**Additional file 1:**

**Table S1 Studies of the begging strategies of parasitic nestlings**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Begging strategy** | **Host** | **Parasite(s)** | **Distribution** | **Methods** | **References** |
| Mimicry of begging calls | Baywing (*Agelaioides badius*) | Screaming cowbird (*Molothrus rufoaxillaris*); Shiny cowbird (*M. bonariensis*) | South America | Playback begging calls | Ursino et al. 2018 |
| Exaggerated begging | House wren (*Troglodytes aedon*) | Shiny cowbird (*Molothrus bonariensis*) | South America | Playback begging calls | Gloag and Kacelnik 2013 |
| Reed warbler (*Acrocephalus arundinaceus*) | Common cuckoo (*Cuculus canorus*) | Europe | A record of observation; Indoor fecal testing; Playback begging calls | Davies et al. 1998; Brooke and Davies 1989 |
| Red-winged blackbird (*Agelaius phoeniceus* | Brown-headed cowbird (*Molothrus ater*) | Europe | Voice recording | Briskie et al. 1994 |
| Indigo Bunting (*Passerina cyanea*) | Brown-headed cowbird (*Molothrus ater*) | North America | Voice recording and playback | Dearborn 1999 |
| Baywing (*Agelaioides badius*) | Brown-headed cowbird (*Molothrus ater*) | South America | Video analysis | Lichtenstein 2001 |
| Magpie (*Pica pica*) | Great spotted cuckoo (*Clamator glandarius*) | Europe | Video analysis; Energy consumption measurement | Soler et al. 1999 |
| Magpie (*Pica pica*) | Great spotted cuckoo (*Clamator glandarius*) | Europe | Video detection; Voice recording | Redondo and Zuñiga 2002 |
| Common Tailorbird (*Orthotomus sutorius*) | plaintive cuckoo (*Cacomantis*  *merulinus*) | Asia | Voice recording | Tunheim et al. 2019 |
| Begging combined with vision | Reed warbler (*Acrocephalus arundinaceus*) | Common cuckoo (*Cuculus canorus*) | Europe | Playback begging calls | Kilner et al. 1999 |
| Low misjudgment rate of begging | Magpie (*Pica pica*) | Great spotted cuckoo (*Clamator glandarius*) | Europe | Begging behavior observation | Soler et al. 2019 |
| Unknown | Great reed warbler (*Acrocephalus arundinaceus*) | Common cuckoo (*Cuculus canorus*) | Europe | Playback of cuckoo's host-absent vocalization | Honza et al. 2018 |
| Adjust begging according to hosts | House wren (*Troglodytes aedon*); Chalk-browed Mockingbird (*Mimus saturninus*) | Brown-headed cowbird (*Molothrus ater*) | South America | Recording; Videotape observation | Tuero et al. 2016 |
| Field sparrow (*Spizella pusilla*); Red-winged blackbird; Brown thrasher (*Toxostoma rufum*) | Brown-headed cowbird (*Molothrus ater*) | North America | Video detection | Rivers 2007 |

**Table S2** **Studies of nest defenses used by hosts against parasites**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Defense strategy** | **Parasite** | **Host(s)** | **Mainland distribution** | **Methods** | **Playback sound type** | **Acoustic analyses (Yes or No)** | **References** |
| Identify alarm calls from conspecific or heterospecific hosts | Common cuckoo (*Cuculus canorus*) | Japanese tit (*Parus minor*) | Asia | Dummy experiment; playback | Alarm calls | No | Yu et al. 2017a |
| Common cuckoo (*Cuculus canorus*) | Swallow (*Hirundo rustica*) | Asia | Dummy experiment; playback | Alarm calls | No | Yu et al. 2016 |
| Common cuckoo (*Cuculus canorus*) | Great tit (*Parus major*) | Asia | Dummy experiment; playback | Alarm calls | Yes | Yu et al. 2017b |
| Common cuckoo (*Cuculus canorus*) | Oriental reed warbler (*Acrocephalus orientalis*); black-browed reed warbler (*Acrocephalus bistrigiceps*) | Asia | Dummy experiment; playback | Alarm calls | No | Yu et al. 2019a |
| Common cuckoo (*Cuculus canorus*) | Reed warbler (*Acrocephalus arundinaceus*) | Europe | Dummy experiment; playback | Alarm calls | No | Welbergen and Davies 2008 |
| Brown-headed cowbird (*Molothrus ater*) | Yellow warbler (*Dendroica petechia*) | North America | Dummy experiment; playback | Seet call (Specifically produced against brown-headed cowbirds) | No | Gill and Sealy 2004 |
