Human children, but not great apes, become socially closer by sharing an experience in common ground

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ABSTRACT

To create social closeness, humans engage in a variety of social activities centered around shared experiences. Even simply watching the same video side by side creates social closeness in adults and children. However, perhaps surprisingly, a similar psychological mechanism was recently shown in great apes. Here we asked whether the process by which this social closeness is created is the same for children and great apes. Each participant entered a room to see an experimenter (E1) watching a video. In one condition, E1 looked to the participant at the start of the video to establish common ground that they were watching the video together. In another condition, E1 did not look to the participant in this way so that the participant knew they were watching the same video, but the participant did not know whether E1 was aware of this as well, so there was no common ground (E1 looked to the participant later in the procedure). Children, but not great apes, approached the experimenter faster after the common ground condition, suggesting that although both humans and great apes create social closeness by co-attending to something in close proximity, creating social closeness by sharing experiences in common ground may be a uniquely human social-cognitive process.

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Introduction

Most primates form social relationships with others through social activities that involve some form of physical interaction such as grooming or physical play (Behncke, 2015; Hare, Schroepfer-Walker, & Wobber, 2015; Lehmann, Korstjens, & Dunbar, 2007). Humans, in addition, form social relationships with others psychologically via social activities that create shared experiences. For example, humans have been shown to feel socially closer to others with whom they make music together (Pearce, Launay, & Dunbar, 2015), dance together (Tarr, Launay, & Dunbar, 2016), play team sports (Artinger et al., 2006), and converse, especially by sharing personal information (Aron, Melinat, Aron, Vallone, & Bator, 1997) or attitudes (Bosson, Johnson, Niederhoffer, & Swann, 2006) or by gossiping (Dunbar, 2004). Because these kinds of social activities are ubiquitous in humans, whereas other primates seemingly do not create social activities centered around sharing experiences solely for the purpose of creating social closeness, the question remains whether sharing experiences works differently and/or has different consequences for humans than for other primates.

In humans, the effect of shared experience on social closeness to partners is so strong that it even occurs in minimally interactive shared experiences such as jointly attending to a video together (Wolf, Launay, & Dunbar, 2015), although its effect is seemingly moderated by the content of the stimulus (Haj-Mohamadi, Fles, & Shteynberg, 2018; Rennung & Göritz, 2015). Recently, a similar effect of shared experience on social closeness has been found in young children (Wolf & Tomasello, 2020). Two-and-a-half-year-old children watched a video on a screen. In one condition, an adult sat next to a child watching with the adult. In a control condition, the adult sat in the same location but did not watch the video: the adult's view of the screen was blocked by a cardboard divider and, in any case, the adult was looking down reading a book. Afterward, the adult sat across the room from the children playing with toys. Those children who had viewed the video with the adult approached the adult more quickly than those who had viewed the video by themselves while sitting next to the reading adult. This study thus demonstrates that the propensity to feel closer to those with whom one has shared an experience emerges early in human ontogeny.

In nonhuman primates, there is also a relationship among coordinated behavior, communication, and social bonds. There is no doubt that facial expressions signaling hostile or friendly intentions shape primate social networks. In addition, multiple studies have reported that coordinated behavior, such as resting or sleeping in proximity, group travel, and mobbing behavior, is shaped by preexisting social relationships within primate groups (Micheletta et al., 2012; Schamberg, Cheney, Clay, Hohmann, & Seyfarth, 2016). Yet, there is no evidence that such coordinated activities in themselves create social closeness. In addition, there are no reports of nonhuman primates creating shared social activities solely for the purpose of connecting with others in the way that humans do. It has therefore been suggested that perhaps human shared experiences allow us to socially connect with one another in unique ways (Dunbar, 2012; Wolf et al., 2015).

Surprisingly, however, recent research using an experimental design similar to that of the shared experiences studies in humans found a similar effect in great apes (Wolf & Tomasello, 2019). In one experiment, chimpanzees and bonobos either watched a video with a human or watched the video by themselves while the human read a book in the exact same location (and was blocked from seeing the video). Replicating the results with children, the apes were faster to approach the human with whom they had watched the video in a subsequent interaction. In a second experiment with conspecifics, chimpanzees either watched the same video together or they sat in the same places but watched videos on different screens. Individuals spent more time in the same part of the room after having watched a video together than when they had watched videos on different screens. These findings potentially undermine the claim that the way in which humans create social closeness through shared experiences is unique to our species.

