of excursions ($N = 101$). The following parameters were analyzed using one-sample t tests: initial group size, group size while merged, distance while viewing both arboreal and terrestrial chimpanzees (A&T), distance while viewing arboreal chimpanzees (A), distance while viewing terrestrial chimpanzees (T), and time spent viewing chimpanzees. The null hypotheses for t tests were values recommended by the International Union for the Conservation of Nature (Gilardi et al., 2015) and Uganda Wildlife Authority (UWA) guidelines (Kibale National Park General Management Plan, 2015–2025).

3 | RESULTS

A total of 15 park guides, 10 interns, and 434 tourists ($N = 459$) visited the chimpanzees during the chimpanzee tracks. "Self-Grooming" occurred during all excursions (100.0%), followed by "Direct Forest Interactions" (99.0%), and "Bodily Functions" (94.1%) (Table 1). Across categories, touching large tree trunks or branches was the most frequent human behavior, followed by hand-to-face contact Table 2.

The total number of groups embarking at any given time ranged from 1 to 6, for a range of 3 to 60 individuals in the forest at the same time. On average, tourist groups merged during 40% of the total excursion time (55.5 ± 32.0) and the mean group size while merged (18.3 ± 5.2) was larger than IUCN recommendation of six people per group, $t\,(93) = 23.1$, $p < .001$. Mean distance while viewing chimpanzees on the ground (6.7 ± 2.3) was closer than the IUCN recommended 8.0 meters, $t\,(87) = 5.2$, $p < .001$. Time spent viewing chimpanzees regardless of terrestrial or arboreal position was longer than the 60 min viewing time recommended by IUCN, $t\,(100) = 8.7$, $p < .001$.

4 | DISCUSSION

Great ape tourism is a "double-edged sword" in that it simultaneously provides economic incentives for conserving apes while also putting them at risk for reverse zoonotic infections. Although visitors and guides are usually conservation-minded, we hypothesized that they might engage in behaviors that could inadvertently expose chimpanzees to reverse zoonotic pathogens. Therefore, our study quantifies potential modes of transmission from humans to chimps that could inform disease risk prevention strategies. Self-grooming and direct forest interactions were the two most common behavioral categories recorded. Each singular instance of hand-to-face contact or touching forest objects could lead to the deposition of infectious agents on fingers and fomites, respectively, even if the person is not clinically ill (Edemekong & Huang, 2019). Using twigs as Q-tips or toothpicks, spitting, bleeding, coughing, sneezing, urinating, defecating, eating, and depositing food scraps on the forest floor, and handling or tasting forest fruits pose risks of depositing infectious agents into the forest as well, with heightened probabilities that chimpanzees will encounter them later. These observed high-risk behaviors support our hypothesis that apes could come into contact with zoonoses if measures are not taken to mitigate these behaviors.

Knowing that nonhuman primates can be infected by many human respiratory pathogens and that great apes are likely susceptible to SARS-CoV-2, it is important to consider the ways in which transmission of these agents might occur (Melin et al., 2020). Airborne transmission and direct contact are modes of reverse zoonotic disease transmission (Epstein & Price, 2009). However, infection through fomites and the environment could also occur as has been suggested by other ape researchers (Gilardi et al., 2005). Some pathogens can remain viable for days after they are deposited into the environment (Baek et al., 2020; Chan et al., 2011; Edemekong & Huang, 2019; Kampf et al., 2020), which could facilitate transmission to chimpanzees long after infected people depart. Patrono et al. (2018) suggested that human coronavirus OC43 in wild chimpanzees in Cote d'Ivore may have been inadvertently introduced into the forest via asymptomatic shedding, which highlights this risk for coronavirus. As a result of the SARS-CoV-2 pandemic, new guidelines are being implemented to protect apes in Uganda (IPS, 2020). These include mandatory face masks for visitors and park staff, handwashing/sanitation facilities at the entrances of all its premises and protected areas, temperature checks for tourists, and maintenance of at least a 10-meter distance from chimpanzees during visits (UWA, 2020). More effectively framed communications from the guides to tourists may also help promote safe tourists behaviors

TABLE 2 Visitor group size, distance to chimpanzees and time spent visiting chimpanzees in Kibale National Park, Uganda

	Group characteristic:	Recommended value	Observed value	Std. Dev.	t	df	p	α
1	Mean initial group size (# of persons)	6.0	6.0	1.2	0.3	100.0	.80	.05
2	Mean group size while merged (# of persons)	6.0	18.3	5.2	23.1	93.0	$p < .001$	.05
3	Mean distance while viewing (m)	8.0	13.7	6.3	8.8	96.0	$p < .001$	.05
4	Mean distance while viewing arboreal chimpanzees (m)	8.0	21.3	9.5	13.0	86.0	$p < .001$	.05
5	Mean distance while viewing terrestrial chimpanzees (m)	8.0	6.7	2.3	5.2	87.0	$p < .001$	.05
6	Mean time spent viewing (min)	60.0	79.1	22.0	8.7	100.0	$p < .001$	.05

as they did in a study of mountain gorillas in Uganda (Gessa & Rothman, 2016). We hope that the results presented herein will enhance the comprehensiveness of these guidelines.

