Ducks lay eggs and lions have manes: The acceptability of gender-specific minority generic sentences

Alessia Passanisi[a], Ugo Pace[a], Khalida T. Kabir[b], & James A. Hampton[b]

[a] Kore University, Viale delle Olimpiadi, 94100 Enna EN, Italy

[b] City, University of London, Northampton Square, London EC1V OHB, UK

Emails:

Corresponding author: Alessia Passanisi, alessiapassanisi@gmail.com

Other authors: Ugo Pace, ugo.pace@unikore.it; Khalida T. Kabir, ktk10@hotmail.com; James A. Hampton, hampton@city.ac.uk

Abstract

Minority characteristic generic statements such as *ducks lay eggs* are judged to be generally true of the class, despite being true of a minority of cases, such as healthy female ducks of egg-laying age. Five studies explored the factors responsible for the acceptance of minority generic statements about biological kinds. Studies 1 and 2 found that minority generic statements about animals that are true of just one sex were no more likely to be accepted as true of the class than were statements true of just one of two sub-types, not differentiated by sex. Further studies showed that gender-specific[1] properties are more often accepted when related to reproduction (*ducks lay eggs)* than to appearance (*deer have antlers)*. It is proposed that reproductive properties are more easily interpreted as referring to the kinds themselves, on account of their role in naïve biological theories of the kinds. The result supports the view that minority generics are accepted to the degree that they are embedded in naïve theories of a biological kind.

Keywords

Generics; concepts; natural kinds; truth conditions

Funding: This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

[1] In keeping with practice in the literature we refer to the male-female distinction as gender-based, although in a biological context it is more appropriate to refer to it as sex-based. We use the terms interchangeably for the purpose of this article.

Our knowledge of the world relies on an informational structure built from individual concept representations. According to recent theories (Hampton, 2012a; Leslie, 2007), these concept representations themselves contain information found to be important and relevant for understanding that concept class. Such information contains definitional or fundamental characteristics (for example, that a *bird* is a *creature*), but also information about the common or typical form that exemplars of the concept may take (such as that *birds fly)*, together with any other information that it is important or striking for someone to know about the class (Hampton, 2012a; Leslie, 2007). Such properties give rise to *generic* statements, which people accept as true in the face of possible counterexamples (such as *penguins* and *ostriches).*

In particular, when describing the properties of the members of a class, all known languages typically make use of generic sentences (Krifka et al., 1995; Dayal, 1999). Examples are *birds fly,* or *ducks lay eggs.* In many languages these statements may take different grammatical forms. In English, for example, there is the bare plural (*ducks lay eggs),* and, when referring to the kind and not to an individual, either the definite singular (*the duck lays eggs)* or the indefinite singular *(a duck lays eggs)*. In Italian, by contrast, there is no bare plural form, the definite article being required (*le anatre depongono le uova*). Across languages, these different forms all have in common that they lack explicit quantification (e.g., 'some', 'all', or 'most'), and express generalizations about a class or kind, rather than claims about specific individuals (Khemlani et al., 2007; Krifka et al., 1995). Generic assertions are particularly interesting semantically as their truth appears to survive the existence of counterexamples. Thus, generics are proposed to reflect the content of the conceptual system, whose prototype structure and vague boundaries sometimes can make an unreliable basis for traditional treatments of truth and logic (Hampton, 2012a, 2012b).

Research on generic sentences has led to differentiation into four types with different linguistic and psychological properties (Prasada & Dillingham, 2006; Prasada et al., 2013). These are:

- majority principled characteristics (e.g., *airplanes have wings*) in which properties are highly prevalent though not necessarily universally present among members of the kind. These generics involve principled connections, by which is meant that people agree to statements such as *an airplane has wings because it is an airplane, it is in virtue of being an airplane that an airplane has wings,* and so forth;

- majority statistical characteristics (e.g., *cars have radios*) in which properties are highly prevalent among members of the kind in the same way, but lack a principled connection (we would not say that *cars have radios* because they are cars, or that it is in virtue of being cars that they have radios);

- minority characteristics (e.g. *lions have manes*), where although properties are only true of a minority of the kind (in this case *male lions*), they still have principled connections to the kind (*lions have manes in virtue of being lions)*;

- striking characteristics (e.g., *pit bulls maul children,* or *oysters contain pearls*), where properties need only be true of a very small minority, but where they refer to something of great significance (Cimpian, Brandone & Gelman, 2010).