Developmental psychology theorists have argued, however, that, human sharing involves some degree of recursive mindreading (Grice, 1957). It has been proposed that, in addition to just experiencing the same thing, a key part of humans' sharing experiences is that individuals know that they both know (i.e., have common ground about the fact) that they are experiencing something together. Thus,

while visually co-attending to something, individuals establish common ground by, for example, a mutual look face to face, allowing both individuals to infer that they both are aware that they are attending to the same thing—and that the other is aware of this also (Bakeman & Adamson, 1984; Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998). That is, a gaze alternation in which individuals alternate looking at a stimulus with a mutual look allows one to infer that (a) the other individual is also attending to this stimulus and (b) the other has seen one looking at him or her and at the screen so that the other knows that one knows he or she has seen one looking at the screen. As such, one now knows that both individuals know that (a) they are looking at the same thing and (b) they both know that they both know they are looking at the same screen, knowledge that is often referred to as the common ground component of joint attention (Siposova & Carpenter, 2019; Tomasello, 2014, 2019). This common ground understanding is crucially important in many uniquely human cooperative activities because it undergirds uniquely human forms of coordination in collaboration and shared reference in cooperative communication (Shteynberg, Hirsh, Bentley, & Garthoff, 2020; Tomasello, 2010, 2019).

Our question in the current study thus was whether this common ground component plays a role in the creation of social closeness through shared experiences and whether this is true for both human children and great apes alike. Given children's propensity to create common ground with others seemingly for its own sake in a way that apes do not—for example, in pointing things out to others via a pointing gesture just to share attention to it (Liszkowski, Carpenter, Henning, Striano, & Tomasello, 2004)—we expected children, but not apes, to be sensitive to a mutual look during the video watching. This is because the mutual look has the potential, for those who understand its significance, to create a common ground understanding that "we" are watching the video together.

To test this hypothesis, we conducted a comparative study in which participants watched a video at the same time as an adult human partner while keeping the setup and procedure as comparable as possible between species. Each participant entered a room where an experimenter was waiting for a video to start. In both cases, the participant was sitting behind the experimenter, with a physical barrier placed in between them. After the video, the experimenter and participant separated for 15 s, after which they reconvened in the same room to engage in the dependent measure. Crucially, in the sharing condition, the experimenter attempted to create common ground (i.e., that they were watching the video together) by turning and looking directly at the participant in response to the video starting. In contrast, in the observer (i.e., control) condition, the experimenter did not turn during the video to look at the participant but instead looked at the participant the moment they reconvened in the same room. In this control condition, then, it was clear to the participant that each of them was attending to the same video, but the participant had no way of knowing whether the experimenter was aware of this as well; there was no information that allowed the participant to establish common ground about the fact that they were watching the video together. As in previous research (Wolf & Tomasello, 2019, 2020), we measured participants' willingness to approach and engage in social behavior toward the experimenter in terms of approach latency after the manipulation. We predicted that children, but not apes, would approach faster in the sharing condition than in the observing condition.

Study 1: Children

Method

Participants and design

The child study was approved by the university's institutional review board. Because the pilots of previous studies using an identical procedure for the dependent measure (Wolf & Tomasello, 2020) had shown a learning effect in children for this measure, we conducted an experiment with a two-factor between-participants (sharing vs. observing) design. Based on our previous studies using similar measures, we collected data until we had 64 (nonexcluded) participants with gender counterbalanced across conditions.

In total, 106 children from mostly middle-class Caucasian families living in a mid-sized U.S. city participated (M_{age} = 32.72 months, SD = 2.01; 48 female). Among this original sample, 2 participants

were excluded due to experimenter errors (e.g., Experimenter 2 [E2] interacted with the participant when E2 was not supposed to) and 4 participants were excluded due to parent errors (e.g., the parent significantly deviated from to the script during the dependent measure). In addition, 18 participants were excluded for child errors (e.g., fussiness), 7 participants were excluded because they attended to the video for less than 30 s (i.e., 50% of the video), and 9 participants were excluded because they approached neither in the baseline measure nor in the experimental approach measure. Finally, 2 participants had initially accidentally been marked as excluded (i.e., a coding error) so that the data of 2 replacement participants were collected before discovering this error. To stay true to our original stopping time criterion, we decided to use the 2 initial participants in the analysis of our counterbalanced sample of 64 participants.[1] As such, the final sample consisted of 64 children aged 2.5–3 years (M_{age} = 32.65 months, SD = 1.96; 32 female).