| Brown-headed cowbird (*Molothrus ater*) | Yellow warbler (*Dendroica petechia*) | North America | Dummy experiment; playback | Alarm calls (seet call and chip call) | No | Gill and Sealy 2003 |
| Shining bronze-cuckoo (*Chalcites lucidus*) | Superb fairy-wren (*Malurus cyaneus*) | Africa and Oceania | Dummy experiment; playback | Alarm calls | Yes | Feeney et al. 2013 |
| Common cuckoo (*Cuculus canorus*); Emerald cuckoo (*Chrysococcyx maculatus*) | Green-backed tit (*Parus monticolus*); Cinereous tit (*P. cinereus*) | Asia | Dummy experiment; playback | Alarm calls | No | Yu et al. 2019b |
| Recognize sound of adult parasites | Common cuckoo (*Cuculus canorus*) | — | Europe | Dummy experiment plus playback | Sound of cuckoo | No | Tryjanowski et al. 2018 |
| Brown-headed cowbird (*Molothrus ater*) | Yellow warbler (*Dendroica petechia*) | North America | Dummy experiment; playback | Sound of cowbird | No | Gill et al. 1997 |
| Brown-headed cowbird (*Molothrus ater*) | Willow Flycatcher (*Empidonax traillii*) | North America | Playback | Sound of cowbird | No | Uyehara and Narins 1995 |
| Horsfield’s bronze-cuckoo (*Chalcites basalis*); Shining bronze-cuckoo (*Chalcites lucidus*); Little bronze-cuckoo (*Chalcites minutillus*) | Superb fairy-wrens(*Malurus cyaneus*) | Oceania | Playback | Sound of cuckoo | No | Kleindorfer et al. 2013 |
| Social learning | Horsfield’s bronze-cuckoo (*Chalcites basalis*) | Superb fairy-wren(*Malurus cyaneus*) | Oceania | Dummy experiment | — | No | Feeney and Langmore 2013 |
| Common cuckoo (*Cuculus canorus*) | Reed warbler (*Acrocephalus arundinaceus*) | Europe | Dummy experiment plus playback | Mobbing calls | No | Davies and Welbergen 2009 |
| Recognize adult parasites | Common cuckoo (*Cuculus canorus*) | Reed warbler (*Acrocephalus arundinaceus*) | Europe | Dummy experiment; playback; Dummy experiment plus playback | Alarm calls | No | Campobello and Sealy 2011 |
| Common cuckoo (*Cuculus canorus*) | Great reed warbler (*Acrocephalus arundinaceus*) | Europe | Dummy experiment plus playback | Sound of cuckoo | No | Bártol et al. 2002 |
| Common cuckoo (*Cuculus canorus*) | Reed warbler (*Acrocephalus arundinaceus*) | Europe | Dummy experiment | — | No | Duckworth 1991 |
| Common cuckoo (*Cuculus canorus*) | Reed warbler (*Acrocephalus arundinaceus*) | Europe | Dummy experiment | — | No | Campobello and Sealy 2010 |
| Common cuckoo (*Cuculus canorus*) | Oriental reed warbler (*Acrocephalus orientalis*) | Asia | Dummy experiment | — | No | Li et al. 2015 |
| Common cuckoo (*Cuculus canorus*) | Great reed warbler (*Acrocephalus arundinaceus*) | Europe | Dummy experiment | — | No | Honza et al. 2006 |
| Brown-headed cowbird (*Molothrus ater*) | Yellow warbler (*Dendroica petechia*); red-winged blackbird (*Agelaius phoeniceus*) | North America | Dummy experiment | — | No | Gill et al. 2008 |
| Brown-headed cowbird (*Molothrus ater*) | Yellow warbler (*Dendroica petechia*) | North America | Dummy experiment | — | No | Gill and Sealy 1996 |
| Adjust behavior according to parasitism risk | Common cuckoo (*Cuculus canorus*) | Reed warbler (*Acrocephalus arundinaceus*) | Europe | Specimen experiment | — | No | Thorogood and Davies 2013 |
| Common cuckoo (*Cuculus canorus*) | Reed warbler (*Acrocephalus arundinaceus*) | Europe | Specimen experiment | — | No | Lindholm and Thomas 2000 |
| Shining bronze-cuckoo (*Chalcites lucidus*) | Superb fairy-wren(*Malurus cyaneus*) | Oceania | Specimen experiment | — | No | Langmore et al. 2012 |
| Make specific alarm calls | Common cuckoo (*Cuculus canorus*) | Blackcaps (*Sylvia atricapilla*) | Europe | Specimen experiment | — | No | Grim 2008 |
| Brown-headed cowbird (*Molothrus ater*) | Yellow warbler (*Dendroica petechia*) | North America | Specimen experiment | — | No | Hobson and Sealy 1989 |
| Brown-headed cowbird (*Molothrus ater*) | 34 potential hosts\* | North America | Specimen experiment | — | No | Robertson and Norman 1977 |
| Brown-headed cowbird (*Molothrus ater*) | Least flycatcher (*Ernpidonax minimus*) | North America | Specimen experiment | — | No | Briskie and Sealy 1989 |