Our current interest in generics focusses on the third class listed above – minority characteristics such as *lions have manes*, or *ducks lay eggs.* The existence of minority characteristic generics is good evidence against the simple view that generics are some form of approximation to a universally quantified sentence. For example, majority characteristics (both principled – *tigers have stripes* – and statistical – *cars have radios*) could be glossed as "most" or "almost all", but this will not work where a minority of the kind has the property. People are very willing to accept that *ducks lay eggs* is true, in spite

of believing that males, juveniles, and female ducks past a certain age do not lay eggs. The acceptability of such sentences is so strong that many people will even readily accept them as universally true – agreeing to statements such as *all ducks lay eggs,* an effect termed the Generic Overgeneralisation Effect (Leslie, Khemlani, & Glucksberg, 2011). On the other hand, there are well-known cases where in spite of a majority of a class having a property, the equivalent generic is not accepted as true, as in the sentences *Canadians are right-handed* or *books are paperbacks.* The two sentences *lions have manes* and *lions are male* have equal statistical support, (in fact there are more of the latter than the former) but only the former sentence is considered true (a result found even in 5-year-old children, Brandone et al., 2012).

The logic of generic sentences and their truth evaluation has been the object of much debate and ongoing research (Cohen, 2004; Greenberg, 2003; Lerner & Leslie, 2016; Leslie, 2007; 2014; Liebesman, 2011). Many different conditions for acceptable generics have been proposed. Cohen (2004) suggests that exceptions to a generic should not constitute a "salient chunk" of the class, so that prevalence in the class must be similar across salient subsets. For example, *books are paperbacks* fails because of subsets of the class such as encyclopaedias which are hardback. For Tessler and Goodman (2019), the property should be more prevalent in the class than it is in a superordinate class (for example having manes is more common in lions than in animals, but being male is of similar prevalence). Other accounts appeal to causal essences for biological kinds (Gelman & Bloom, 2007), and to either essences or external constraints for social kinds (Noyes & Keil, 2019; Vasilyeva & Lombrozo, 2019).

For minority characteristics, which we are considering here, two contrasting positions can be identified. One view relies on Gricean pragmatics to suggest that the subject of the sentence *ducks lay eggs* is intended by the speaker, and understood by the

hearer, to refer only to the relevant subset (adult females etc.). An example is the account offered by Asher & Pelletier (2012), who suggest that the semantics of the sentence *ducks lay eggs*, has an underlying logical form such that it is true if and only if *those ducks that reproduce* do so by laying eggs (as opposed to some other means of reproduction). In this way the domain of discourse is said to be *restricted* to the relevant ducks – namely the ones that are involved in reproduction. According to this account, generic statements will be acceptable if they are normally true of a well-defined and relevant subset of the class, in this case the females. (See also Declerck, 1991). What makes females a relevant subset in this case is presumably the fact that they have a different role from males in reproduction.

Alternatively, Leslie (2008) introduced the notion that generics are statements expressing expected characteristics of concepts. When a property is strongly integrated into deeper knowledge about the kind, then it becomes an acceptable minority characteristic. As Leslie puts it:

> "… for certain types of kinds, including biological, artifact, and institutional kinds, our background knowledge leads us to have certain strong expectations concerning them. For example, we expect that biological kinds will exhibit certain characteristics, or else face extinction. The most obvious expectation of biological kinds is that reproduction will be possible. It is common knowledge that for an animal kind to survive, certain conditions must be met. We generally suppose that: There must be both male and female members of the species. There must be a manner in which this reproduction and subsequent gestation occurs. There must be adult members of the species. The young must be nourished in some way. I suggest that generic statements that express determinate versions of these claims are true even if there happen to be a large number of exceptions. Our background assumption is that these claims are true in virtue of the kind under consideration

being a successful biological kind, so it takes a very large proportion (almost 100 percent) of exceptions for us to give up these claims." (Leslie, 2008, p. 14)

For this view, the truth of generic sentences depends on what is considered a relevant or characteristic fact about a kind (Khemlani et al., 2012). The relevance of different facts depends on the wealth of causal-explanatory knowledge about the concept's features (e.g., about their origins, centrality, functions), and the links between them in semantic memory (Ahn et al., 2000; Barrett et al., 1993; Cimpian, Gelman, & Brandone, 2010; Gelman, 2003; Keil, 1992; Rehder & Hastie, 2001).