Procedure

After the informed consent, Experimenter 1 (E1) conducted a baseline approach measure to get an idea of a child's propensity to approach a novel adult irrespective of the manipulation. The child sat down on the floor on a mark with the parent right behind them, and the experimenter sat down 2 m away while putting a marble run in front of E1. The experimenter then offered a ball for the marble run to the child and said, "If you want, you can go play!" We then measured how long it took for the participant to approach the experimenter and take the ball from E1. If the child did not approach after 90 s, we stopped the baseline measure and coded the time as 90 s (the maximum). If the participant did not approach, E1 placed the marble run closer to the child so that all children took the ball from E1 and played with the marble run before proceeding to the experimental phase. Shortly after the child had taken the ball from E1, E2 briefly entered the room to give the participant some exposure to E2 before the experimental trial. However, E2 did not interact in any way with the participant. Instead, E2 came in with a form, handed the form to E1, and said, "Here is the form you wanted." E2 then turned around and walked out of the room.

Next, E1 took the participant and the parent to the experimental room. Here, E2 was already sitting on a toddler chair on one side of the room, with E2's back to the door through which the participant entered, facing a TV screen on which a moving placeholder image was playing. At this point, the experimenter was not looking at the screen but was instead reading a book. The child sat down on a toddler chair behind E2, 1.5 m from E1, at an angle at which the toddler could easily see E2's face to infer where E2 was looking but where it was unlikely that E2 could see the toddler unless E2 turned around. Furthermore, there was a row of toddler tables in between E2 and the participant so that the participant could not easily walk into the visual field of E2. Finally, the parent sat down on a pillow behind the participant to provide comfort in terms of physical proximity but was instructed to fill out some forms during the manipulation and not to engage with the child in the watching of the video.

Once the participant and parent had sat down, E1 started the video. It was a 1-min video similar to a video used in previous research (Wolf & Tomasello, 2020) containing short clips of animal behavior without sound. Crucially, in the sharing condition, when the video was started E2 turned around and made eye contact with the participant to establish common ground about the video having started. In the observer condition, E2 simply started looking at the screen.

After the video, E1 took the participant and the parent out of the room to "go look for some toys" until after 15 s of looking around outside the door E1 "realized" that the toys were actually back in the room they just left. This part of the procedure provided a natural opportunity to incorporate an instance of eye contact between E2 and the participant in the observer condition that was not related to the watching of the video so that the absolute amount of social engagement would be equalized

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[1] In addition to the analysis reported in Results, we also ran the same analysis with a larger group based on slightly more lenient exclusion criteria that, in addition to the original 64 participants, now also included children who had watched more than 15 s but less than 30 s of the movie (*n* = 6), children who waved at the experimenter during the baseline phase but who E2 did not wave back to (*n* = 2), and the 2 backup participants whose data were collected after their respective cells were already filled. The results for this group (*N* = 74) were not meaningfully different from the results for the original counterbalanced design of 64 participants (estimated mean group difference of the larger sample: Bayesian estimation of mean group difference: mode = 17.93 s, 95% HDI = 4.88 to 30.98).

across conditions. As such, when E1, the parent, and the participant came back into the room, E2, who at that moment was busy putting away the pillow and toddler chair to make space for the dependent measure, stopped what E2 was doing for a second, looked to the door, and made eye contact with the child (as opposed to doing exactly the same without looking to the door in the shared condition).

Next, the participant sat down on a mark on the floor, flanked by the parent and E1 who was holding a stopwatch to keep track of the time during the dependent measure. E2 sat down on a mark 2 m away from the participant, similar to what E1 had done during the baseline measure. Next, the participant engaged in the same approach latency procedure used in earlier studies (Wolf & Tomasello, 2020). That is, E1 gave E2 a cue and started a stopwatch. E2 responded by taking out a stuffed animal from under a blanket and offering it to the participant. The moment the toy was offered, E1 told the participant, "If you want, you can go play with the toy," which the parent repeated after E1 (following the instructions received before the warmup phase). If the child had not approached after 15 s, E1 gave E2 another cue to give the stuffed animal a hug and offer it again. After another 15 s, E1 gave a cue to E2, who responded by putting away the stuffed animal. E2 then took a toy truck with blocks from underneath a blanket and offered one of the blocks to the participant. Again, E1 cued E2 after 15 s. In this case, E2 tilted the back of the truck so that the blocks would fall out. E2 then grabbed another block and offered it to the participant. Finally, if the participant had still not approached, E1 cued E2 to put the truck away and take a marble run identical to the one in the warmup phase. E2 put the marble run next to E2 and offered a ball to the participant. During this part of the experiment, E2 looked at the participant but never said anything to the participant.

Once the child approached (i.e., touched the toy that E2 was holding) or if the child had not approached after 90 s, the experiment was stopped. If the child did not approach within 90 s in both the baseline measure and the experimental measure, the child was most likely too shy to engage in this procedure and therefore was excluded from data analysis.[2] For a schematic overview of the child study, see Fig. 1 (upper box).

