PREPRINT: Toddlers Prefer Those Who Win, But Not When They Win by Force

Ashley J. Thomas* ^a, Lotte Thomsen ^{c,d}, Angela F. Lukowski ^b, Meline Abrayam^a, and Barbara

W. Sarnecka^a

^a Department of Cognitive Sciences, University of California, Irvine

^b Department of Psychology and Social Behavior, University of California, Irvine

^c Department of Psychology, University of Oslo

^d Department of Political Sciences, University of Aarhus

Email address: ashleyjt@uci.edu

Social hierarchies occur across human societies, so all humans must navigate them. Infants can detect when one individual outranks another¹⁻³, but it is unknown whether they approach others based on their social status. This paper presents a series of seven experiments investigating whether toddlers prefer high- or low-ranking individuals. Toddlers ages 21 to 31 months watched a zero-sum, right-of-way conflict between two puppets, in which one puppet 'won' because the other yielded the way. Of the 23 toddlers who participated, 20 reached for the puppet that won. However, when one puppet used force and knocked the other puppet down in order to 'win', 18/22 toddlers reached for the puppet that 'lost'. Five follow-up experiments ruled out alternative explanations for these results. The findings suggest that humans, from a very early age, not only recognize relative status but also incorporate status into their decisions about whether to approach or avoid others in a way that differs from our nearest primate relatives⁴.

We are born into a complex social world that we must learn to navigate. This world includes hierarchical relationships where people are ranked along some dimension such as age, wealth, prestige, or authority.⁵⁻⁹ Such hierarchies are found across human societies and across social settings (e.g. domestic, recreational and professional).^{7,10} Hierarchies are also found in non-human species as varied as orangutans, ants, wolves, bees, and cuttlefish, where individuals are ranked according to size and strength.^{7,11-15} Across these contexts an individual's status has consequences: Having higher status means having more access to resources, territory and mates.^{7,16,17} Thus, individuals who can recognize and respond to status cues have an advantage in many situations.¹⁸

Theorists have distinguished between two types of social hierarchy: Those based on dominance and those based on prestige or authority^{7-9,17,19-23}. In dominance-based hierarchies (found in many non-human primates as well as a range of other species) status comes from one's ability to inflict physical harm on others. This follows from individual formidability (e.g. being larger or more powerful) or from being allied with a more formidable group (i.e. having allies who are more numerous, larger, or more powerful).^{17,24,25} In human social groups, people can also attain social status through prestige, which does not come from physical threats, but from the ability to provide benefits such as cultural know-how, protection, or guidance.^{5,9,20}

Theorists do not agree on the extent to which human social rank derives from either dominance or prestige. However, one reliable cue to status that occurs across these hierarchical relationships occurs where two individuals have a conflict and only one can win (i.e. a *zero-sum conflicts*), and the conflict is resolved because one individual defers or yields to the other.^{7,26} Yielding and deference are signals of rank in both dominance- and prestige-

based hierarchies. When status derives from dominance, less-formidable individuals and groups yield to more-formidable foes in zero-sum conflicts, in order to avoid getting hurt. Over many such interactions, relative status stabilizes: Some individuals routinely claim contested food, territory, and mates, and others routinely yield.^{7,12,27} Thus, yielding becomes a stable signal of lower social status.^{13,28,29}

In prestige-based hierarchies, deference also signals relative status. Here, lower-status individuals yield, not because they are afraid of being hurt, but because they want to form or maintain relationships with people who have more authority, competence, or knowledge.^{5,7,9,20,30} For example, if a graduate student and their adviser wanted the same office, we would expect the graduate student to step aside (i.e. to yield the resource) not because they would fear retaliation in the physical sense, but because we expect students to defer to their advisers in return for the guidance they receive. Of course the graduate student might also be afraid that the adviser would withhold resources such as grant money, letters of recommendation, etc. In this way, human hierarchies often contain elements of both dominance and prestige.^{7,20,31} And indeed, in laboratory experiments with adults, dominance and prestige are both ways that humans can attain social influence in a group.³² Thus, whether human hierarchies are based on prestige, dominance or some combination of the two, the way that people act in conflicts is a reliable cue to their social status. Specifically, when one individual voluntarily yields to another, it signals that the two are in a hierarchical relationship where the yielding one is ranked lower.

Even preverbal infants make inferences about social status when they see one individual yield to another. In fact, infants use several formidability cues to predict who will yield

in a zero-sum conflict. Infants 9 to 13 months of age expect smaller individuals to yield: When they watch two animated characters try to cross a platform in opposite directions, each blocking the other's path, they look longer (presumably indicating surprise) when the larger character yields to the smaller one than when the smaller yields to the larger.¹ In a similar setup, 6-to 9-month-old infants expect a character with fewer allies (i.e. fewer same-colored characters on its side) to yield to a character with more allies.² Moreover, older infants seem to expect that individuals who have lost one zero-sum conflict will keep losing: After 15-month-olds watch a scene where one individual pushes another out of a territory, they expect that in a subsequent scene, the individual who was pushed out will yield a contested resource to the 'pusher'.³ By 17 months old, toddlers expect that a high-ranking individual will be given more resources.³³ Likewise, preschoolers respect social rank when interacting with novel individuals: They give a larger cookie to a higher-status individual (i.e. the person who has made a decision for the pair).³⁴ Preschoolers also endorse the testimony of someone who previously won a zero-sum conflict over one who deferred.³⁵

This literature suggests that infants and young children can infer and even reason about the relative social status of two individuals. But children must also form relationships. In the current studies we asked whether toddlers, having watched one novel individual yield to another, tend to *approach* either the individual who yielded or the one who did not.