Although originating as an issue in linguistic semantics, our understanding of how minority characteristic generics are evaluated has been greatly helped through empirical studies. Leslie, Khemlani, Prasada and others have provided good empirical evidence for the intuitions that drove earlier linguistic debates. Our aim in the present paper is to report further empirical tests of the basis of the acceptability of minority characteristic generics. The first concerns whether a particular attribute that is present in just 50% of a kind will be more likely to be accepted as generically true of the kind as a whole if it is associated with one of two genders, as opposed to being true of just one of two different arbitrary sub-varieties of the species.

Some preliminary evidence suggests that this advantage for sexually differentiated features will not be found. Cimpian, Gelman and Brandone (2010) conducted a study of minority characteristics in which the task was to pick which one of two displayed sets of cartoon animals, Set A or Set B, was more likely to bear a name such as Dontrets (with the implication that it formed a natural kind). Each set was composed of 8 animals. In a typical condition, each set displayed four adult and four immature animals labelled as such and differentiated either by size (Expt 1) or by a pair of distinctive features (Expt 2). In addition, just half the animals in each set had a long tail. The participants were told that

"Dontrets have long tails", and were asked to choose whether Set A or Set B were the Dontrets. For Set A, the tail was possessed by two of the adults and two of the young, whereas in Set B it was either possessed by all four adults and none of the young, or by all the young and none of the adults. Participants reliably chose Set B only in the case where the long tail was possessed by the four adults, and not when it was possessed by the four young. Cimpian et al. concluded that people use their theories of biological development (characteristic appearance features often emerge in animals as they mature) to decide that the class with all the adults having a long tail must be the kind in question.

Interestingly for our purposes, Cimpian, Gelman & Brandone (2010) included a further condition in their Study 2 in which the adult/young labelling was replaced with a male/female distinction, such that in Set A half the males and half the females possessed the long tail, whereas in Set B it was just the four males, or just the four females. In this condition, there was no preference shown for selecting Set B as the Dontrets. Even though people are well aware of sexual differentiation in many species, they failed to see this as providing increased validity to the set as a natural kind class.

This lack of evidence is perhaps surprising since many of the minority characteristic generics which have been shown to be widely accepted involve just such a distinction. Examples are *lions have manes, deer have antlers* or *cardinals are bright red.* Our first two studies (Studies 1 and 2) were therefore aimed to test whether sex differentiation leads to better generics than differentiation into sub-varieties. If sex represents a relevant subdivision of a species for pragmatic purposes of restricted domain semantics, then minority characteristic generics should be preferred when they are true of just one sex, compared to when they are true of just one of an arbitrary division into two well-defined subclasses. An alternative prediction can be derived from Cohen's (2006) *homogeneity* condition, which proposes that subsets of the class should have similar prevalence for the

property in question. In our case, if two differentiated subclasses exist, then generics should be accepted neither for gender-based nor for arbitrary class divisions.

The second research question that we chose to investigate followed from the first, and concerned the degree to which different potential minority characteristic properties represent the deep conceptual core of the kind. The range of minority properties that has been studied empirically is relatively limited. For example, Leslie et al. (2011) employed 12 sentences, six of which described appearance features (*lions have manes)* and six behaviours relating to reproduction (*ducks lay eggs).* While their data showed that people were more ignorant of the gender-specific appearance features (many believed that female cardinals are red, for example), there was no reported breakdown of their data between the two types of feature. We hypothesized, following Leslie's argument (quoted above), that features relating directly to reproduction and care of the young should be more deeply embedded in people's naïve theories of biological kinds than features that serve to differentiate the appearance of the sexes. Perhaps males and females can form "relevant subsets" for the restricted domain hypothesis (Asher & Pelletier, 2012) only in the case of reproductive features where their contributions are differentiated but serve the common goal of reproduction, but not in the case of appearance features.

Our second set of studies (Studies 3, 4 and 5) investigated this hypothesis. We predicted that a key factor in accepting the truth of gender-specific minority characteristics may relate to reproduction per se, rather than to other gender-related features.

