



Supplementary Materials for  
**Deception by Flexible Alarm Mimicry in an African Bird**

Tom P. Flower,\* Matthew Gribble, Amanda R. Ridley

\*Corresponding author. E-mail: [thomas.flower@uct.ac.za](mailto:thomas.flower@uct.ac.za)

Published 2 May 2014, *Science* **344**, 513 (2014)  
DOI: 10.1126/science.1249723

**This PDF file includes:**

Materials and Methods  
Tables S1 to S5  
References

## Materials and Methods

### Study site and population

Data were collected between March 2008 and August 2010 on a wild population of fork-tailed drongos in the southern Kalahari Desert, (26°58'S, 21°49'E). Details of the habitat and climate have been published elsewhere (29). 64 drongos were habituated to observation at a distance of <5 metres and each individual was given a unique combination of colour rings. The age of each drongo was determined from plumage coloration (11). The drongo population associated with 13 groups of southern pied babblers (*Turdoides bicolor*) and 13 groups of meerkats (*Suricata suricatta*) whose members were habituated and individually recognisable by colour rings and fur marks respectively (12, 29), enabling close observation of interactions with these species. Drongos also associated with 23 other species at the study site (17), and observations of interactions with these species were undertaken at 20 - 30 metres using binoculars.

### Data collection

In total we recorded the false alarm calls made by 64 ringed drongos in 688 food theft attempts (mean  $\pm$  SE = 10.75  $\pm$  1.62 attempts per drongo) in which a drongo made a false alarm call from a perch when watching an individual of a target species handling food; no predators were observed when false alarm calls were made, nor did drongos show predator evasion responses by fleeing to cover as they did when producing true alarm calls at approaching predators (11). From March to July 2008, food theft attempts were observed during 292 focal watches (mean focal length  $\pm$  SE: 54  $\pm$  1 minutes) on 25 drongo individuals (total hours = 261.7, mean time per drongo = 10.5 hours, range 4.0 - 20.1). We also observed food theft attempts by a further 11 ringed drongos when they associated with a focal drongo. From April to September 2009, 8 groups of pied babblers and 7 groups of meerkats were followed for approximately three hours of foraging once per week (pied babblers: total hours = 363.6, mean per group = 45.4, range 39.1 - 59.5; meerkats: total hours = 222.2, mean per group = 31.87, range 24.2 - 33.6). Observations were undertaken on 40 ringed drongos (mean total observation time per drongo = 2.1 hours, range 0.2 - 7.2) that stole food using false alarms from pied babblers or meerkats and other species associating with these two in mixed species groups.

Details of all food theft attempts were entered onto a Palm T/X hand held computer and a Sennheiser ME67 shotgun microphone coupled to a Marantz PMD660 digital recorder (sampling rate of 44.1 kHz; 16 bit resolution) was simultaneously used to record all vocalisations made by drongos in food theft attempts. For each food theft attempt with a false alarm call we recorded: (i) the species targeted, (ii) the type of false alarm calls made, and (iii) whether the attempt was successful (food item obtained). A drongo often made several successive food theft attempts for different food items on the same target species group during an observation session and we therefore recorded attempt number. We observed such successive food theft attempts on 151 occasions ( $n = 42$  drongos; mean time between attempts  $\pm$  1 SE = 19  $\pm$  3 minutes), enabling investigation of the factors affecting: (i) whether false alarm call type was kept the same or changed, and (ii) whether changing false alarm call type increased food theft. To increase sample sizes, false alarms made in a further nine successive food theft attempts by six unringed habituated drongos, during six observation sessions (one session per drongo), were included in these two analyses. Recordings on unringed drongos were all made at locations >2 km apart, measured using a Garmin Etrex GPS, which is greater than the diameter of a drongo territory (<

600 metres (30)), ensuring that two sets of recordings were highly unlikely to have been made on the same unringed drongo. In each food theft attempt involving false alarms, drongos produced a series of 1 - 8 different false alarm call types (mean number of call types per attempt =  $2.5 \pm 0.3$ ). Call types were considered to have been the same in two successive food theft attempts when drongos repeated a call type made in the first false alarm at least once in the second false alarm. To determine call type, all calls made in false alarms were displayed in spectrograms using the program Avisoft SASLab Pro (v. 4.53) and classified into one of 51 call types based on visual and acoustic characteristics (11).