A priori, either preference is plausible. The deference shown by preschool-aged children in earlier studies (accepting that the boss is right, or giving the larger resource to a high-ranking individual^{34,35}) could reflect a fear of high-ranking individuals, which might lead us to expect toddlers to avoid them. And indeed, studies with adults have found that people will

sometimes 'go along' with the wishes of a dominant individual whom they fear.³² In many other animal species including non-human primates, subordinates avoid or withdraw from dominant individuals, who may commit random acts of unprovoked aggression.^{20,36–38} Indeed, in some species being able to avoid dominant individuals is associated with lower stress levels.¹⁵ Consistent with this, preverbal infants avoid individuals who are aggressive toward others³⁹ and individuals who hinder others in achieving their goals.⁴⁰ Thus, if toddlers see the higher-ranking individual as potentially aggressive, they may wish to avoid it.

Conversely, one can also imagine justifications for why toddlers might prefer a high-ranking individual. In human societies, affiliations with high-ranking individuals can provide benefits such as coalitional strength, access to resources, and access to cultural knowledge. Several non-human primates prefer dominant individuals as coalitional partners.^{4,41–43} Adult bonobos prefer even *novel* dominant individuals: In experiments modeled on the helping/hindering studies with human infants, experimenters found that bonobos prefer animated characters who push another one out of a contested territory and characters who hinder over those who help (presumably because the hinderers are seen as dominant).⁴ Likewise, baboons compete for more dominant allies,²³ when macaques form alliances, they consistently choose allies who outrank themselves and their opponents.⁴⁴ They will also pay (in fruit juice) to look at pictures of higher-ranking male macaques,⁴⁵ just as adult humans prefer to look at high-ranking humans.⁴⁶

Like non-human primates, human toddlers may be motivated to approach high-status individuals in order to form beneficial relationships. Consistent with this studies have shown that toddlers identify and prefer competent individuals. In one experiment, they were shown a

puppet who struggled to make a toy play music and another puppet who did it easily. When asked who they wanted to play with, they preferred the puppet who operated the toy easily.⁴⁷ This could reflect a preference for prestigious individuals, or it could reflect a preference for individuals who can produce a desirable outcome (i.e. perhaps the toddlers just liked hearing music, and so liked the puppet who could readily produce it).

In the present study, we asked whether toddlers ages 21 to 31 months evaluate novel individuals by their social status, and if so, whether they like higher- or lower-ranking individuals. We looked for this preference by showing toddlers a conflict in which one individual wins and the other loses. In one version of this conflict (explored in Experiments 1.0 through 1.4), the loser voluntarily yields to the winner. In another version (Experiments 2.0 and 2.1) the contest is won by force. Experiments 1.0 and 2.0 test the basic vignettes; the other experiments are follow-up studies to rule out alternative explanations..

In Experiment 1, toddlers watched a vignette that was closely modeled after animations used in previous studies; it featured two puppets in a zero-sum-conflict.^{1,2} The vignette began with a familiarization phase: First one puppet crossed the stage alone. Then the action was repeated: The same puppet crossed the stage again , going the same direction as before. Then the first puppet exited the stage and a second puppet appeared. This puppet crossed the stage twice going the opposite direction. The purpose of this familiarization phase was to show that the puppets had opposing goals: They each wanted to cross the stage, but in opposite directions.

After the familiarization phase came the action phase: The two puppets appeared simultaneously on opposite sides of the stage and tried to cross at the same time, stopping at

center stage when they bumped into each other. Both puppets then backed up and tried to cross again, bumping again in the middle. This sequence was repeated 5 times. Finally the puppets approached one another but stopped before meeting, and one puppet yielded the way by rotating downward (so that its eye faced the ground) and moving aside. The other puppet passed in front of the downward-facing puppet and continued on across the stage (see Figure 1, Panel 1.0). This entire action phase was repeated three times. See <https://osf.io/km5by/> for videos of this and all other vignettes described in this paper.

Figure 1. Diagrams depicting ‘Action Phase’ of each puppet show used in Experiments 1.0-1.4. (1.0) Exp. 1.0: One puppet yields to the other; (1.1) Foot-Race Follow-Up; (1.2A) Exp. 1.2A Replication (1.2B) Exp. 1.2B Barrier Follow Up; (1.3) Exp.1.3 Stop-and-Face-Down Follow-Up; (1.4) Exp. 1.4 Yielding Follow-Up. In each panel, the top depicts the beginning of the sequence, and the bottom depicts the end of the sequence.

After the vignette was completed came the test question: An experimenter (who did not know which puppet had yielded during the vignette) presented both puppets to the child on a board and asked, "Which one do you like?". The dependent measure was which puppet the child reached for ⁴⁰ (See Figure 2). Parents were asked to close their eyes during this procedure.