Study 1

The first pair of studies were directed at testing whether minority characteristics true of only half of a class would be more readily accepted if the class was divided on the basis of males versus females, as opposed to being divided into two interbreeding varieties just differentiated by surface features. If the acceptability of *ducks lay eggs* is owing to

restriction of the domain of discourse to females, then having a property that is true of half of a species where the division is not based on gender should not provide an acceptable generic. To avoid prior knowledge effects, we devised materials based on fictional but familiar creatures.

Method.

Participants. Fifty students (35 female) at "Kore University" of Enna, Italy, participated voluntarily. Power calculations suggested 25 participants per group would provide 94% power to detect a large effect (d = 1.0).

Materials. Booklets were prepared with four different species of dimorphic creatures, a toad, a bird, a beetle and a fish, each named using a non-word modifier.[2] At the top of each page was a text describing the creature in question. Fig. 1 shows the English translation of the page in the booklet for the Rattle Bird, *L'Ucello Bilbo.*

In each story, a picture and description were given of the two different types, and of the species in general, which was referred to with a Definite Singular noun phrase (e.g. The Rattle Bird, *L'Ucello Bilbo*). In the Gender group, the two types were labeled as male and female, while in the Neutral group they were labeled as two sub-varieties. The Neutral version of the story was similar but began:

The Rattle Bird comes in two closely related forms (versions) with some minor differences. Both male and the female of the species can have either appearance, and the two forms, which are equally common, interbreed freely. This is the brown form of the Rattle Bird (left). This is the yellow form of the Rattle Bird (right). In spring, the yellow form grows spots…… [etc. as above]

[2] The actual names in Italian were il Rospo Cleo, l'Uccello Bilbo, lo Scarafaggio Ballo, and il Pesce Dido, All had masculine grammatical gender. We use the name Rattle Bird in translation to English for ease of comprehension by anglophone readers. Italian and English translations of all materials may be found in the Appendix.

To keep the stories from seeming too repetitive, there was some minor variation in how the subtypes were identified using modifiers, versions or types. Appendix A contains the full Italian stories for Lo Scarafaggio Ballo (Dance Beetle) in the Gender condition and Il Pesce Dido (Dido Fish) in the Neutral condition, together with English translations. Each text was followed by 10 sentences: 4 generic (2 for each of the subtypes), 3 true and 3 false. These have been labeled in italic in Fig. 1. Two booklets were created, one for each condition. The order of the stories within the booklets was randomized, as was the order of statements for each story.

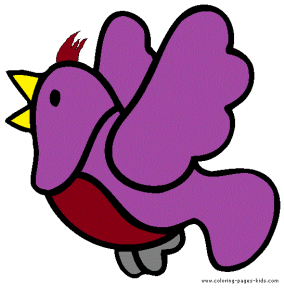
The task was translated into Italian by the first author using the bare singular form for the statements. For example, *It eats small fishes* was translated as *Mangia pesci piccoli.*

Fig. 1: English translation of the Gender-based story for one of four creatures in Study 1.

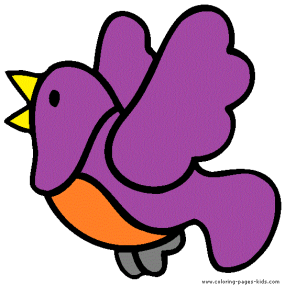
Labels to indicate types of sentence (*True, False, Generic*) have been added.

The Rattle Bird comes in two forms corresponding to the male and to the female of the species. The male and the female differ in various ways.

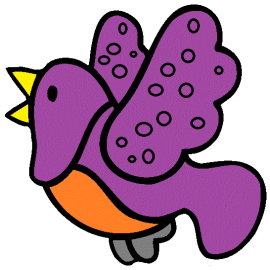
This is the male Rattle Bird



This is the female Rattle Bird



In spring, the female Rattle Bird grows spots on its wings.



Rattle Birds[3] are found in France. The male has a sharp beak, and a crest on its head, whereas the female has neither one nor the other. The female emits a calling whistle similar to a coo-ing, but the male is voiceless. The Rattle Bird lives in forests and dense woodland and is related to the dove; it only eats worms, beetles and small fishes that can be found in small lakes and rivers.

Which of the following statements are true or false of the Rattle bird?