### Experiment 1: Does mimicry of target species alarm calls increase the intensity of target responses?

To determine whether mimicked alarm calls, and more specifically the mimicked alarm calls of the target species, were more effective than drongo-specific alarms, four single call types were played separately to a pied babbler individual provisioned with a food item (three meal worms impaled on a thorn) with a 20 minute gap between playback of each call. The duration of the individual's alarm response (seconds) was recorded, timed from when the call was played and the individual stopped handling the food item, to when it resumed foraging (response was set to 0 when individuals ignored). The four drongo-generated call types were: (i) a non-alarm territory call (control), (ii) a drongo-specific 'chink' alarm call, (iii) a mimicked Cape glossy starling (*Lamprotornis nitens*) alarm call (other species), and (iv) a mimicked pied babbler alarm call (target species), (see Fig. 2A for spectrograms of calls). When these alarm calls (ii - iv) were made honestly they were similarly produced in response to flying raptor species and were of comparable urgency (11). Ten exemplar call sets each comprising the four call types were created and played to 20 pied babbler individuals at 10 groups, two individuals per group. Playbacks to individuals in the same group were undertaken a minimum of seven days apart (termed group order) and the same exemplar set was never used twice at the same group. Call order was randomised for each individual and the four calls were played in the morning after pied babblers had begun foraging (see below for further details of exemplar creation and call playback).

### Experiment 2: Does flexible variation of false alarm calls during repeated food theft attempts maintain the intensity of target responses?

To determine whether target species habituated to repeated presentation of the same alarm call type, and if so, whether drongos could maintain deception by changing their false alarm call, we compared responsiveness to three consecutive alarm calls of the same type with three consecutive alarm calls where the last call was changed. On four separate days, one of four call treatment sets, comprising three single alarm calls, was played to an individual pied babbler provisioned with a food item, with a 20 minute interval between each of the three calls and a minimum three-day interval between each call treatment. The duration of the individuals alarm response to each call was recorded. The drongo-generated calls played in the four call treatments were as follows: (i) *Same drongo-specific*; three drongo-specific chink alarm calls, (ii) *Same mimic glossy starling*; three mimicked glossy starling alarm calls, (iii) *Change to drongo-specific*; two mimicked glossy starling alarm calls followed by a drongo-specific chink alarm call, and (iv) *Change to glossy starling*; two drongo-specific chink alarm calls followed by a mimicked glossy starling alarm call (see Fig. 3A for spectrograms of calls). Eleven exemplar call sets each comprising all four treatments were created and played to 22 pied babblers at 11

groups, two individuals per group. Playbacks to individuals in the same group were undertaken a minimum of three days apart (termed group order) and the same exemplar set was never used twice at the same group. The three drongo-specific chink alarm calls and three mimicked glossy starling alarm calls used in each exemplar were made by the same drongo and the same two calls were never played twice within a call treatment. The order in which the four call treatments were played was randomized between individuals (see below for further details of exemplar creation and playback).

#### Playback experiments 1 and 2: details of exemplar creation and playback

To create exemplars for experiment one, ten recordings of each alarm call type were obtained from recordings of false alarm calls made by drongos in food theft attempts. Only high quality recordings were used, defined as having high amplitude relative to background noise and no overlap with other sounds. Each exemplar set comprised one of each of the four different call types (Fig. 2A), each made by a different drongo individual and the same drongo never contributed two calls to a given call type. Calls selected as control drongo non-alarm calls were produced in territorial contexts when no predators were present (11). The chink alarm call was chosen as the drongo-specific alarm call type because it is one of the most frequently produced drongo-specific alarm calls in both true and false contexts (11). False mimicked pied babbler alarm calls were chosen to represent mimicry of the target species and false mimicked glossy starling alarm calls were chosen to represent mimicry of a different species since glossy starlings were commonly observed at the study site and were frequently mimicked by drongos (11).

To create exemplars for experiment two, three false drongo-specific chink alarm calls and three false mimicked glossy starling alarm calls made by 11 drongos were obtained from high quality recordings of false alarm calls made in food theft attempts. Calls of each type were then classified as one, two and three, for the *same drongo-specific* and *same glossy starling* treatments. The third call of these two treatments was then swapped with the third call from the other to create the *change to drongo-specific* and *change to glossy starling* treatments (Fig. 3A).

