

2 **CONFORMITY AND ITS LOOK-A-LIKES**

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15 Following the crowd is usually dismissed as mindless acquiescence, devoid of original
16 thought and authenticity. Despite this seemingly undesirable predicate, in human
17 interactions, majority influences seem pervasive, even beyond conscious control
18 (Sweeny & Whitney 2014). The influence of majorities on individuals' learning and
19 decision-making has therefore received ample attention in the scientific community. In
20 particular, psychologists and cultural evolutionists have been intrigued: the former
21 group of scholars aiming at understanding the workings of specific social influences
22 (Asch 1956; Sherif 1936), the latter interested in exploring evolutionarily stable
23 strategies explaining the emergence and persistence of cultural diversity (Boyd &
24 Richerson 1985; Cavalli-Sforza & Feldman 1981). These focused investigations have
25 led to some seminal findings, for instance the robust fact that, in certain contexts,
26 roughly a third of human adults adopt an erroneous majority stance against their better
27 knowledge (Asch 1956; Bond & Smith 1996) and the fact that preferentially adopting
28 the majority strategy can yield culture-like phenomena (i.e., relatively high level of

29 within-group behavioural homogeneity) under a wide range of conditions (Boyd &
30 Richerson 1985; Henrich & Boyd 1998; Richerson & Boyd 2005).

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32 Despite subtle differences of approach or interpretation (Morgan & Laland
33 2012; van Leeuwen & Haun 2014), psychologists and cultural evolutionists have in
34 principle all adhered to conformity's definitional aspect of adopting the preferred
35 strategy of *the majority of group members* rather than simply the strategy observed most
36 frequently. Besides the benefits of trans-disciplinary definitional consistency, there is
37 another reason for this particular adherence, which can be succinctly summarized by
38 appealing to: "the wisdom of the crowd". Mathematical and empirical analysis show
39 that large groups of individuals are better equipped to find correct answers to challenges
40 than relatively small groups, a phenomenon that is also referred to as "collective
41 cognition" (Hastie & Kameda 2005; King & Cowlshaw 2007; Wolf et al. 2013) (note
42 that "the majority" by definition constitutes the largest sub-group in a population).
43 Intuitively, this finding can be understood by acknowledging that the majority strategy
44 is the strategy that most group members, with their unique sets of learning skills, have
45 converged upon. As such, the majority strategy represents a robust synergy of
46 individual capacities for discovering useful contingencies, which speaks to the adaptive
47 potential of majority influences.

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49 Within this definition of copying the majority of group members, cultural
50 evolutionists study the *disproportionate tendency of naïve individuals* to adopt the
51 majority strategy (originally coined "conformist transmission", see Boyd & Richerson
52 1985). In contrast, psychologists focus on individuals' tendencies to *forgo their*
53 *personal strategy* and adopt the conflicting majority variant (originally coined
54 "conformity", see Asch 1956). By now, a plethora of studies have evidenced *conformity*

55 in both human children (Corriveau & Harris 2010; Haun & Tomasello 2011) and adults
56 (Asch 1956; Bond 2005) and some evidence for *conformist transmission* in human
57 adults exists as well (Coultas 2004; Jacobs & Campbell 1961; Morgan et al. 2011).
58 Recently, scholars have similarly started to explore majority influences in non-human
59 animals, either for reasons of understanding species-specific learning patterns (Aplin et
60 al. 2014), or aiming at reconstructing the evolutionary path that led to the conformity
61 observed in humans (Whiten, Horner & de Waal 2005). While this endeavour is to be
62 applauded, crucial mismatches between the original majority influence constructs and
63 the recent non-human animal studies significantly hamper our insights. By focusing on
64 the most recent non-human animal study in this area (Aplin et al. 2014), we wish to
65 clarify the study of majority biased learning so that both species-specific behaviour and
66 the evolutionary trajectory of (human) tendencies can be more validly assessed.

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68 Aplin and colleagues claim an emergence and persistence of behavioural
69 traditions via *conformist transmission* and *conformity* in wild great tits (Aplin et al.
70 2014). After training one individual in each of several sub-populations to obtain a
71 reward from an automated food dispenser by sliding a small door either to the left or to
72 the right, the researchers were able to observe how entire sub-populations converged on
73 the same door-sliding technique. Yet, while their evidence regarding the emergence and
74 persistence of great tit traditions (i.e., group-specific behavioural variants) seems robust,
75 and represents an admirable contribution to the limited literature on traditions in wild
76 animals, their pivotal claim of demonstrating culture via *conformist transmission* and
77 *conformity* is seemingly misguided, as we will argue below.