1) It is only found in Asia	True/False	(*False)*
2) It is related to the dove	True/False	(*True)*
3) It lives in forests	True/False	(*True)*
4) It grows spots on its wings in spring	True/False	(*Generic)*
5) It has crest on its head	True/False	(*Generic)*
6) It eats nuts and seeds	True/False	(*False)*
7) It has a yellow tail	True/False	(*False)*
8) It eats small fishes	True/False	(*True)*
9) It has a sharp beak	True/False	(*Generic)*
10) It emits a calling whistle similar to a cooing	True/False	*(Generic)*

[3] Due to an oversight, the plural generic form ("Gli Ucelli Bilbo") was used at this point for Rattle Birds in both Gender and Neutral conditions. The other three creatures consistently used the singular form throughout, e.g. "The Rattle Bird", or in Italian "L'Uccello Bilbo". No differences in results between the four creatures were observed.

Design and Procedure. Participants were randomly allocated to either the gender or the neutral conditions (N = 25 per condition). Participants circled one of 2 response options (true or false), printed to the right of each sentence.

Results and Discussion.

True and False control statements were judged appropriately by all participants (91% correct for True and 97% for False). Each participant judged four generic statements (true of only half the class) about each of four creatures, giving a total of 16 judgments. The dependent measure was the number or proportion of True judgments made by each of the two groups to the generic statements. Generics were rated as true 52% of the time in the Gender condition and 66% of the time in the Neutral condition, the reverse of the predicted difference. Before testing the difference between the groups, the assumption of a normal distribution needed for a parametric test was examined, and found to be violated.

Fig. 2: Distribution of Number of True Responses to Generics responses across conditions in Study 1

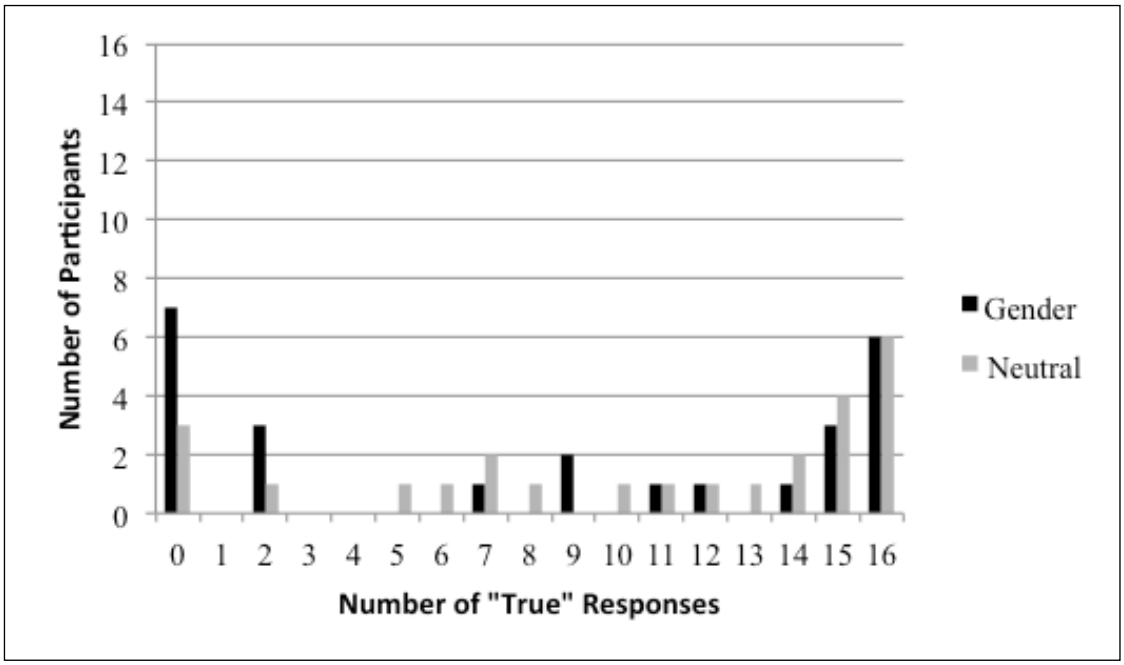


Fig. 2 shows the distribution of number of true judgments to these generics by condition (gender or neutral). Fig, 2 shows that the distributions were strongly non-normal and tending to bimodality, as would be expected if participants tended to adopt one of two consistent strategies for responding. Both conditions showed considerable variation between individuals, with 6 of the 25 participants in the Gender condition choosing to accept all of the statements and 7 accepting none of them. For the Neutral condition, the numbers were respectively 6 and 3.