Figure 2. Choice Procedure used in all experiments. The experimenter would say 'Hi! 'Look!', then would rotate the board down so the infant could see the puppets and would look in the center between the puppets; and finally, "Which one do you like?" and would push the board toward the infant.

Of the 23 toddlers who contributed data to the analysis, 20 reached for the puppet that continued across the stage (i.e., presumably the 'high-status' puppet, two-tailed binomial test

$p < .001$; 95% CI: .664-.977; probability of success=.869). The Bayes Factor was 197.36 in favor of the hypothesis that toddlers chose the non-yielding puppet either more or less than 50% of the time (See Figure 4). This is decisive evidence⁴⁸ that the toddlers preferred the high-status puppet. All data from this and all other experiments in the study are available at <https://osf.io/km5by/>.

The purpose of Experiment 1.1 (Footrace Follow-Up) was to test a number of alternative explanations for why toddlers might have liked the non-yielding puppet (i.e., the ‘winner’) in Experiment 1.0. One was that toddlers might prefer a puppet that reaches its goal over one that fails to do so, independent of social status. The other alternative explanation was that toddlers might prefer the winner for some other nonsocial reason—because it moved farther or moved last, because it remained visible throughout the vignette (whereas the yielding puppet was briefly occluded when the winner passed it by), or because it moved the same way during the action phase as it did during the familiarization phase--remaining upright and traveling all the way across the stage in both phases of the vignette.

In this follow-up experiment, toddlers watched a scene in which the puppets moved across the stage as in Experiment 1.0, but without any social interaction. First, the familiarization phase: Each puppet crossed the stage twice, alone. But unlike in Experiment 1.0, both puppets traveled in the same direction. Next came the action phase: Both puppets appeared together at one side of the stage. One puppet traveled halfway across the stage and stopped, rotated downward, and moved aside, just like the yielding puppet in Experiment 1.0. Then the second puppet came from behind the first, passed in front of the prostrate puppet

and continued on across the stage. Thus, the vignette included the same puppet movements as Experiment 1.0; but without any social conflict (see Figure 1, Panel 1.1).

Of the 24 toddlers who contributed data to this analysis, 12 chose the puppet that stayed upright and completed its journey across the stage (two-tailed binomial test $p=1.0$; 95% CI: .291-.709; probability of success=.5). The Bayes Factor was 4.02 in favor of the hypothesis that toddlers chose the non-yielding puppet 50% of the time. This is strong evidence in favor of the null, considered strong evidence in favor of a single point—in this case the hypothesis that participants chose each puppet 50% of the time. In other words, toddlers showed no preference for the puppet that continued across the stage in this vignette, even though like the ‘winning’ puppet in Experiment 1.0, it (a) remained visible the whole time; (b) remained upright the whole time; (c) traveled farther than the other puppet; (d) moved last; and (e) moved in the same way (same path and posture) in the action phase as it had during the familiarization phase (See Figure 4). Thus, Experiment 1.1 provides positive evidence that none of these low-level factors explain the findings of Experiment 1.0, and also that toddlers don’t necessarily prefer a puppet just because it achieves its goal of crossing the stage.

In the previous experiment, the footrace follow-up (Experiment 1.1) the puppet that stopped halfway across the stage did not face any kind of obstacle. So toddlers might have thought the puppet simply decided to stop. If so, then it could still be the case that toddlers prefer agents who achieve their goals. Toddlers may not have shown a preference for either puppet in Experiment 1.1 because they thought that *both* puppets achieved their goals: One achieved its longstanding goal of crossing the stage, and the other achieved its new goal of stopping halfway. To test this, in Experiment 1.2 (Barrier Follow-Up) we used a stage with two

levels-- one above the other, like bookshelves. The two puppets performed the same movements as in Experiment 1.0, but on different levels. Instead of running into each other at center stage, each puppet ran into a barrier. Because Experiment 1.0 had not taken place on a two-level stage, we also used Experiment 1.2 to replicate the original findings on the new, two-level stage.

Toddlers were assigned to one of two conditions: Condition A replicated of Experiment 1.0, with all the action occurring on either the upper or the lower stage (See Figure 1, Panel 1.2A). In Condition B, the puppets moved as they had in Experiment 1.0, but on different levels—one puppet above, the other below.. In the Condition B familiarization phase, each puppet crossed the stage alone twice, on either the top or bottom level. In the action phase, barriers appeared on stage and the puppets approached and retreated from the barriers, mimicking the movements in Experiment 1.0, to show that the barriers were obstructing them. Then the curtains closed again and re-opened to show only one barrier remaining, on either the upper or the lower stage, allowing only one puppet to continue across the stage (see Figure 1, Panel 1.2B).

Of 38 toddlers who contributed data to this analysis, 19 were assigned to Condition A (the replication condition) and 19 were assigned to Condition B (the barrier condition). Results from the replication matched those of Experiment 1.0, with 16 of 19 toddlers choosing the non-yielding or 'winner' puppet (two-tailed binomial test $p=.004$; 95% CI: .604-.966; probability of success=.842). The Bayes Factor was 27.05, which is strong evidence in favor of the hypothesis that toddlers chose the non-yielding puppet either more or less than 50% of the time. In contrast, in the barrier condition, only 9 of the 19 toddlers chose the puppet that

crossed the stage and thus achieved its goal (two-tailed binomial test $p=1.0$; 95% CI: .244-.711; probability of success=.474.) The Bayes Factor was 3.52, which is moderate evidence in favor of the single point hypothesis that children chose both puppets equally.