We note certain limitations to this study. Specifically, observations were recorded at only one tourism site in one country over a short period of time, such that their generality to other settings and seasons remains to be seen. Also, no biological samples were collected to document actual instances of infection. Nevertheless, to the extent that our findings from Kanyanchu prove representative of other great ape tourism sites, we suggest that future guidelines for ape tourism take into consideration the behavioral propensities of individual tourists, and actively discourage these high-risk behaviors.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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REFERENCES

Baek, W. K., Sohn, S., Mahgoub, A., & Hage, R. (2020). A comprehensive review of severe acute respiratory syndrome coronavirus 2. *Cureus*, *12*(5), e7943.

Bulbeck, C. (2005). *Facing the wild: Ecotourism, conservation and animal encounters*. London: Earthscan.

Chan, K. H., Peiris, J. S., Lam, S. Y., Poon, L. L., Yuen, K. Y., & Seto, W. H. (2011). The effects of temperature and relative humidity on the viability of the SARS coronavirus. *Advances in Virology*, *2011*, 1–7.

Chapman, C. A., Gillespie, T. R., & Goldberg, T. L. (2005). Primates and the ecology of their infectious diseases: How will anthropogenic change affect host-parasite interactions? *Evolutionary Anthropology*, *14*, 134–144.

Edemekong, P. F., & Huang, B. (2019). Epidemiology of prevention of communicable diseases. Stats Pearls Publishing LLC.

Emery Thompson, M., Machanda, Z. P., Scully, E. J., Enigk, D. K., Otali, E., Muller, M. N., Goldberg, T. L., Chapman, C. A., & Wrangham, R. W. (2018). Risk factors for respiratory illness in a community of wild chimpanzees (Pan troglodytes schweinfurthii). *Royal Society Publishing*, *5*(9), 180840.

Epstein, J. H., & Price, J. T. (2009). The significant but understudied impact of pathogen transmission from humans to animals. *Mount Sinai Journal of Medicine*, *76*(5), 448–455.

Gessa, S. J., & Rothman, J. M. (2016). Communication for conservation: Reducing disease transmission to mountain goriallas (*Gorilla beringei*) through better message framing to tourists. *American Journal of Physical Anthropology*, *159*, 153–154.

Gilardi, K. V., Gillespie, T. R., Leendertz, F. H., Macfie, E. J., Travis, D. A., Whittier, C. A., & Williamson, E. A. (2015). *Best Practice Guidelines for Health Monitoring and Disease Control in Great Ape Populations*. Gland, Switzerland: IUCN SSC Primate Specialist Group.

Gillespie, T. R., & Leendertz, F. H. (2020). COVID-19: Protect great apes during human pandemics. *Nature*, *579*(7800), 497.

Hanes, A., Kalema-Zikusoka, G., Svensson, M. S., & Hill, C. M. (2018). Assessment of health risks posed by tourists visiting mountain gorillas in Bwindi Impenetrable National Park, Uganda. *Primate Conservation*, *32*, 123–132.

International Primatological Society (IPS). (2020). Great Apes, COVID-19 and the SARS CoV-2. Joint statement of the IUCN SSC Wildlife Health Specialist Group and the Primate Specialist Group, section on great apes. Retrieved from http://www.internationalprimatologicalsociety.org/docs/Final%20-%20SARS%20CoV-2%20and%20Great%20Apes%20Joint%20Communique%2016-05-20.pdf

Kampf, G., Todt, D., Pfaender, S., & Steinmann, E. (2020). Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. *Journal of Hospital Infection*, *104*(3), 246–251. https://doi.org/10.1016/j.jhin.2020.01.022

Kaur, T., Singh, J., Tong, S., Humphrey, C., Clevenger, D., Tan, W., Szekely, B., Wang, Y., Li, Y., Alex Muse, E., Kiyono, M., Hanamura, S., Inoue, E., Nakamura, M., Huffman, M. A., Jiang, B., & Nishida, T. (2018). Descriptive epidemiology of fatal respiratory outbreaks and detection of a human-related metapneumovirus in wild chimpanzees (Pan troglodytes) at Mahale Mountains National Park, Western Tanzania. *American Journal of Primatology*, *70*(8), 755–765.

Leendertz, F. H., Pauli, G., Maetz-Rensing, K., Boardman, W., Nunn, C., Ellerbrok, H., Jensen, S. A., Junglen, S., & Christophe, B. (2006). Pathogens as drivers of population declines: The importance of systematic monitoring in great apes and other threatened mammals. *Biological Conservation*, *131*(2), 325–337.