To test for differences between groups, the number of participants in each condition who accepted the majority of generics as true was compared with a chi square test. Similar numbers of participants in each condition accepted the majority of the generics as true (14 out of 25 for the Gender condition compared to 16 out of 25 for the Neutral condition, ($\chi^2 = 0.3$, $p > .5$). There was no difference between generics true of Male (52%) versus Female (52.5%) creatures in the Gender group, and there were no significant differences between the four creatures (see left panel in Fig. 3).

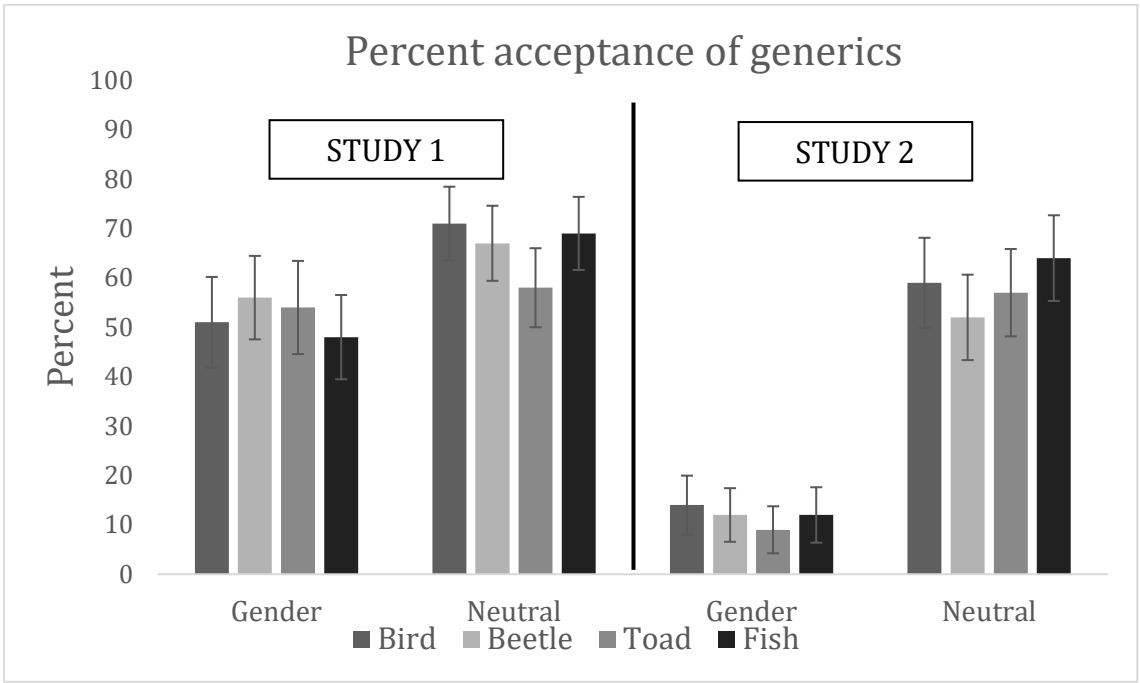


Fig. 3: Percent acceptance of generics for the Gender and Neutral Conditions in Studies 1 and 2. Error bars are Standard Errors.

The results therefore leant no support to our hypothesis that minority characteristics would be better supported when they were specifically related to one sex. To test the robustness of this result we decided to replicate the study while making minor changes to the materials. In Study 1 we used the Definite Singular form for describing the kinds (*L'Uccello Bilbo)* and an anaphoric singular sentence to express the generic statements (in Italian no subject pronoun is present, hence "It lives in forests" becomes *vive nelle schiere*). Previous research (e.g. Khemlani et al., 2007; 2012; Leslie et al., 2011) used bare plurals in their studies (i.e. ducks lay eggs) and found higher rates of acceptance (e.g. 89% of gender-based minority characteristics were accepted as true in Khemlani et al., 2007). We therefore sought to replicate the results of Study 1 with the same materials and design, but changing the definite singular phrase to the plural form. Another change was that instead of using compound nouns (*L'Uccello Bilbo*) we introduced the creatures with a monolexemic name (Rattle Birds became "*I Carpillini*").