Children who saw the vignette with barriers chose the puppet that reached its goal significantly less than children who saw the original vignette replicated ($\chi^2(1) = 4.51$, $p=.034$; $r=.34$, which is the square root of the chi-square statistic (4.51) divided by $N=38$; Bayes Factor=3.46 in favor of the hypothesis that the two conditions differed). Thus, toddlers' preference for the individual who did not yield in Experiment 1.0 cannot be attributed to a general preference for individuals who complete their goals over ones that do not.

Experiments 1.0, 1.1 and 1.2 demonstrated that toddlers like an individual who prevails in a conflict better than an individual who yields, and this is not just a preference for any individual who reaches their goal. In Experiment 1.3 (Stop-and-Face-Down Follow-Up), we asked whether the preference is elicited as soon as one of the puppets rotates downward to face the floor, a display of deference that was meant to look like the human prostration or bowing found in many cultures^{5,49}. For this experiment, toddlers watched a vignette similar to the one in Experiment 1.0, except that it ended after one puppet rotated downward to face the ground. This replicated the first part of the yielding gesture made by one puppet in Experiment 1.0. The scene ended before the puppet made the second part of that gesture, which was to move aside to yield the way for the other puppet to cross the stage. In this follow-up experiment, the upright puppet never crossed the stage, but simply stayed standing where it was, with the other puppet prostrated before it, until the curtain closed (See Figure 1; Panel 1.3).

Of 24 toddlers who contributed data to this analysis, 10 chose the puppet that stayed upright suggesting that toddlers liked both puppets equally (two-tailed binomial test $p=.543$; 95% CI: .221-.633; probability of success=.417). The Bayes Factor was 2.92, which is moderate evidence in favor of the single point that toddlers chose each puppet half of the time. In other words, the preference shown in Experiments 1.0 and 1.2a was not elicited when one puppet merely prostrated downward without yielding the way (See Figure 4).

In Experiment 1.4. (yielding follow up) we asked whether the preference for the upright puppet would be elicited when one puppet did the whole yielding action (prostrating downward and moving aside) and the vignette stopped there. Experiment 1.4 was like Experiment 1.3, but after one puppet rotated downward, it moved aside. This replicated the entire yielding motion from Experiments 1.0 and 1.2a. As in Experiment 1.3, the upright puppet never crossed the stage, but remained standing in its place until the curtains closed. (See Figure 1, Panel 1.4).

Of the 30 toddlers who contributed to the analysis, 23 chose the upright puppet (two-tailed binomial test $p=.0052$; 95% CI: .577-.900; probability of success=.767.) The Bayes Factor was 17.01, which is moderate evidence in favor of the hypothesis that toddlers chose the non-yielding puppet either more or less than 50% of the time. In other words, toddlers liked the puppet who was yielded to more than the puppet who yielded, even when the upright puppet did not go on to reach its goal (See Figure 4). The results of Experiments 1.0 through 1.4 thus suggest that toddlers prefer those who are yielded to in zero-sum conflicts. The preference is not explained by the fact that the upright puppet reaches its goal, nor is it elicited when one puppet 'bows' (i.e., rotates downward) without yielding the way.. In other words,

being yielded to is a sufficient and necessary condition to solicit this preference whereas *only* achieving one's goal nor being 'prostrated toward' is not sufficient.

Experiments 1.0 through 1.4 suggest that toddlers prefer high-status individuals, even when those individuals hinder others from achieving their goals. In the next experiment, we tested whether toddlers prefer *any* individual who wins, or only one who is yielded to. Specifically, we tested whether toddlers prefer a puppet who wins because it uses coercive force. In Experiment 2.0 (One Puppet Wins by Physical Force), we showed toddlers a vignette nearly the same as in Experiment 1.0. But after the puppets reached their standoff, neither puppet yielded. Instead, one puppet physically knocked the other puppet over and out of the way before crossing in front of it to continue across the stage (See Figure 3, Panel 2.0).

Of the 22 toddlers who contributed data to this analysis, 18 reached for the puppet who was knocked down (two-tailed binomial test, $p=.00434$, 95% CI: .597-.948; probability of success=.818; Bayes Factor= 24.93 in favor of the hypothesis that children chose one puppet more often than the other). Thus, we found strong evidence that toddlers preferred the loser (who was a victim of violence) rather than the winner (who inflicted the violence to get its way). Thus, toddlers' preference for winners of a conflict does not seem to extend to those who win by using force against someone else (See Figure 4). This result is consistent with previous studies showing that younger infants avoid those who use force against others in general, or to hinder others^{40,50}. It appears that toddlers care not only *who* wins a conflict, but also *how* they win. They prefer not just winners, but winners to whom others defer.