Litchfield, C. (2001). Responsible tourism with great apes in Uganda. In S. McCool & R. N. Moisey (Eds.), *Tourism, Recreation and Sustainability: Linking Culture and the Environment* (pp. 87–117) Oxon, UK.

Melin, A. D., Janiak, M. C., Marrone, F., Arora, P. S., & Higham, J. P. (2020). Comparative ACE2 variation and primate COVID-19 risk. *Communications Biology*, *3*(641).

Muehlenbein, M. P., & Wallis, J. (2014). Considering risks of pathogen transmission associated with primate-based tourism. In A. E. Russon & J. Wallis (Eds.), *Primate Tourism: A Tool for Conservation?* (pp. 278–291). Cambridge, MA: Cambridge University Press.

Nakamura, M., & Nishida, T. (2009). Chimpanzee tourism in relation to the viewing regulations at the Mahale Mountains National Park. *Tanzania. Primate Conservation*, *24*(1), 85–90.

Negrey, J. D., Reddy, R. B., Scully, E. J., Phillips-Garcia, S., Owens, L. A., Langergraber, K. E., Mitani, J. C., Emery Thompson, M., Wrangham, R. W., Muller, M. N., Otali, E., Machanda, Z., Hyeroba, D., Grindle, K. A., Pappas, T. E., Palmenberg, A. C., Gern, J. E., & Goldberg, T. L. (2019). Simultaneous outbreaks of respiratory disease in wild chimpanzees caused by distinct viruses of human origin. *Emerging Microbes & Infections*, *8*(1), 139–149.

Palacios, G., Lowenstine, L. J., Cranfield, M. R., Gilardi, K. V. K., Spelman, L., Lukasik-Braum, M., Kinani, J. F., Mudakikwa, A., Nyirakaragire, E., Bussetti, A. V., Savji, N., Hutchison, S., Egholm, M., & Lipkin, W. I. (2011). Human metapneumovirus infection in wild mountain gorillas, Rwanda. *Emerging Infectious Diseases*, *17*(4), 711–713.

Patrono, L. V., Samuni, L., Corman, V. M., Nourifar, L., Röthemeier, C., Wittig, R. M., Drosten, C., Calvignac-Spencer, S., & Leendertz, F. H. (2018). Human coronavirus OC43 outbreak in wild chimpanzees, Côte d´Ivoire, 2016. *Emerging Microbes & Infections*, *7*(1), 1–4.

Reid, M. J. (2020). Is 2020 the year when primatologists should cancel fieldwork? *American Journal of Primatology*, *82*(8).

Scully, E. J., Basnet, S., Wrangham, R. W., Muller, M. N., Otali, E., Hyeroba, D., Grindle, K. A., Pappas, T. E., Thompson, M. E., Machanda, Z., Watters, K. E., Palmenberg, A. C., Gern, J. E., & Goldberg, T. L. (2018). Lethal respiratory disease associated with human Rhinovirus C in wild chimpanzees, Uganda, 2013. *Emerging Infectious Diseases*, *24*(2), 267–274.

Spelman, L. H., Gilardi, K. V. K., Lukasik-Braum, M., Kinani, J. F., Nyirakaragire, E., Lowenstine, L. J., & Cranfield, M. R. (2013). Respiratory disease in mountain gorillas (*Gorilla beringei beringei*) in Rwanda, 1990-2010: Outbreaks, clinical course, and medical management. *Journal of Zoo and Wildlife Medicine*, *44*(4), 1027–1035.

UWA. Uganda Wildlife Authority. (2015). Kibale National Park General Management Plan. Retrieved from https://www.ugandawildlife.org/wildlife-a-conservation-2/researchers-corner/general-management-plans

UWA. Uganda Wildlife Authority. (2020). Standard operating procedures for tourism services and research activities in UWA estates and the reopening of the protected areas to the general public during COVID-19 pandemic. Retrieved from https://www.ugandawildlife.org/covid-19-sops

Wallis, J., & Lee, D. R. (1999). Primate conservation: The prevention of disease transmission. *International Journal of Primatology*, *20*(6), 803–826.

Weber, A., Kalema-Zikusoka, G., & Stevens, N. J. (2020). Lack of rule-adherence during mountain gorilla tourism encounters in Bwindi Impenetrable National Park, Uganda, places gorillas at risk from human disease. *Frontiers in Public Health*, *8*(1).

Williamson, E., & Macfie, E. (2014). Guidelines for best practice in great ape tourism. In A. Russon & J. Wallis, *Primate tourism: A tool for conservation?* (pp. 292–310). Cambridge, MA: Cambridge University Press.

Wrangham, R., & Ross, E. (2008). *Science and conservation in African forests: The benefits of long-term research*. Cambridge, MA: Cambridge University Press.

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