Playbacks were undertaken using a Marantz PMD660 coupled to a Radioshack mini audio amplifier, placed on a tripod at a height of 1.2 metres and concealed by a tree or bush 3 metres from the food item. Playback was started when the individual touched the provisioned food item and amplitude was standardised at 80.3 db at 3 metres. This was the mean amplitude of alarm calls given by drongos in response to a hawk glider model (11). For both experiments calls were similar in length ranging from 0.3 to 0.5 seconds. Calls were filtered below 400Hz which was less than the frequency range of all calls and standardised to a peak amplitude of -15db using the program Cool Edit Pro (v. 2.0). One second of background noise was inserted prior to the call and four seconds of background noise were inserted after the call.

#### Statistical Analysis

All statistical analyses were conducted in R (v.3.0.1) (R Foundation for Statistical Computing, Vienna, Austria). For multivariate analyses involving repeated sampling of individuals the package lme4 (31) was used to fit General Linear Mixed Models (LMMs) with identity link functions or Generalized Linear Mixed Models (GLMMs) with logit link functions and binomial distributions. In each model all explanatory terms and their interactions were entered together and then dropped sequentially in order of significance using likelihood ratio

tests for model comparison until a minimal adequate model was obtained. Each dropped term was then reinstated into the minimal model to obtain the level of non-significance. Data were checked for overdispersion (binomial) or normality (Shapiro-Wilk tests) and  $\log^{10}$  transformed where appropriate, homogeneity of variances was assessed visually. There is a lack of consensus regarding whether degrees of freedom can be accurately determined in mixed-effect models (32); we therefore examined effect sizes and their standard errors to assess the significance of terms in our final model and the package LMERConvenienceFunctions (33) was used to undertake LRT, generating  $p$ -values for effects ( $\alpha = 0.05$ ). Where multiple comparisons were undertaken, Tukey tests were used to determine pair-wise differences in the package multcomp (34).

**Table S1.**

GLMM with a binomial response term of the factors affecting whether or not drongos mimicked their target species' alarm call in food theft attempts. Data were available for the false alarm calls produced in 147 food theft attempts by 10 drongos that could mimic a target and had made at least one food theft attempt on that target species as well as on at least one other target species. Four targets were represented; meerkats, pied babblers, sociable weavers (*Philetairus socius*) and glossy starlings. Explanatory terms were: target type (mimicked target, other target), species (meerkat, babbler, weaver, starling), and drongo age (adult, juvenile). Drongo identity was included as a random term. For factorial explanatory terms, the level set to zero is shown in brackets in this and subsequent tables.

|                            |          | Effect $\pm$ S.E.  | $\chi^2$ | d.f. | $P$   |
|----------------------------|----------|--------------------|----------|------|-------|
| Constant                   |          | -2.730 $\pm$ 0.480 |          |      |       |
| Target type (other target) |          | 1.420 $\pm$ 0.560  | 2.55     | 1    | 0.011 |
| Species (babbler)          | Weaver   | -0.762 $\pm$ 0.604 | 1.26     | 3    | 0.207 |
|                            | Meerkat  | 0.0694 $\pm$ 1.229 |          |      |       |
|                            | Starling | 0.507 $\pm$ 0.824  |          |      |       |
| Age (adult)                |          | -0.856 $\pm$ 0.689 | -1.24    | 1    | 0.214 |

**Table S2.**

LMM of the factors affecting the response time ( $\text{Log}^{10}$  transformed) of pied babblers to playback of drongo control non-alarm calls, drongo-specific alarm calls, mimicked glossy starling alarm calls and mimicked pied babbler alarm calls ( $n = 80$  alarm responses by 20 pied babblers). Explanatory terms were: call type (control, drongo-specific, mimic starling, mimic babbler), call order (one, two, three, four) and group order (first, second). Pied babbler identity was included as a random term.

|                     |                 | Effect $\pm$ S.E.    | F     | d.f. | <i>P</i> |
|---------------------|-----------------|----------------------|-------|------|----------|
| Constant            |                 | 0.127 $\pm$ 0.0853   |       |      |          |
| Call type (control) | Drongo-specific | 0.368 $\pm$ 0.0845   | 38.38 | 3    | <0.001   |
|                     | Mimic babbler   | 0.796 $\pm$ 0.0848   |       |      |          |
|                     | Mimic starling  | 0.718 $\pm$ 0.0844   |       |      |          |
| Call order (one)    | Two             | -0.191 $\pm$ 0.0800  | 2.83  | 3    | 0.044    |
|                     | Three           | 0.0249 $\pm$ 0.0803  |       |      |          |
|                     | Four            | 0.00192 $\pm$ 0.0804 |       |      |          |
| Group order (first) |                 | -0.0619 $\pm$ 0.0756 | 0.67  | 1    | 0.417    |