Coding

Every session was recorded by two cameras. Independent research assistants (i.e., research assistants who were not part of the procedure and thus were unaware of what the participant did in the dependent measure) coded the baseline phase and the manipulation phase for exclusion criteria such as experimenter errors, parent errors (e.g., the parent significantly deviated from to the script during the dependent measure), and child errors. Every trial marked for exclusion was checked by a second independent coder for confirmation. If the two coders did not agree, a third independent coder examined the trial and cast a final deciding vote. Next, a different research assistant coded the approach latency, with a second research assistant coding 25% of the trials for reliability assessment (intraclass correlation coefficient = .995).

Results

Because the skewness and kurtosis of all dependent variables were between − 1.96 and 1.96, we deemed the data to be normal enough for using Bayesian parameter estimation models with normal likelihoods and priors. A Bayesian independent-samples test of group means (N = 64) showed an effect of condition on approach latency (estimated mean group difference: mode = 16.41 s, 95% highest density interval [HDI stands for highest densitiy interval] = 2.49–30.33). Children in the sharing condition approached the experimenter faster (M = 16.70 s, SD = 21.00) than children in the observer condition (M = 33.11 s, SD = 32.49). See Fig. 2 for the distribution of approach latency for the child sample.

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[2] In addition to using the baseline measure as an exclusion criterion, we also used it to conduct the analyses on the same sample while controlling for individual differences in shyness. We first regressed the approach latency of the baseline phase on the dependent measure, after which we ran the analysis with the (unstandardized) residuals. The results were not meaningfully different from our original analysis (Bayesian estimation of mean group difference: mode = 17.76 s, 95% HDI = 5.13 to 30.39).
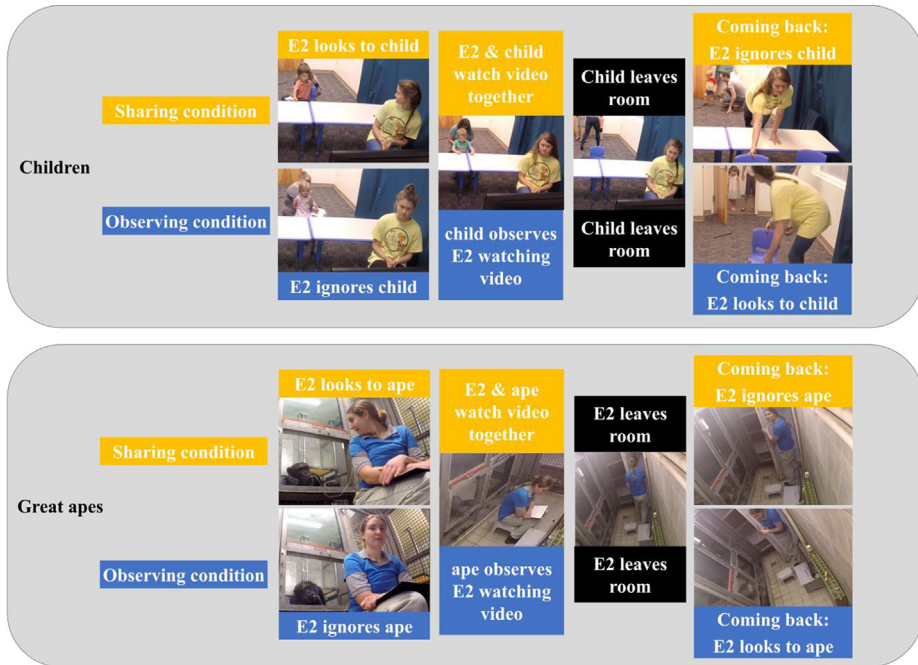
Fig. 1. Schematic overview of the manipulation for children (upper box) and great apes (lower box).

Study 2: Great apes

Method

Participants and design

The ape study was approved by the local animal research committee and was done in accordance with all the governing local laws and regulations concerning research with animals. The animals were housed in a zoo, where all groups spend different parts of their day in their sleeping rooms, a heated, tropical indoor enclosure, and a large outdoor enclosure that they can access when weather permits. The animals are regularly exposed to enrichment activities, and all of them had previously engaged in social and cognitive experiments with humans. No food or water restrictions were associated with this study. Furthermore, for this study the maximum amount of diluted grape juice that could be offered to individuals during the study was established in cooperation with the zoo staff in charge of the animals' diets.