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79 First and foremost, where Aplin et al. report that great tits consider the majority
80 when learning socially, they operationalized the majority strategy as the strategy that is

81 “performed most *frequently*” (Aplin et al. 2014). As explained above, however, in terms
82 of both cultural evolution and the study of psychology, the meaningful
83 operationalization is the strategy that is “performed by most *individuals*”. Sometimes
84 these two definitions will capture the same thing, but – crucially – sometimes they will
85 not. If, for instance, individual A performs Strategy 1 six times and individuals B, C, D,
86 and E perform Strategy 2 one time each, under Aplin et al.’s account (Aplin et al. 2014),
87 Strategy 1 is the majority strategy, while – to the best of our knowledge – in terms of all
88 studies on cultural evolution, Strategy 2 would be considered the majority strategy. Note
89 that the aforementioned synergy of individuals’ learning capacities (collective cognition
90 - represented by the majority strategy) does not apply to behavioural repetitions by one
91 individual (in this example: individual A). Hence, this critique is not just a plea for
92 definitional consistency: (mathematical) logic and empirical work actually indicates the
93 central role of *individuals* in majority influences, not mere *frequencies* of behaviour
94 patterns (Boyd & Richerson 1985; Hastie & Kameda 2005; King & Cowlshaw 2007;
95 Wolf et al. 2013). Confusion over individuals versus frequencies may, in part, arise
96 because modelling studies often use a *conformist transmission* function expressed in
97 terms of frequencies, but derived from the number of individuals in a population
98 (Walters & Kendal 2013). A recent empirical study even shows that the effects of
99 individuals and frequencies can be teased apart experimentally, with the evidenced
100 differences in behavioural outcomes corroboratively indicating the necessity to refrain
101 from confounding individuals and frequencies (Haun et al. 2013).

102

103 One way in which Aplin et al. claim the majority influenced the birds’ behaviour
104 is through *conformist transmission* (Aplin et al. 2014). Recapitulating, *conformist*
105 *transmission* is adaptive because it represents collective cognition: it allows a learner to
106 integrate the output of multiple individuals’ social and individual learning experiences

107 (Boyd & Richerson 1985; Richerson & Boyd 2005). Under Aplin et al.'s
108 operationalization of the majority, however, this advantage may not have been present
109 (Aplin et al. 2014). Minimally, we must know how many other birds were actually
110 observed by the learners (including their relative strategy preferences), yet these details
111 are not provided (Aplin et al. 2014). If Aplin et al. were able to re-analyse their data
112 such that each individual could be scrutinized in light of their unique *individual-based*
113 observation records (e.g., individual A observes three conspecifics using Strategy 1 and
114 nine conspecifics using Strategy 2), a valid investigation of *conformist transmission*
115 would be possible by comparing the majority sizes they observed (in this example:
116 75%) to their likelihood of adopting the majority strategy (in this example: Strategy 2).
117 Note further that while *conformist transmission* can result in tradition formation (Boyd
118 & Richerson 1995; Henrich & Boyd 1998), the fact that Aplin et al. (Aplin et al. 2014)
119 found that birds formed traditions does not in itself evidence *conformist transmission*.
120 Traditions may arise and stabilize due to many different transmission biases, not just
121 conformist transmission (Boyd & Richerson 1985; Haun, van Leeuwen & Edelson
122 2013; Kendal, Coolen & Laland 2009).