One question we had about the results of Experiment 2.0 was whether toddlers might have avoided the puppet who used force simply because they don't like any puppet who uses

force for any reason. In other words, do they dislike individuals who use force in general, or do they specifically dislike individuals who use coercive force to win a conflict? In Experiment 2.1 (Helpful-Force Follow-Up), toddlers watched a vignette in which one puppet knocks over a barrier, thus enabling both puppets to cross the stage. The vignette begins with a familiarization stage like that of Experiment 1.1, where the two puppets each cross the stage going the same direction. Then in the action phase, a barrier appears at center stage. As in earlier experiments, one puppet moves across the stage until it meets the barrier, backs up and moves forward again, only to meet the barrier again. Then (unique to this experiment), the other puppet crosses in front of the first one and knocks the barrier down, using the same 'knocking down' motion as in Experiment 2.0, but with the force directed against the barrier instead of against the other puppet. Both puppets then hop over the collapsed barrier and continue on their way (See Figure 3, Panel 2.1).

Figure 3. Diagrams depicting 'Action Phase' of each puppet show used in Experiments 2.0 & 2.1; (2.0) Exp 2.0 One Puppet Wins by Force ; (2.1) Exp. 2.1 Helpful Force Follow-Up In each panel, the top depicts the beginning of the sequence, and the bottom depicts the end of the sequence.

Of the 22 toddlers who contributed data to this analysis, 19 reached for the puppet who knocked the barrier down (two-sided binomial test; $p < .001$; 95% CI: .651-.971; probability of success=.863; $BF=118$ in favor of the alternative hypothesis that toddlers were choosing one of the puppets more than 50% of the time). Thus, we found strong evidence that toddlers do not automatically avoid a puppet just because it knocks something down. In fact, they showed a strong preference for the puppet who used force to knock over a barrier (See Figure 4). This is consistent with previous work showing that infants prefer those who use force to help others.⁴⁰ Hence, the reason that toddlers avoided the puppet who knocked another individual over in Experiment 2.0 cannot be that they avoid anyone who forcefully knocks something over, because toddlers strongly preferred the puppet who knocked down the barrier in Experiment 2.1.

Figure 4. Number of Toddlers who chose each Puppet in All Experiments. In all experiments, Bayes Factors were computed by comparing the likelihood of the data given the null hypothesis (that children were choosing each puppet 50% of the time) against the alternative hypothesis (that children were choosing one of the puppets more than 50% of the time). ^ indicates a Bayes Factor in favor of the null, otherwise the Bayes Factor favored the alternative hypothesis. Two-sided binomial tests were used to calculate the p-values. The diagrams below each graph depict the last segment of the 'action phase' in each experiment. The colors of the bar graphs correspond to the role of the puppet in the diagram below each graph. However, in the experiment, the roles of the puppets were counterbalanced as well as the direction that the puppets traveled. (Experiment 1.0 95% CI: .664-.977; probability of success=.869; Experiment 1.1 95% CI: .291-.709; probability of success=.5; Experiment 1.2A 95% CI: .604-.966; probability of success=.842; Experiment 1.2B 95% CI: .244-.711; probability of success=.474; Experiment 1.3 95% CI: .221-.633; probability of success=.417; Experiment 1.4 95% CI: .577-.900; probability of success=.767; Experiment 2.0 95% CI: .597-.948; probability of success=.818; Experiment 2.1 95% CI: .651-.971; probability of success=.863.)

This series of experiments shows that toddlers prefer puppets who are yielded to by others, and that this preference is not simply for winners over losers: They care not only about

who wins, but also about *how* they win. Toddlers prefer a puppet who is yielded to in a conflict, but not one that uses force to get its way. We have several types of evidence this preference is not simply for any puppet that achieves its goal. First, as shown in Experiment 2.0, toddlers do not like a puppet who achieves its goal by force. Second, as shown in Experiments 1.1 and 1.2, in a situation where only one puppet reaches its goal but there is no conflict between them, toddlers like the two puppets equally. Finally, as shown in Experiment 1.4, toddlers do prefer a puppet who is yielded to (where ‘yield’ means to rotate toward the ground and move out of the way) even when they don’t see that puppet continue on to reach its goal. All together, these studies suggest that just linguistic toddlers like and approach high-ranking individuals.

These results are consistent with findings from a range of non-human species. For example, as mentioned above, male macaques pay fruit juice to look at pictures of high-status conspecifics,⁴⁵ and they also prefer to ally themselves with higher-status others.⁴⁴ Several species including dogs, rats, and prairie voles take social status into account when choosing mates.^{51–53} For humans and other highly social species, affiliating with high-status others may provide access to resources, support, protection and know-how.^{20,54} But if high-status others behave violently, the benefits of being near them may be outweighed by the costs. This principle is consistent with our findings that toddlers prefer those who win because others yield, but not those who use force to win.

These findings are also interesting to compare to recent reports about adult bonobos. It seems that adult bonobos prefer novel dominant individuals to subordinate individuals, even when the dominants use physical aggression.⁴ Our Experiment 2.0 provides a clear contrast

with these findings, in showing that human toddlers reject those who use physical coercion. This is perhaps related to the different types of hierarchy in the two species. Whereas non-human primate hierarchies are largely characterized by coercive social dominance,^{23,38} human hierarchies involve not just coercion but also guidance, protection⁵ and cultural learning.^{5,9,55} Perhaps human toddlers are more sensitive to whether people are *voluntarily* yielded to because voluntary yielding is given to people who can provide cultural benefits. In contrast, an individual may use physical force because their status is not recognized by others, and such a person may simply be dangerous to approach.