**Table S3.**

LMM of the factors affecting the alarm response time of pied babblers ( $\text{Log}^{10}$  transformed) to playback of four treatment combinations of three drongo-specific and mimicked glossy starling false alarm calls, where the last call was changed or the same ( $n = 264$  alarm responses by 22 pied babblers). Explanatory terms included: change or not (change, same), call type (drongo-specific, mimic glossy starling), call number (call 1, call 2, call 3), treatment order (one, two, three, four) and group order (first, second). Pied babbler identity was included as a random term.

| Model term                     |        | Effect $\pm$ S.E.    | F      | d.f. | <i>P</i> |
|--------------------------------|--------|----------------------|--------|------|----------|
| Constant                       |        | 0.701 $\pm$ 0.0588   |        |      |          |
| Group order (first)            |        | 0.210 $\pm$ 0.0417   | 25.46  | 1    | <0.001   |
| Treatment order (one)          | Two    | 0.0393 $\pm$ 0.0485  | 8.21   | 3    | <0.001   |
|                                | Three  | -0.130 $\pm$ 0.0485  |        |      |          |
|                                | Four   | -0.163 $\pm$ 0.0486  |        |      |          |
| Change or not * Call number    |        | See Fig. 3B          | 5.73   | 2    | 0.004    |
| Species call (drongo-specific) |        | -0.0886 $\pm$ 0.0343 | 6.2991 | 1    | 0.013    |
| Call number (call 1)           | Call 2 | -0.0502 $\pm$ 0.0593 | 4.54   | 2    | 0.012    |
|                                | Call 3 | -0.206 $\pm$ 0.0593  |        |      |          |
| Change or not (same)           |        | 0.0380 $\pm$ 0.0594  | 2.75   | 1    | 0.099    |

**Table S4.**

GLMM with a binomial response term of the factors affecting whether drongos changed the type of false alarm call they made in food theft attempts when the previous attempt either succeeded or failed (151 repeat food theft attempts by 42 drongos). Explanatory terms were: outcome of previous food theft attempt (succeeded, failed), drongo age (juvenile, adult), target species size relative to a drongo (small, large) (see (17) for size details) and attempt number; drongo identity was included as a random term. Attempt number was included to exclude the possibility that drongos simply changed the alarm call they made after a specific number of food theft attempts on target species.

| Model term                   | Effect $\pm$ S.E.   | $\chi^2$ | d.f. | <i>P</i> |
|------------------------------|---------------------|----------|------|----------|
| Constant                     | 0.885 $\pm$ 0.233   |          |      |          |
| Previous outcome (succeeded) | 0.888 $\pm$ 0.429   | 2.07     | 1    | 0.039    |
| Drongo age (adult)           | -0.660 $\pm$ 0.418  | -1.58    | 1    | 0.114    |
| Attempt number               | -0.128 $\pm$ 0.0822 | -1.56    | 1    | 0.119    |
| Species (small)              | -0.319 $\pm$ 0.428  | -0.75    | 1    | 0.455    |

**Table S5.**

GLMM with a binomial response term of the factors affecting whether drongos were successful in food theft attempts following a failed attempt, when they changed the type of call they made or kept it the same (60 food theft attempts where a previous attempt failed by 31 drongos). Explanatory terms were: change or not (change, same), drongo age (juvenile, adult), and target species size relative to a drongo (small, large); drongo identity was included as a random term.

|                       | Effect $\pm$ S.E.   | $\chi^2$ | d.f. | <i>P</i> |
|-----------------------|---------------------|----------|------|----------|
| Constant              | -2.515 $\pm$ 1.119  |          |      |          |
| Species (small)       | -1.352 $\pm$ 0.621  | 2.17     | 1    | 0.030    |
| Change or not (same)  | 2.269 $\pm$ 1.129   | 2.01     | 1    | 0.045    |
| Drongo age (juvenile) | -0.0527 $\pm$ 0.643 | 0.82     | 1    | 0.935    |