In addition, to be sure that the scope of the sentences was understood, the sentences to be judged also used a plural generic form (e.g. *Rattle birds are only found in Asia* instead of *It is only found in Asia*).

Study 2

Method

Participants. A further 50 students (30 female) at "Kore University" of Enna (Italy), participated voluntarily. The sample size was kept the same as in Study 1.

Materials, Design and Procedure. The materials were the same as in Study 1 save for the changes described above. The booklets in Italian and English translation are in the Appendix. The design and procedure were the same as in Study 1. Definite plurals were used for the introduction of the species and for the statements. Description of the properties of genders and subtypes used the singular form (see Appendix B).

Results and Discussion.

Each set of generics included three true and three false sentences as a control. True and False control statements were judged appropriately by all participants (88% correct for True and 94% for False). This time, agreement with the generic statements was clearly greater for the neutral stories (58%) than for the gender-based stories (12%). Each participant judged 4 generics for each of the four creatures, and the number (out of 16) of generics judged as true by each participant are shown as a distribution in Fig. 4. As in Study 1, the distributions were far from normal, and so the same analysis strategy was employed. Of the 25 participants in each group, 14 in the neutral group responded True to a majority of generic statements, compared with only 2 in the gender-based group ($\chi 2 = 13.3$, $p < .001$ on a median test). Thus, contrary to our prediction, people were actually much happier to allow a generic to be true of only one kind of creature when it was NOT associated with a male/female difference. As before, there were no differences between the four creatures (see Fig. 3, right panel), nor between generics true of the male (15%) rather than of the female (8%), ($\chi^2(1) = 3.60$, p = .06).