| Increase incubation call rate | Horsfield’s bronze-cuckoo (*Chalcites basalis*) | Superb fairy-wrens(*Malurus cyaneus*) | Oceania | Playback | Sound of cuckoo | No | Kleindorfer et al. 2014 |
| Alarm; protect nest | Brown-headed cowbird (*Molothrus ater*) | Yellow warbler (*Dendroica petechia*) | North America | Specimen experiment | — | No | Kuehn et al. 2016 |
| Brown-headed cowbird (*Molothrus ater*) | Yellow warbler (*Dendroica petechia*) | North America | Specimen experiment | — | No | Teather and Cronin 2000 |
| Aggressive behavior including alarm calls | Common cuckoo (*Cuculus canorus*) | Great reed warbler (*Acrocephalus arundinaceus*) | Europe | Specimen experiment plus playback | Sound of cuckoo | No | Moskát 2005 |
| Common cuckoo (*Cuculus canorus*) | Reed warbler (*Acrocephalus arundinaceus*) | Europe | Specimen experiment | — | No | Welbergen and Davies 2009 |
| Common cuckoo (*Cuculus canorus*) | Reed warbler (*Acrocephalus arundinaceus*) | Europe | Specimen experiment | — | No | Honza et al. 2004 |
| Common cuckoo (*Cuculus canorus*) | Great reed warbler (*Acrocephalus arundinaceus*); Reed warbler (*Acrocephalus arundinaceus*) | Europe | Specimen experiment plus playback | — | No | Dyrcz and Hałupka 2006 |
| Brown-headed cowbird (*Molothrus ater*) | Song sparrow (*Melospiza*  *melodia*) | North America | Specimen experiment | — | No | Smith et al. 1984 |
| Brown-headed cowbird (*Molothrus ater*) | Red-winged blackbird (*Agelaius phoeniceus*); Gray catbird (*Dumetella carolinensis*); northern oriole (*Icterus galbula*); cedar waxwing (*Bombycilla cedrorum*) | North America | Specimen experiment | — | No | Sealy and Neudorf 2012 |
| Brown-headed cowbird (*Molothrus ater*) | Field sparrows (*Spizella pusilla*) | North America | Specimen experiment | — | No | Burhans 2001 |
| Brown-headed cowbird (*Molothrus ater*) | Acadian flycatcher (*Empidonax virescens*) | North America | Specimen experiment | — | No | Olendorf and Robinson 2000 |
| Brown-headed cowbird (*Molothrus ater*) | Carolina wren (*Thryothorus ludovicianus*) | North America | Specimen experiment | — | No | D'Orazio and Neudorf 2008 |
| Cuckoo finches (*Anomalospiza imberbis*) | Tawny-flanked prinia (*Prinia subflava*) | Africa | Specimen experiment | — | No | Feeney et al. 2015 |
|  | Great spotted cuckoo (*Clamator glandarius*) | Azure-winged magpies (*Cyanopica cyanus*); Magpie (*Pica pica*) | Europe | Specimen experiment | — | No | Avilés and Parejo 2006 |
|  | Horsfield’s bronze-cuckoo (*Chalcites basalis*) | Splendid wren (*Malurus splendens*) | Oceania | Specimen experiment | — | No | Payne et al. 1985 |

\*The 34 potential hosts include the eastern kingbird (*Tyrannus tyrannus*), great-crested flycatcher (*Myiarchus crinitus*), eastern wood pewee (*Contopus virens*), eastern phoebe (*Sayornis phoebe*), least flycatcher (*Ernpidonax minimus*), Traill’s flycatcher (*Empidonax traillii*), grey catbird (*Dumetella carolinensis*), robin (*Turdus migratorius*), eastern bluebird (*Sialia sialis*), wood thrush (*Hylocichla mustelina*), cedar waxwing (*Bombycilla cedrorum*), red-eyed vireo (*Vireo olivaceus*), yellow-throat (*Geothlypis trichas*), yellow-rumped warbler (*Dendroica coronata*), yellow warbler (*Dendroica petechia*), common grackle (*Quiscalus quiscula*), redwing blackbird (*Agelaius phoeniceus*), northern oriole (*Icterus galbula*), eastern meadowlark (*Sturnella magna*), bobolink (*Dolichonyx oryzivorus*), American goldfinch (*Spinus tristis*), rose-breasted grosbeak (*Pheucticus ludovicianus*), swamp sparrow (*Melospiza georgiana*), indigo bunting (*Passerina cyanea*), song sparrow (*Melospiza Melodia*), field sparrow (*Spizella pusilla*), chipping sparrow (*Spizella passerine*), western kingbird (*Tyrannus verticalis*), brown thrasher (*Toxostoma rufum*), warbling vireo (*Vireo gilvus*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), Brewer’s blackbird (*Euphagus cyanocephalus*), clay-colored sparrow (*Spizella pallida*), and black-billed cuckoo (*Coccyzus erythropthalmus*).

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