123

124 Aplin et al. furthermore claim that the majority continued to influence the birds,
125 even after they had acquired a working strategy. Two cases are reported as evidence for
126 their majority influence interpretation, i) of the birds that used both foraging solutions
127 ($n=78$), 8 birds gradually switched from using the non-seeded variant to the seeded
128 variant, and ii) 10 out of 14 birds switched their strategy preference when immigrating
129 into groups where the alternative solution had been seeded to match the new groups'
130 preference (Aplin et al. 2014). Aplin et al. interpret these cases as evidence for 'social
131 conformity' (or *conformity*), a term that refers to forgoing preferred behaviour in order
132 to match the majority of individuals (see above; Asch 1956). Aplin et al.'s study (Aplin

133 et al. 2014), however, does not provide sufficient evidence for *conformity* because, as
134 previously outlined, i) frequencies do not necessarily equal individuals, and ii) it is
135 unknown what the birds observed before switching their preferences. In other words, in
136 the cases where information was available on *how many times* the two foraging
137 solutions were observed by the respective birds, there is no information presented on
138 across *how many individuals* these occurrences were distributed, and in the cases where
139 only the relative strategy preferences are reported, the observation records of the
140 respective birds remain entirely opaque. Hence, interpretation in terms of majority
141 influence (here, *conformity*) seems premature. Indeed, a likely alternative explanation
142 for the outlined behavioural patterns is that the great tits employed a learning strategy in
143 which social information was always preferred over individual information, perhaps
144 especially when this social information was the most recently acquired piece of
145 information. For instance, the first ‘*conformity*’ case reported by Aplin et al. (preference
146 switch within populations; see above) could be explained by the respective birds
147 individually learning the non-seeded foraging solution followed by subsequent social
148 learning of the seeded solution. In a similar vein, the second ‘*conformity*’ case reported
149 by Aplin et al. (preference switch after immigrating into a new population; see above)
150 could be explained by immigrant birds updating their foraging strategies by copying the
151 behaviour of locally attuned conspecifics, for instance based on a ‘copy when uncertain’
152 bias, since the respective birds had entered a new group/environment. Crucially, such
153 cases of (biased) social learning do not automatically allow for interpretation of the
154 respective behavioural patterns in terms of majority influences: while social influences
155 comprise many different mechanisms and biases, majority influence can only be
156 demonstrated by providing evidence of the behavioural influence being caused by the
157 majority of group members (van Leeuwen & Haun, 2014).

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159 In general, within-group behavioural convergence can come about in many
160 different ways and should not be taken as evidence for majority influences without
161 closer scrutiny, not even when individuals explore alternatives and *re-converge* on their
162 first learned solution (see van Leeuwen & Haun, 2013 & van Leeuwen et al. 2013 in
163 response to e.g., Dindo et al. 2009; Hopper et al. 2011; Whiten et al. 2005). Not only
164 individual learning proclivities (e.g., “habit formation”, see Pesendorfer et al. 2009), but
165 also social learning tendencies other than majority influences must be ruled out before
166 (re-)convergence patterns can be interpreted in terms of majority influences (van
167 Leeuwen & Haun, 2014). Another illustrative case of premature majority-influence
168 conclusions is present in a recent wild vervet monkey study by van de Waal and
169 colleagues (van de Waal, Borgeaud & Whiten 2013). In this study, immigrating male
170 vervet monkeys adjusted their food colour preference (e.g., pink) to the food colour
171 preference of the new group (e.g., blue). This preference-switch was interpreted in
172 terms of *conformity*, yet it was unknown what and whom the immigrating males had
173 observed prior to their preference switching (van de Waal et al. 2013). In both the great
174 tit and vervet monkey cases, therefore, we wish to stress that the identification of
175 transmission biases (e.g., copy dominant individuals, copy when uncertain, copy the
176 majority) requires robust measurement of individual’s observation records (e.g., see van
177 Leeuwen et al. 2013; Kendal et al. 2015). Thus, potentially premature conclusions – in
178 the absence of supporting evidence regarding who observed whom perform which
179 strategy – will only hamper the empirical study of transmission biases.

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181 Recapitulating, we believe that, due to an invalid operationalization of “the
182 majority”, and the absence of data on birds’ observation records, Aplin et al. (Aplin et
183 al. 2014) cannot substantiate their conclusions that the great tit traditions emerged and
184 stabilized due to the claimed majority-influenced learning – neither *conformist*

185 *transmission* nor *conformity* has been sufficiently evidenced yet. More generally, with
186 the aim to streamline the study of species-typical social learning behaviour (e.g. Laland
187 2004) and the evolutionary trajectory of (human) cultural transmission tendencies, we
188 wish to emphasize that the identification of *conformist transmission* and *conformity*
189 necessitates scrutiny on the level of the majority of individuals.
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191 **REFERENCES**