Turning our attention to human adults, the present findings have many parallels in adult social psychology. Adults who participate in a group decision-making exercise, for example, pay more attention to an individual who has been influential in that exercise than to one who has not³². Adults also like individuals who appear to have influence on a group because they are respected,³² those who have higher-status jobs,^{46,56} and those whose gaze is followed by others.⁵⁷ And adults like winners: The approval ratings of politicians go up right after they win an election,⁵⁸ and adults tend to affiliate with winners rather than losers. For example, students talking about their own university's sports teams tend to use the word 'we' for victories (*we* won) and 'they' for losses (*they* lost).⁵⁹ When adults look at novel people who have been labeled 'high-ranking' (as opposed to 'low-ranking'), there is greater activity in the ventral striatum, a brain area associated with monetary reward.⁶⁰

It is not surprising that adults prefer to affiliate with high-status people rather than low-status people. Adults may have learned from experience that it's useful to have friends in high places. A similar explanation could apply to children who endorse the testimony of high-status

individuals—they may have learned from experience that high-status people in their world (i.e., adults) know more than children do.

But the analogous arguments seem less plausible when applied to the toddlers in the present experiments. Whereas adults have been able to observe over a period of many years that high-status people receive and sometimes share benefits, it seems less plausible that 21-month old children would already have inferred this, given their much more limited experience. It seems more likely to us that toddlers have an evolved, innate or early-developing (implicit) preference for high-status individuals¹⁸.

When comparing these results to the adult social psychology literature, a word of caution is in order. Much debate in social psychology has focused on the question of whether human social hierarchies are better described as dominance-based or prestige-based. Although the results of Experiments 2.0 and 2.1 are consistent with accounts of human social hierarchy that emphasize prestige, there is no reason to think that a toddler's understanding of the social world is anything like an adult's conception of a prestige-based hierarchy. Toddlers might be concerned mainly with avoiding harm (which is the central issue in a dominance-based hierarchy) and still prefer the nonviolent winner of a conflict. Actual violence is not always common in dominance-based hierarchies, because lower-status individuals tend to defer to higher-status ones.^{7,12,24,38} This is especially true when social rank is stable. Thus, the fact that toddlers like winners and dislike those who use violence would actually make sense within either type of hierarchical structure.

It is also interesting to compare these findings to research showing that infants prefer helpers over hinderers.⁴⁰ Consistent with that literature, we found that toddlers avoided a

puppet who used coercive force to win a zero-sum conflict, but preferred a puppet who knocked down a barrier, allowing itself and another puppet to reach their common goal. Our findings constitute an independent conceptual replication of these original, widely-cited helper-hinderer findings. This is important because although the findings have been replicated many times over by the original researchers^{40,61–63}, some replication attempts have failed.^{64,65}

Whereas our Experiments 2.0 and 2.1 confirm the basic helper/hinderer findings, our Experiments 1.0 and 1.2a diverge from them. In these experiments, the puppet that yields the way could be seen as ‘helping’ the other puppet by stepping aside. If toddlers viewed the scene this way and preferred helpers, then they should have preferred the puppet who yielded—but they didn’t. We take this to mean that just-linguistic toddlers are not only sensitive to prosociality (as shown by the helping/hindering studies); they are also sensitive to social status. In our Experiments 1.0 and 1.2a status was a more salient social dimension to the toddlers than prosociality.

All of the results presented here should be interpreted in light of the fact that the participants had only recently started walking, talking, and in most cases interacting with similar-age peers. Status may be a particularly salient social dimension for toddlers, whose world has recently broadened from just caregivers to include other children with whom they might compete for attention, food, space or other resources. This is consistent with observations from day-care centers suggesting that social hierarchies form among toddlers as young as 18 months, and that higher-ranking toddlers become sought-after play partners⁶.

Taken together, the results of these seven experiments suggest that when toddlers ages 21 to 31 months witness a zero-sum conflict between two novel individuals, they not only

make inferences about the social status of those individuals, they also form preferences based on that status: They selectively approach the high-status individual. We conducted several control experiments to test alternative explanations, showing that the preference was not just for a puppet who successfully reached its goal, crossed the stage, remained upright, remained visible, traveled farther, etc. We also found that toddlers do not like *all* winners; specifically, they do not like a puppet who wins by knocking another one down. Thus, toddlers not only care who wins, but also *how* they win, and both of these components affect their decisions about who they like. Overall, these results suggest that human toddlers evaluate others based on social rank in ways that differ qualitatively from our nearest primate relatives.

Methods

General Methods

Participants were recruited at a children's museum during regular business hours. Each experiment used a different set of toddlers. Before entering the testing room, parents gave informed consent to allow us to test their child. Parents were asked to remain quiet during the puppet show; before the test question, they were asked to close their eyes. The participating child usually sat on the parent's lap. When this was not possible (e.g., because the parent was holding a younger sibling), the participant sat in a chair next to their parent. The puppet show consisted of a familiarization phase that was shown twice, an action phase that was shown three times, and a test question.