Due to the limited availability of great apes, as well as a lack of learning effects in previous studies using the current dependent measure (Wolf & Tomasello, 2019), we conducted an experiment with a two-factor within-participants (sharing vs. observing) design, where the participants' trials were at least a week apart. In total, we tested 20 great apes, each of which engaged in both conditions. Among this original sample, 1 chimpanzee did not approach in either condition and therefore was excluded from analysis. The final sample therefore consisted of 14 chimpanzees (M_{age} = 28.00 years, SD = 10.64; 10 female) and 5 bonobos (M_{age} = 17.20 years, SD = 8.93; 2 female). For additional information about the apes, see Appendix 1 in the online supplementary materials.

Procedure

The procedure of the ape study was as similar as possible to that of the child study. However, due to practical and safety considerations, the procedure was different for great apes in some respects. The
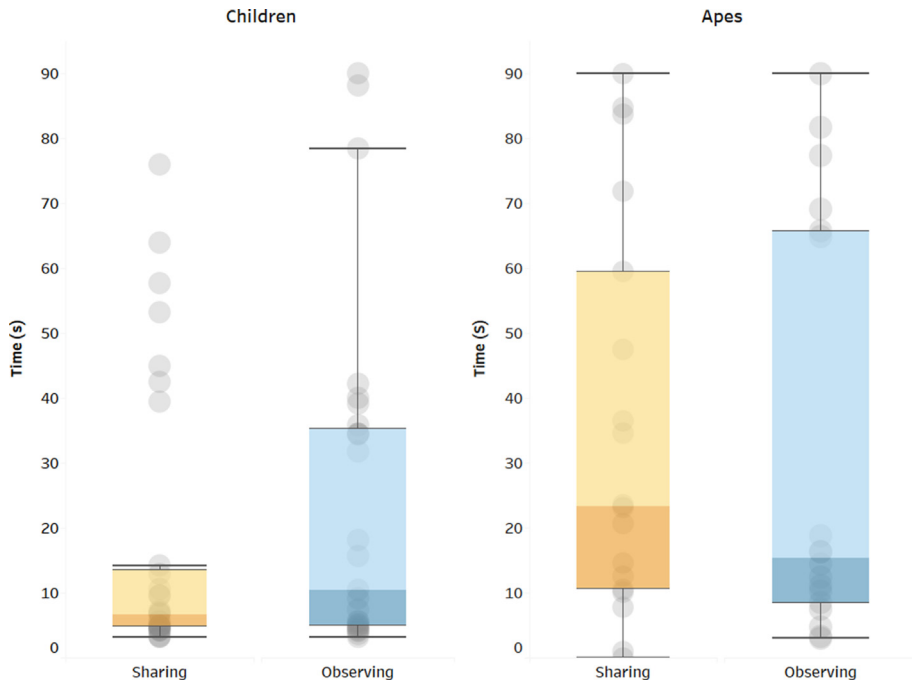
Fig. 2. Distributions of approach latency by condition for children (left) and great apes (right).

experiment was conducted in the sleeping rooms of the bonobos and chimpanzees, which have multiple segments separated by hydraulic doors. When a participant had entered the segment adjacent to the segment in which the participant would be watching the video, E2 went into the room, allowing a brief moment of exposure for the participant, and sat down in front of a screen in a way similar to in the child study. Next, the keeper opened the hydraulic door (after which the keeper left the room), at which point the participant entered the segment behind E2. Importantly, in each of the two trials the participant interacted with a different female experimenter who the participant had never seen or interacted with before. E1 then offered the participant dilated grape juice through a juice tube with a mouthpiece at the end (commonly used to motivate great apes to stay in place when doing studies involving video material; e.g., Krupenye, Kano, Hirata, Call, & Tomasello, 2016; Wolf & Tomasello, 2019), which was available to the participant through a hole in the Plexiglas panel behind E2.

Once the participant had sat down, E1 walked out of the room to the laptop in the hallway that was connected to the screen inside the room and started one of several 1-min silent videos of playing juvenile chimpanzees, similar to the videos previously used in similar studies (Wolf & Tomasello, 2019). There were different videos for different trials so that all participants watched each video only once. To make sure that the videos were highly similar in content, they were short 1-min clips taken from a longer video showing a juvenile chimpanzee playing with other juvenile chimpanzees and an adult chimpanzee sitting in the background. The manipulation in the sharing condition was identical to that of the child study; when the video started, E2 turned around and looked back at the participant, making brief eye contact to allow the participant to infer that they both knew that they were both watching the video.

Next, just like in the child study, we provided an opportunity for E2 to make eye contact with the participant in the observer condition. That is, after the video was finished, E2 got up and briefly left the room and came back after 15 s. In the sharing condition, E2 walked back in without looking at the participant and sat down at the other end of the room. In the observer condition, when coming in E2 socially engaged the participant by means of a communicative look, looked away again, and then pro-

ceeded to walk on to the side of the room where they would be sitting during the dependent measure. In both cases, E2 was holding a stopwatch to keep track of the time during the dependent measure.