- 192
- 193 Aplin, L. M., Farine, D. R., Morand-Ferron, J., Cockburn, A., Thornton, A., & Sheldon,
 194 B. C. (2014). Experimentally induced innovations lead to persistent culture via
 195 conformity in wild birds. *Nature*, *518*, 538-541. doi: 10.1038/nature13998
- 196 Asch, S. E. (1956). Studies of Independence and Conformity .1. A Minority of One
 197 against a Unanimous Majority. *Psychological Monographs*, *70*(9), 1-70.
- 198 Bond, R. (2005). Group size and conformity. *Group Processes & Intergroup Relations*,
 199 *8*(4), 331-354. doi: 10.1177/1368430205056464
- 200 Bond, R., & Smith, P. B. (1996). Culture and conformity: A meta-analysis of studies
 201 using Asch's (1952b, 1956) Line judgment task. *Psychological Bulletin*, *119*(1),
 202 111-137.
- 203 Boyd, R., & Richerson, P. (1985). *Culture and the Evolutionary Process*. Chicago:
 204 University of Chicago press.
- 205 Boyd, R., & Richerson, P. J. (1995). Why does culture increase human adaptability?
 206 *Ethology and Sociobiology*, *16*, 125-143.
- 207 Cavalli-Sforza, L. L., & Feldman, M. W. (1981). *Cultural transmission and evolution:
 208 A quantitative approach*. Princeton, N.J.: Princeton University Press.
- 209 Chudek, M., & Henrich, J. (2011). Culture-gene coevolution, norm-psychology and the
 210 emergence of human prosociality. *Trends in Cognitive Sciences*, *15*(5), 218-226.
 211 doi: Doi 10.1016/J.Tics.2011.03.003
- 212 Corriveau, K. H., & Harris, P. L. (2010). Preschoolers (Sometimes) Defer to the
 213 Majority in Making Simple Perceptual Judgments. *Developmental Psychology*,
 214 *46*(2), 437-445. doi: 10.1037/a0017553
- 215 Coultas, J. C. (2004). When in Rome... An evolutionary perspective on conformity.
 216 *Group Processes & Intergroup Relations*, *7*(4), 317-331. doi: Doi
 217 10.1177/1368430204046141
- 218 Dindo, M., Whiten, A., & de Waal, F. B. M. (2009). In-Group Conformity Sustains
 219 Different Foraging Traditions in Capuchin Monkeys (*Cebus apella*). *Plos One*,
 220 *4*(11). doi:10.1371/journal.pone.0007858
- 221 Hastie, R., & Kameda, T. (2005). The robust beauty of majority rules in group
 222 decisions. *Psychological Review*, *112*(2), 494-508. doi: Doi 10.1037/0033-
 223 295x.112.2.494
- 224 Haun, D. B. M., Rekers, Y., & Tomasello, M. (2012). Majority-biased transmission in
 225 chimpanzees and human children, but not orangutans. *Current Biology*, *22*, 727-
 226 731. doi: 10.1016/j.cub.2012.03.006
- 227 Haun, D. B. M., & Tomasello, M. (2011). Conformity to Peer Pressure in Preschool
 228 Children. *Child Development*, *82*(6), 1759-1767. doi: 10.1111/j.1467-
 229 8624.2011.01666.x
- 230 Haun, D. B. M., van Leeuwen, E. J. C., & Edelson, M. G. (2013). Majority influence in
 231 children and other animals. [review]. *Developmental Cognitive Neuroscience*, *3*,
 232 61-71.
- 233 Henrich, J., & Boyd, R. (1998). The evolution of conformist transmission and the
 234 emergence of between-group differences. *Evolution and Human Behavior*,
 235 *19*(4), 215-241.
- 236 Hopper, L. M., Schapiro, S. J., Lambeth, S. P., & Brosnan, S. F. (2011). Chimpanzees'
 237 socially maintained food preferences indicate both conservatism and conformity.
 238 *Animal Behaviour*, *81*(6), 1195-1202. doi: 10.1016/j.anbehav.2011.03.002
- 239 Jacobs, R. J., & Campbell, D. T. (1961). The perpetuation of an arbitrary tradition
 240 through several generations of a laboratory microculture. *Journal of Abnormal
 241 and Social Psychology*, *62*(3), 649-658.