In all seven experiments, one puppet at a time was visible during the familiarization phase, and both puppets were visible at the same time during the action phase. Each puppet's direction of travel (leftward or rightward across the stage) was counterbalanced with its role in

the action phase (e.g., yielding or remaining upright), as was the order in which the puppets crossed the stage and the specific puppet (e.g., yellow oval or red square) assigned to play each role. We also counterbalanced the position of the high-status puppet (on the child's left or right) during the test question. Participants were randomly assigned to conditions within each experiment (i.e. which puppet won or lost, which direction the winner traveled etc.). In Experiment 1.2 participants were randomly assigned to either Experiment 1.2A or 1.2B. Videos of all the puppet shows can be viewed at <https://osf.io/km5by/> and more detail can be found in the Supplementary Materials.

The test-question procedure was modeled after the helper/hinderer studies⁴⁰. First, an experimenter who was blind to the condition asked the parent to close his or her eyes. The experimenter then held out the board with the two puppets so that the child could see, but not reach them. The experimenter looked at the child and said, "Hi! Look!" and then looked down at the board, fixing her gaze directly in the center of the board between the two puppets. Then the experimenter said, "Which one do you like?" and moved the board toward the child so that the child could reach it. If the child reached simultaneously for both puppets (one with each hand), the trial was coded 'both.' If the child chose neither puppet, the procedure was repeated. If after three times the child had still made no choice, the trial was coded 'no response.' These exclusion criteria, along with others described below, were decided after pilot testing and before we started data collection for Experiment 1.0. The video of the choices were coded by an experimenter blind to the condition.

To calculate the Bayes Factor we used the calculator here: <http://pcl.missouri.edu/bf-binomial>. In the calculator we left prior successes as '1' and prior failures as '1'. We used a

flexible stopping rule where we checked the Bayes Factor after each testing session, and tested toddlers until we had a sufficiently strong Bayes Factor to answer the question. During each testing session we tested between 1 and 12 toddlers (the average was around 2). Note that although frequentist statistical analyses do not allow for preferential stopping, Bayesian analyses do^{66,67}. We also included frequentists statistics in the paper since more people in our field are familiar with this type of analysis.

Experiment 1.0: One Puppet Yields to the Other

Participants

A total of 31 toddlers participated in the experiment. Of these, 8 were excluded from the analysis for the following reasons: Choosing both puppets (n=3); not choosing a puppet (n=3); extreme fussiness (n=1); distraction in the testing environment—a janitor noisily entered the testing room and distracted the child (n=1). The remaining 21 toddlers (8 girls, 13 boys) contributed data to the analysis. Their ages ranged from 21 to 31 months (M=24.95 months, SD=2.92 months). Data collection was stopped when Bayesian analyses showed a sufficiently strong effect to answer the question (see analysis above). Note that although frequentist statistical analyses do not allow for preferential stopping, Bayesian analyses do.^{66,67}

Experiment 1.1: Footrace Follow-Up

Participants

A total of 37 toddlers participated in the experiment. Of these, 13 were excluded from the analysis for the following reasons: Choosing both puppets (n=7); not choosing a puppet (n=3); extreme fussiness (n=3); experimenter error (the puppets were moved backward in the

puppet show, $n=1$). The remaining 24 toddlers (7 girls, 17 boys) contributed data to the analysis. Their age ranged from 21 to 31 months ($M=26.56$ months; $SD=3.25$ months).

Experiment 1.2: Barrier Follow-Up

Participants

A total of 64 toddlers participated in the experiment. Of these, 34 were assigned to Condition A. Of the children in Condition A, 15 were excluded from the analysis for the following reasons: choosing both puppets ($n=8$); not choosing a puppet ($n=2$); experimenter error ($n=2$: the puppet was facedown instead of upright in 1 trial; the 'choice' puppets were visible to the child when they walked in); fussiness ($n=1$; the puppet show was stopped because the child started crying in one trial); interference by a sibling ($n=1$); and one child was excluded because they stood up at the end of the puppet show and didn't watch the end ($n=1$). The remaining 19 toddlers (7 boys, 12 girls) contributed data to the analysis. Their ages ranged from 21 to 32 months ($M=26.05$ months; $SD=3.14$ months.)

The other 30 children were assigned to Condition B. Of those, 11 children were excluded from analysis for the following reasons: choosing both puppets ($n=6$); not choosing a puppet ($n=1$); experimenter error ($n=3$: the puppet was facedown instead of upright in 1 trial; the experimenter used her hands to present the puppets to the child; the puppeteer did the wrong number of sequences at the ends); interference by a sibling ($n=1$). The remaining 19 toddlers (9 girls and 10 boys) contributed data to the analysis. Their ages ranged from 21 to 32 months ($M=25.23$ months; $SD=2.88$ months).

Experiment 1.3: Stop-and-Face-Down Follow-Up

Participants

A total of 37 toddlers participated in the experiment. Of these, 13 were excluded from the analysis for the following reasons: choosing both puppets ($n=7$); not choosing a puppet ($n=3$); experimenter error ($n=1$: the experimenter made the wrong puppet face downward during one trial and accidentally let the oval puppet roll onto its back in another trial); interference ($n=1$: the participant's sibling pointed to one of the puppets before the participant made a choice); object in hand ($n=1$: the toddler had an object in their hand while choosing). The remaining 24 toddlers (12 girls, 12 boys) contributed data to the analysis. Their ages ranged from 21 to 32 months ($M=25.25$ months; $SD=2.96$ months).