Next, like in previous studies (Wolf & Tomasello, 2019) and the current child study, we measured the participant's willingness to approach E2. Similarly to previous studies using this measure with great apes, approach latency was operationalized as the moment the participant entered the area four tiles behind the Plexiglas screen behind which E2 was now sitting (similar to previous studies; see Wolf & Tomasello, 2019). If the participant did not approach after 30 s, the experimenter started brushing her fingers along the mesh to prompt the participant to come over. If the participant still had not approached after 60 s, the experimenter, in addition to rattling the mesh, also called out the participant's name. The moment the participant entered the approach area, or if the participant did not approach within 90 s, the trial was finished. If the participant did not approach in one of the two conditions, the time was coded as the maximum time (i.e., 90 s). If the participant did not approach in either trial, the participant was excluded from data analysis. For a schematic overview of the ape study, see Fig. 1 (lower box).

Coding

Three cameras recorded the sessions. The footage from a camera under the TV screen was used to capture (and check) the look between E2 and the participant. An overview camera recorded the overall movement of the experimenters, keeper, and participant. A ceiling camera positioned above the approach area was used to determine whether the participant stepped into the approach area. One independent research assistant coded the approach latency for all individuals from the ceiling camera (from which it was impossible to discern which condition the participant was in), and a second reliability coder coded 25% of the trials (intraclass correlation coefficient = .995).

Results

Because the skewness and kurtosis of all dependent variables were between -1.96 and 1.96, we deemed the data to be normal enough for using Bayesian parameter estimation models with normal likelihoods and priors. A Bayesian independent-samples test showed no effect of the order in which the conditions were presented on the difference in approach latency between conditions (estimated within-participants difference: mode = 12.98 s, 95% HDI = -32.84 to 58.81), suggesting that, like in previous research using the same measure with great apes in a within-participants design (Wolf & Tomasello, 2019), there were no order effects. Crucially, a Bayesian related samples test estimating the difference score between conditions did not show an effect of condition on approach latency (estimated within-participants difference: mode = 3.01 s, 95% HDI = -19.52 to 25.55). That is, the apes approached the experimenter roughly equally fast after the sharing condition ($M = 38.02$ s, $SD = 32.15$) and after the observer condition ($M = 35.01$ s, $SD = 33.76$). See Fig. 2 for an overview of the distribution of approach latency of the apes.

Additional analyses showed no difference between chimpanzees ($n = 14$) and bonobos ($n = 5$) in their between-condition difference scores (estimated within-participants difference: mode = -9.54 s , 95% HDI = -54.8 to 34.7) or between participants that were hand reared ($n = 5$) and those that were reared by their parents ($n = 12$)[3] (estimated within-participants difference: mode = -18.4 s, 95% HDI = -77.8 to 38.0). A cautious interpretation of these between-participants comparisons is warranted, however, given the unbalanced distribution of individuals across the groups within these comparisons.

Discussion

The current results highlight a subtle but important difference in the way that human children and great apes experience situations in which they are co-orienting with a partner to a visual stimulus. Great apes experience it in the same way whether or not there is a confirming look from the partner

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[3] The rearing history of 2 individuals was unknown.

with eye contact, whereas children experience these two situations differently, potentially suggesting that humans share experiences in a way that apes do not.

To interpret these findings, most notably the absence of an effect for the great apes, it is important to evaluate whether apes are, in principle, capable of correctly inferring the attentiveness of the experimenter toward the video and toward themselves during the manipulation. Although initial research questioned apes' capacity to do so (Povinelli & Eddy, 1996a, 1996b), subsequent work has shown that those results were most likely a methodological artifact (Kaminski, Call, & Tomasello, 2004) and that apes do in fact understand what others can and cannot see (Bräuer, Call, & Tomasello, 2007; Hare, Call, Agnetta, & Tomasello, 2000; Hare, Call, & Tomasello, 2001) and do so in a context where the individual's line of sight goes through a transparent window as opposed to an opaque barrier (Okamoto-Barth, Call, & Tomasello, 2007; Tempelmann, Kaminski, & Liebal, 2011).

As such, it seems that apes should, in principle, be able to correctly infer that (a) the experimenter attended to the screen and (b) the experimenter attended to them. A related concern might be that the dependent measure itself is not appropriate for great apes (but only for human children). However, previous studies (conducted in the exact same physical environment as the current study) have shown that both children and great apes are, in principle, sensitive to this approach latency-based dependent measure (Wolf & Tomasello, 2019, 2020). More specifically, these studies show that the current dependent measure is sensitive specifically to an experimental procedure in which the attention of an experimenter is manipulated, making it particularly appropriate for the current study.