## References and Notes

1. A. Zahavi, Mate selection—a selection for a handicap. *J. Theor. Biol.* **53**, 205–214 (1975). [doi:10.1016/0022-5193\(75\)90111-3](https://doi.org/10.1016/0022-5193(75)90111-3) [Medline](#)
2. A. Grafen, Biological signals as handicaps. *J. Theor. Biol.* **144**, 517–546 (1990).
3. M. Broom, G. D. Ruxton, H. M. Schaefer, *Proc. Biol. Sci.* **280**, 20131560 (2013).
4. R. A. Johnstone, A. Grafen, Dishonesty and the handicap principle. *Anim. Behav.* **46**, 759–764 (1993). [doi:10.1006/anbe.1993.1253](https://doi.org/10.1006/anbe.1993.1253)
5. D. W. Pfennig, W. R. Harcombe, K. S. Pfennig, Frequency-dependent Batesian mimicry. *Nature* **410**, 323 (2001). [doi:10.1038/35066628](https://doi.org/10.1038/35066628) [Medline](#)
6. R. A. Fisher, *The Genetical Theory of Natural Selection* (Clarendon, Oxford, 1930).
7. R. Thorogood, N. B. Davies, Cuckoos combat socially transmitted defenses of reed warbler hosts with a plumage polymorphism. *Science* **337**, 578–580 (2012). [doi:10.1126/science.1220759](https://doi.org/10.1126/science.1220759) [Medline](#)
8. P. M. Sheppard, The evolution of mimicry: A problem in ecology and genetics. *Cold Spring Harb. Symp. Quant. Biol.* **24**, 131–140 (1959). [doi:10.1101/SQB.1959.024.01.013](https://doi.org/10.1101/SQB.1959.024.01.013) [Medline](#)
9. R. R. Jackson, R. S. Wilcox, Spider flexibly chooses aggressive mimicry signals for different prey by trial and error. *Behaviour* **127**, 21–36 (1993). [doi:10.1163/156853993X00407](https://doi.org/10.1163/156853993X00407)
10. N. E. Langmore, G. Maurer, G. J. Adcock, R. M. Kilner, Socially acquired host-specific mimicry and the evolution of host races in Horsfield’s bronze-cuckoo *Chalcites basalis*. *Evolution* **62**, 1689–1699 (2008). [doi:10.1111/j.1558-5646.2008.00405.x](https://doi.org/10.1111/j.1558-5646.2008.00405.x) [Medline](#)
11. T. Flower, Fork-tailed drongos use deceptive mimicked alarm calls to steal food. *Proc. Biol. Sci.* **278**, 1548–1555 (2011). [doi:10.1098/rspb.2010.1932](https://doi.org/10.1098/rspb.2010.1932) [Medline](#)
12. A. R. Ridley, N. J. Raihani, Facultative response to a kleptoparasite by the cooperatively breeding pied babbler. *Behav. Ecol.* **18**, 324–330 (2007).
13. C. A. Munn, Birds that ‘cry wolf’. *Nature* **319**, 143–145 (1986). [doi:10.1038/319143a0](https://doi.org/10.1038/319143a0)
14. See supplementary materials on *Science Online*.
15. R. D. Magrath, B. J. Pitcher, J. L. Gardner, An avian eavesdropping network: Alarm signal reliability and heterospecific response. *Behav. Ecol.* **20**, 745–752 (2009). [doi:10.1093/beheco/arp055](https://doi.org/10.1093/beheco/arp055)
16. A. N. Radford, M. B. V. Bell, L. I. Hollén, A. R. Ridley, Singing for your supper: Sentinel calling by kleptoparasites can mitigate the cost to victims. *Evolution* **65**, 900–906 (2011). [doi:10.1111/j.1558-5646.2010.01180.x](https://doi.org/10.1111/j.1558-5646.2010.01180.x) [Medline](#)
17. T. P. Flower, M. F. Child, A. R. Ridley, The ecological economics of kleptoparasitism: Pay-offs from self-foraging versus kleptoparasitism. *J. Anim. Ecol.* **82**, 245–255 (2013). [doi:10.1111/j.1365-2656.2012.02026.x](https://doi.org/10.1111/j.1365-2656.2012.02026.x) [Medline](#)
18. J. Hutchinson, G. Gigerenzer, Simple heuristics and rules of thumb: Where psychologists and behavioural biologists might meet. *Behav. Process.* **69**, 97–124 (2005).