242 Kendal, R. L., Coolen, I., & Laland, K. N. (2009). Adaptive trade-offs in the use of
243 social and personal information. In R. Dukas & R. J. (Eds.), *Cognitive ecology*
244 *II*. (pp. 249-271). Chicago: University of Chicago Press.

245 Kendal, R. L., Hopper, L. M., Whiten, A., Brosnan, S. F., Lambeth, S. P., Schapiro, S.
246 J., & Hoppitt, W. (2015). Chimpanzees copy dominant and knowledgeable
247 individuals: implications for cultural diversity. *Evolution and Human Behavior*,
248 *36*, 65-72.

249 King, A. J., & Cowlshaw, G. (2007). When to use social information: the advantage of
250 large group size in individual decision making. *Biology Letters*, *3*(2), 137-139.
251 doi: 10.1098/Rsbl.2007.0017

252 Laland, K. N. (2004). Social learning strategies. *Learning & Behavior*, *32*(1), 4-14.

253 Morgan, T. J. H., & Laland, K. (2012). The biological bases of conformity. *Frontiers in*
254 *Neuroscience*, *6*(87). doi: 10.3389/fnins.2012.00087

255 Morgan, T. J. H., Rendell, L., Ehn, W., Hoppitt, W., & Laland, K. (2011). The
256 evolutionary basis of human social learning. *Proceedings of the Royal Society B-*
257 *Biological Sciences*, 1-10. doi: 10.1098/rspb.2011.1172

258 Pesendorfer, M. B., Gunhold, T., Schiel, N., Souto, A., Huber, L., & Range, F. (2009).
259 The Maintenance of Traditions in Marmosets: Individual Habit, Not Social
260 Conformity? A Field Experiment. *Plos One*, *4*(2).
261 doi:10.1371/journal.pone.0004472

262 Richerson, P. J., & Boyd, R. (2005). *Not by genes alone: how culture transformed*
263 *human evolution*. Chicago: The University of Chicago Press.

264 Rogers, E. M. (1995). *Diffusion of Innovations* (4th ed.): Free Press.

265 Rudolf von Rohr, C., Burkart, J. M., & van Schaik, C. P. (2010). Evolutionary
266 precursors of social norms in chimpanzees: a new approach. *Biology &*
267 *Philosophy*, *26*, 1-30.

268 Sherif, M. (1936). *The psychology of social norms*. Oxford, England: Harper.

269 Sweeny, T. D., & Whitney, D. (2014). Perceiving Crowd Attention: Ensemble
270 Perception of a Crowd's Gaze. *Psychological Science*, *25*(10), 1903-1913. doi:
271 10.1177/0956797614544510

272 van de Waal, E., Borgeaud, C., & Whiten, A. (2013). Potent Social Learning and
273 Conformity Shape a Wild Primate's Foraging Decisions. *Science*, *340*, 483-485.
274 doi: 10.1126/science.1232769

275 van Leeuwen, E. J. C., Cronin, K. A., Schütte, S., Call, J., & Haun, D. B. M. (2013).
276 Chimpanzees flexibly adjust their behaviour in order to maximize payoffs, not to
277 conform to majorities. *Plos One*, *8*(11). doi: 10.1371/journal.pone.0080945

278 van Leeuwen, E. J. C., & Haun, D. B. M. (2013). Conformity in primates: fad or fact?
279 [review]. *Evolution and Human Behavior*, *34*, 1-7.

280 van Leeuwen, E. J. C., & Haun, D. B. M. (2014). Conformity without majority? The
281 case for demarcating social from majority influences. *Animal Behaviour*, *96*,
282 187-194.

283 Walters, C. E., & Kendal, J. R. (2013). An SIS model for cultural trait transmission with
284 conformity bias. *Theoretical Population Biology*, *90*, 56-63.

285 Whiten, A., Horner, V., & de Waal, F. B. M. (2005). Conformity to cultural norms of
286 tool use in chimpanzees. *Nature*, *437*(7059), 737-740. doi: 10.1038/nature04047

287 Wolf, M., Kurvers, R. H. J. M., Ward, A. J. W., Krause, S., & Krause, J. (2013).
288 Accurate decisions in an uncertain world: collective cognition increases true
289 positives while decreasing false positives. *Proceedings of the Royal Society B-*
290 *Biological Sciences*, *280*. doi: 10.1098/rspb.2012.2777

291
292