Of course, as always, methodological differences between the child and ape studies could be at play. The most obvious one in this case, that children are dealing with a conspecific and apes are dealing with a human, is a concern. A conspecific partner was not possible in the current study because the partner's behavior was carefully prescribed. Yet, in a previous highly similar study showing that great apes show more social closeness after co-orienting to the same stimulus (Wolf & Tomasello, 2019), the effect was the same for both a human and a conspecific partner.

Our conclusion thus is that the most likely explanation for our current results is that the children, but not the apes, interpreted the look differently between conditions. That is, the children, but not the apes, understood that the experimenter's look to them in response to the onset of the video, followed by a look back to the video, was an attempt to constitute a common ground understanding that they were watching the video together. In contrast, when the experimenter in the control condition looked to the child, the child interpreted it as merely a response to noticing another individual in the same room when the experimenter and participant reconvened. For children to understand the two looks differently—such that it had a significant effect on their willingness to interact with the experimenter—required them to understand that mutual looks in response to a stimulus onset allow individuals to infer that both individuals now know that they both know that their attention was drawn by this same stimulus, thereby allowing individuals to create common ground about the onset of this stimulus.

To understand the difference between this and a situation in which individuals look to one another because they merely are salient stimuli to one another (i.e., after reconvening in the same room), children thus needed to align and coordinate mental states with the experimenter cognitively (perhaps recursively) in ways that apparently were not available to the great apes. That is, the creation of common ground with a partner might require a unique form of recursive mental coordination or some other way of establishing socially shared experiences, perhaps through creating a collective agent (see Shteynberg et al., 2020), although the question remains whether such a collective agent can be construed without the capacity to process recursively structured social information.

The current results therefore might help to explain why humans, but not other species, go to such great lengths to create and engage in social activities centered around shared experiences. Previous research showed that on a basic level, simply co-attending to something creates social closeness in both humans and great apes. However, the current results show that, in addition to this co-attending mechanism, humans, but not great apes, create more social closeness when they create common ground about their experience being shared than when they are merely observing someone co-attending to the same thing. This suggests that the human motivation to spend large amounts of time, energy, and resources in shared social activities might not be driven just by a desire to go through similar experiences with others but also by the unique opportunity such activities provide

for creating shared common ground with others, which serves to both create social closeness and support many further cooperative and cultural activities.

More generally, the current results provide support for a uniquely human form of shared cognition that in this particular case is operating in the realm of social closeness. It would seem that only humans have evolved the psychological processes (or at least sensitivity) necessary for creating common ground about things we experience together. Because this common ground plays a crucial part in a variety of human social dynamics such as sophisticated (e.g., role-based) behavior coordination, collaboration, and cooperative communication, the current results help to explain how and why human social cognition and behavior is different from that of other primates.

Acknowledgment

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jecp.2020.104930.

References

Aron, A., Melinat, E., Aron, E. N., Vallone, R. D., & Bator, R. J. (1997). The experimental generation of interpersonal closeness: A procedure and some preliminary findings. *Personality and Social Psychology, 23*, 363–377.

Artinger, L., Clapham, L., Hunt, C., Meigs, M., Milord, N., Sampson, B., & Forrester, S. A. (2006). The social benefits of intramural sports. *Journal of Student Affairs Research and Practice, 43*, 69–86.

Bakeman, R., & Adamson, L. B. (1984). Coordinating attention to people and objects in mother–infant and peer–infant interaction. *Child Development, 55*, 1278–1289.

Behncke, I. (2015). Play in the Peter Pan ape. *Current Biology, 25*, 24–27.

Bosson, J. K., Johnson, A. B., Niederhoffer, K., & Swann, W. B. (2006). Interpersonal chemistry through negativity: Bonding by sharing negative attitudes about others. *Personal Relationships, 13*, 135–150.

Bräuer, J., Call, J., & Tomasello, M. (2007). Chimpanzees really know what others can see in a competitive situation. *Animal Cognition, 10*, 439–448.

Carpenter, M., Nagell, K., Tomasello, M., Butterworth, G., & Moore, C. (1998). Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monographs of the Society for Research in Child Development, 63* (4), i. https://doi.org/10.2307/1166214.

Dunbar, R. I. M. (2004). Gossip in evolutionary perspective. *Review of General Psychology, 8*, 100–110.

Dunbar, R. I. M. (2012). Bridging the bonding gap: The transition from primates to humans. *Philosophical Transactions of the Royal Society B: Biological Sciences, 367*, 1837–1846.