Experiment 1.4: Yielding Follow-Up

A total of 42 toddlers participated in the experiment. Of these, 12 were excluded for the following reasons: choosing both puppets ($n=4$); not choosing a puppet ($n=1$); fussiness ($n=1$); interference ($n=2$ parent was talking to their child during the choice procedure and didn't close their eyes; in another trial the parent touched one of the puppets while the child was making their choice); experimenter error ($n=3$, the experimenter did not remind parents to close their eyes during choice procedure so parents had their eyes open) developmental delays ($n=1$ the parent indicated that their child was on the autism spectrum on the consent form); inattention ($n=1$ the child was turned around, facing their parent during the test sequence of the puppet show). The remaining 30 toddlers (23 girls and 7 boys) contributed data to the analysis. Their age ranged from 21 to 32 months ($M=24.2$; $SD=2.4$ months).

Experiment 2.0: One Puppet Wins by Physical Force

Participants

A total of 29 toddlers participated in the experiment. Of these, 7 were excluded from the analysis for the following reasons: choosing both puppets ($n=2$); not choosing a puppet ($n=1$); extreme fussiness ($n=2$); parental interference ($n=1$); sibling interference ($n=1$). The remaining 22 toddlers (10 girls, 11 boys, 1 parent did not specify) contributed data to the analysis. Their age ranged from 20 to 31 months ($M=24.91$ months; $SD=3.13$ months).

Experiment 2.1: Helpful-Force Follow-Up

Participants

A total of 36 toddlers participated in the experiment. Of these, 14 were excluded from the analysis for the following reasons: choosing both puppets ($n=5$); not choosing a puppet ($n=2$); extreme fussiness ($n=2$); parental interference ($n=1$); sibling interference ($n=1$); experimenter error ($n=2$: which puppet knocked the barrier over was different in two test sequences) and one child was excluded because she had an object in one of her hands during the choice procedure ($n=1$). The remaining 22 toddlers (12 girls, 11 boys) contributed data to the analysis. Their age ranged from 21 to 32 months ($M=26.48$ months; $SD=3.18$ months).

These procedures were approved by the Institutional Review Board at the University of California, Irvine

Data Availability: All data, including pilot data and videos of puppet shows can be found here:

<https://osf.io/km5by/> .

Coding Availability: No coding was used to analyze this data. We used the `binom.test` function in R⁶⁸ and the Bayesian calculator found here <http://pcl.missouri.edu/bayesfactor>. For all experiments ‘prior successes (a)’ = 1 and prior failures (b)=1.

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Figure Legends

Figure 1. Diagrams depicting ‘Action Phase’ of each puppet show used in Experiments 1.0-1.4. (1.0) Exp. 1.0: One puppet yields to the other; (1.1) Foot-Race Follow-Up; (1.2A) Exp. 1.2A Replication (1.2B) Exp. 1.2B Barrier Follow Up; (1.3) Exp.1.3 Stop-and-Face-Down Follow-Up;

(1.4) Exp. 1.4 Yielding Follow-Up. In each panel, the top depicts the beginning of the sequence, and the bottom depicts the end of the sequence.

Figure 2. Choice Procedure used in all experiments. The experimenter would say ‘Hi! ‘Look!’, then would rotate the board down so the infant could see the puppets and would look in the center between the puppets; and finally, “Which one do you like?” and would push the board toward the infant.

Figure 3. Diagrams depicting ‘Action Phase’ of each puppet show used in Experiments 2.0 & 2.1; (2.0) Exp 2.0 One Puppet Wins by Force ; (2.1) Exp. 2.1 Helpful Force Follow-Up In each panel, the top depicts the beginning of the sequence, and the bottom depicts the end of the sequence.

Figure 4. Number of Toddlers who chose each Puppet in All Experiments. In all experiments, Bayes Factors were computed by comparing the likelihood of the data given the null hypothesis (that children were choosing each puppet 50% of the time) against the alternative hypothesis (that children were choosing one of the puppets more than 50% of the time). [^] indicates a Bayes Factor in favor of the null, otherwise the Bayes Factor favored the alternative hypothesis. Two-sided binomial tests were used to calculate the p-values. The diagrams below each graph depict the last segment of the ‘action phase’ in each experiment. The colors of the bar graphs correspond to the role of the puppet in the diagram below each graph. However, in

the experiment, the roles of the puppets were counterbalanced as well as the direction that the puppets traveled. (Experiment 1.0 95% CI: .664-.977; probability of success=.869; Experiment 1.1 95% CI: .291-.709; probability of success=.5; Experiment 1.2A 95% CI: .604-.966; probability of success=.842; Experiment 1.2B 95% CI: .244-.711; probability of success=.474; Experiment 1.3 95% CI: .221-.633; probability of success=.417; Experiment 1.4 95% CI: .577-.900; probability of success=.767; Experiment 2.0 95% CI: .597-.948; probability of success=.818; Experiment 2.1 95% CI: .651-.971; probability of success=.863.)