19. K. W. Deitsch, S. A. Lukehart, J. R. Stringer, Common strategies for antigenic variation by bacterial, fungal and protozoan pathogens. *Nat. Rev. Microbiol.* **7**, 493–503 (2009).[doi:10.1038/nrmicro2145](https://doi.org/10.1038/nrmicro2145) [Medline](#)
20. S. Dong, D. F. Clayton, Habituation in songbirds. *Neurobiol. Learn. Mem.* **92**, 183–188 (2009).[doi:10.1016/j.nlm.2008.09.009](https://doi.org/10.1016/j.nlm.2008.09.009) [Medline](#)
21. R. Bshary, A. S. Grutter, Image scoring and cooperation in a cleaner fish mutualism. *Nature* **441**, 975–978 (2006).[doi:10.1038/nature04755](https://doi.org/10.1038/nature04755) [Medline](#)
22. D. L. Cheney, R. M. Seyfarth, Assessment of meaning and the detection of unreliable signals by vervet monkeys. *Anim. Behav.* **36**, 477–486 (1988). [doi:10.1016/S0003-3472\(88\)80018-6](https://doi.org/10.1016/S0003-3472(88)80018-6)
23. L. A. Kelley, R. L. Coe, J. R. Madden, S. D. Healy, Vocal mimicry in songbirds. *Anim. Behav.* **76**, 521–528 (2008). [doi:10.1016/j.anbehav.2008.04.012](https://doi.org/10.1016/j.anbehav.2008.04.012)
24. E. S. Fortune, C. Rodríguez, D. Li, G. F. Ball, M. J. Coleman, Neural mechanisms for the coordination of duet singing in wrens. *Science* **334**, 666–670 (2011).[doi:10.1126/science.1209867](https://doi.org/10.1126/science.1209867) [Medline](#)
25. G. L. Patricelli, J. A. C. Uy, G. Walsh, G. Borgia, Male displays adjusted to female's response. *Nature* **415**, 279–280 (2002).[doi:10.1038/415279a](https://doi.org/10.1038/415279a) [Medline](#)
26. A. Whiten, R. W. Byrne, Tactical deception in primates. *Behav. Brain Sci.* **11**, 233 (1988). [doi:10.1017/S0140525X00049682](https://doi.org/10.1017/S0140525X00049682)
27. R. W. Mitchell, N. S. Thompson, Eds., *Deception: Perspectives on Human and Nonhuman Deceit* (State Univ. New York Press, Albany, NY, 1986).
28. D. L. Cheney, R. M. Seyfarth, *How Monkeys See the World: Inside the Mind of Another Species* (Univ. Chicago Press, Chicago, 1990).
29. T. H. Clutton-Brock, D. Gaynor, G. M. McIlrath, A. D. C. Maccoll, R. Kansky, P. Chadwick, M. Manser, J. D. Skinner, P. N. M. Brotherton, Predation, group size and mortality in a cooperative mongoose, *Suricata suricatta*. *J. Anim. Ecol.* **68**, 672–683 (1999). [doi:10.1046/j.1365-2656.1999.00317.x](https://doi.org/10.1046/j.1365-2656.1999.00317.x)
30. P. A. R. Hockey, W. R. J. Dean, P. G. Ryan, *Roberts Birds of Southern Africa* (John Voelcker Bird Fund, Cape Town, South Africa, ed. 7, 2005).
31. D. Bates, M. Maechler, B. Bolker, lme4: Linear Mixed-Effects Models Using S4 Classes (2011); <http://cran.mirror.ac.za/web/packages/lme4/index.html>.
32. D. Bates, Fitting linear mixed models in R. *R News* **5**, 27–30 (2005).
33. A. Tremblay, LMERConvenienceFunctions: A Suite of Functions to Back-Fit Fixed Effects and Forward-Fit Random Effects, as Well as Other Miscellaneous Functions (2011); <http://cran.mirror.ac.za/web/packages/LMERConvenienceFunctions/index.html>.
34. T. Hothorn, F. Bretz, P. Westfall, R. Heiberger, Multcomp: Simultaneous Inference for General Linear Hypotheses (2009); <http://cran.mirror.ac.za/web/packages/multcomp/index.html>.