Grice, P. (1957). Meaning. *Philosophical Review, 66*, 377–388.

Haj-Mohamadi, P., Fles, E. H., & Shteynberg, G. (2018). When can shared attention increase affiliation? On the bonding effects of co-experienced belief affirmation. *Journal of Experimental Social Psychology, 75*, 103–106.

Hare, B., Call, J., Agnetta, B., & Tomasello, M. (2000). Chimpanzees know what conspecifics do and do not see. *Animal Behaviour, 59*, 771–785.

Hare, B., Call, J., & Tomasello, M. (2001). Do chimpanzees know what conspecifics know?. *Animal Behaviour, 61*, 139–151.

Hare, B., Schroepfer-Walker, K., & Wobber, V. (2015). Experimental evidence that grooming and play are social currency in bonobos and chimpanzees. *Behaviour, 152*, 545–562.

Kaminski, J., Call, J., & Tomasello, M. (2004). Body orientation and face orientation: Two factors controlling apes' begging behavior from humans. *Animal Cognition, 7*, 216–223.

Krupenye, C., Kano, F., Hirata, S., Call, J., & Tomasello, M. (2016). Great apes anticipate that other individuals will act according to false beliefs. *Science, 354*, 107–110.

Lehmann, J., Korstjens, A. H., & Dunbar, R. I. M. (2007). Group size, grooming and social cohesion in primates. *Animal Behaviour, 74*, 1617–1629.

Liszkowski, U., Carpenter, M., Henning, A., Striano, T., & Tomasello, M. (2004). Twelve-month-olds point to share attention and interest. *Developmental Science, 7*, 297–307.

Micheletta, J., Waller, B. M., Panggur, M. R., Neumann, C., Duboscq, J., Agil, M., & Engelhardt, A. (2012). Social bonds affect anti-predator behaviour in a tolerant species of macaque, *Macaca nigra. Proceedings of the Royal Society B: Biological Sciences, 279*, 4042–4050.

Okamoto-Barth, S., Call, J., & Tomasello, M. (2007). Great apes' understanding of other individuals' line of sight. *Psychological Science, 18*, 462–468.

Pearce, E., Launay, J., & Dunbar, R. I. M. (2015). The ice-breaker effect: Singing mediates fast social bonding. *Royal Society Open Science, 2*(10), 150221.

Povinelli, D. J., & Eddy, T. J. (1996a). Chimpanzees: Joint visual attention. *Psychological Science, 7*, 129–135.

Povinelli, D. J., & Eddy, T. J. (1996b). Factors influencing young chimpanzees' (*Pan troglodytes*) recognition of attention. *Journal of Comparative Psychology, 110*, 336–345.

Rennung, M., & Göritz, A. S. (2015). Facing sorrow as a group unites. Facing sorrow in a group divides. *PLoS One, 10*(9), e136750.

Schamberg, I., Cheney, D. L., Clay, Z., Hohmann, G., & Seyfarth, R. M. (2016). Call combinations, vocal exchanges and interparty movement in wild bonobos. *Animal Behaviour, 122*, 109–116.

Shteynberg, G., Hirsh, J. B., Bentley, R. A., & Garthoff, J. (2020). Shared worlds and shared minds: A theory of collective learning and a psychology of common knowledge. *Psychological Review*. https://doi.org/10.1037/rev0000200. Advance online publication.

Siposova, B., & Carpenter, M. (2019). A new look at joint attention and common knowledge. *Cognition, 189*, 260–274.

Tarr, B., Launay, J., & Dunbar, R. I. M. (2016). Silent disco: Dancing in synchrony leads to elevated pain thresholds and social closeness. *Evolution and Human Behavior, 37*, 343–349.

Tempelmann, S., Kaminski, J., & Liebal, K. (2011). Focus on the essential: All great apes know when others are being attentive. *Animal Cognition, 14*, 433–439.

Tomasello, M. (2010). *Origins of human communication*. Cambridge, MA: MIT Press.

Tomasello, M. (2014). *A natural history of human thinking*. Cambridge, MA: Harvard University Press.

Tomasello, M. (2019). *Becoming human. A theory of ontogeny*. Cambridge, MA: Harvard University Press.

Wolf, W., Launay, J., & Dunbar, R. I. M. (2015). Joint attention, shared goals, and social bonding. *British Journal of Psychology, 107*, 322–337.

Wolf, W., & Tomasello, M. (2019). Visually attending to a video together facilitates great ape social closeness. *Proceedings of the Royal Society B: Biological Sciences, 286*, 20190488.

Wolf, W., & Tomasello, M. (2020). Watching a video together creates social closeness between children and adults. *Journal of Experimental Child Psychology, 189*, 104712.