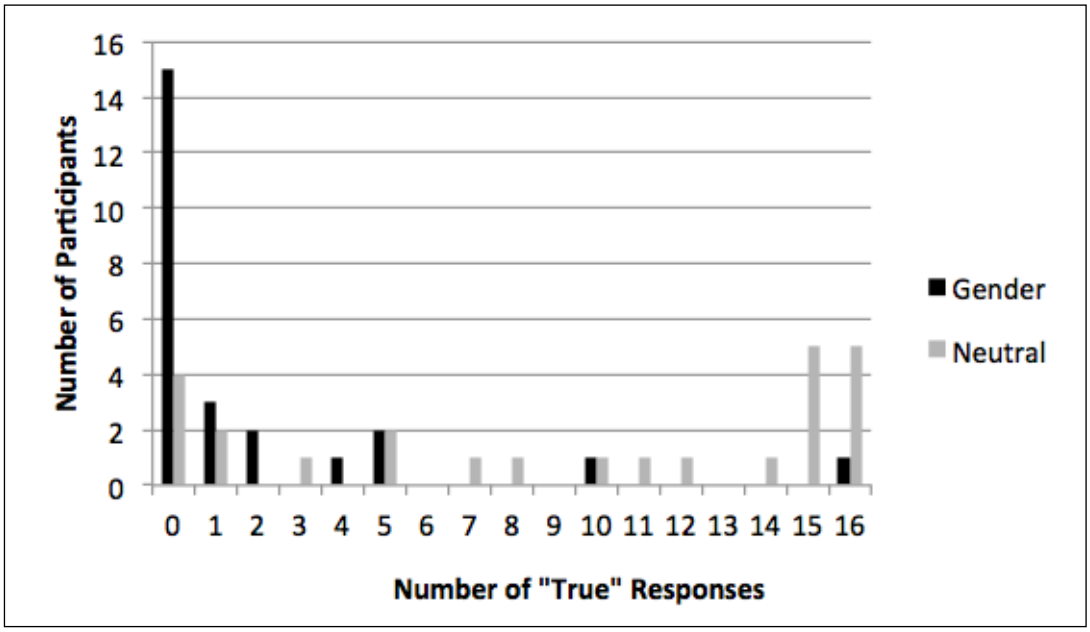


Fig. 4: Distribution of Number of True Responses to Generics in Study 2

The large-scale rejection of the gender-based generics is clearly evidence against an account of minority characteristic generics based on restricted domains. The results in fact parallel those of Cimpian, Gelman, & Brandone (2010), that presenting people with classes where males had long tails and females had short tails failed to trigger a sense that this was a natural kind (in contrast to classes where the adults had the long tails, and the young did not). The different results from Studies 1 and 2 could possibly be owing to the different linguistic formulations used (this was the only change in procedure). It is unclear why shifting to a monolexemic name and a definite plural (*I Carpillini)* and repeating the phrase at the start of each sentence should have depressed the acceptability of the gender-based generics in the way that it did. Perhaps a plural form is prone to triggering reasoning about the extension of the kind (the individuals) rather than focusing on the kind itself, but then a similar effect should have been seen in the neutral condition, where only a small drop (66% to 58%) was seen. All four creatures had masculine gender in Italian, yet there was no significant difference seen between the generics true just of the males (15%), and those true just of the females (8%), so it is unlikely that the statements were taken as applying only to the males. (The results of Study 3, reported below, suggest that the very low acceptance rate for the Gender condition in this study was an outlier).

It is striking that we found that gender-specific appearance features were not accepted, given that many of the examples used by Prasada et al. (2013) and others involve just this kind of sentence. Cimpian, Gelman, & Brandone (2010) justified using novel features on the grounds that people may agree with many common generic statements (such as *lions have manes*) "just because it is something they have been told – and not necessarily because the distribution of the relevant property matches their essentialist expectations" (pp. 263-264). It is possible that this factor may explain the failure of novel

appearance features to work in the way that a lion's manes or deer's antlers do. We consider this in Study 3.

In considering our results, one important aspect of our materials struck us as very relevant. Amongst our 16 generic properties, there were properties about a whole range of appearance, origins and behaviour, but none directly related to reproductive functions. In other words, the gender-specific properties we were describing were not themselves directly related to the biological function of sexual reproduction and care of offspring, hypothesized by Leslie (2008) to lie at the heart of acceptable minority characteristics. Accordingly, in the second half of the paper, we turn to a closely related research question, namely whether gender-specific minority characteristics will be more acceptable if they relate to biological functions, rather than simply to differentiating males from females.

Study 3

In Studies 3, 4 and 5 we considered whether gender-minority characteristics relating to reproductive functions would be accepted as true more readily than those relating to physical appearance. Our failure to find evidence of the acceptance of gender-based characteristics relating to appearance in the first two studies, suggests that this might be the case. Gender-based generics in previous research have sometimes used reproductive properties ("lay eggs", "give live birth") and sometimes differential appearance ("have antlers", "have a mane", "are red"). One difficulty with testing familiar statements of this kind is that people may be uncertain or ignorant about whether the appearance features actually are gender-specific. When Leslie et al. (2011), tested participants with false statements such as *Female deer have antlers,* or *Male sheep produce milk*, there was a very clear distinction between the mean percentages of agreement for reproductive features (8%) and appearance features (34%). To avoid the problem of variable knowledge of this kind, we designed our study in a way that meant that participants were given all of the

relevant facts before deciding on the acceptability of the sentences. As in Studies 1 and 2, they were first provided with a story accompanied by pictures of the male and female of the species, before they made their judgments.

Study 3 also used both fictional cases (as in Studies 1 and 2) and real-life examples. Fictional cases have the advantage of removing dependence on the prior knowledge of the participants, but raise the issue of whether people accept the validity of the examples, or whether they find the task too artificial. We therefore constructed gender stories differentiating between features of physical appearance and reproduction for both fictional cartoon animals and examples taken from the natural world. We predicted that acceptance would be stronger for real-life than for fictional cases, and that the difference between reproductive and appearance features would be evident in both kinds of cases.

Method

Participants. Fifty students (33 females) at "Kore University" of Enna, Italy, participated voluntarily. The sample size was the same as the previous studies.

Materials. Each booklet contained four sets of descriptions in Italian with pictures: two based on real creatures (Lions and Deer) and two on fictional dimorphic creatures (the toad and the bird from Study 2). For example, the text for the Lions was as follows (in Italian), accompanied by the images in Fig. 5:

> *Lions come in two forms corresponding to the male and the female of the species. This is the male (left). This is the female (right). Lions currently are found in sub-Saharan Africa and in Asia. They generally inhabit savannah and steppe, although they can also be found in the woods. Lions live for 10–20 years. The male has a mane, while the female does not. The female hunts for the pride and gives birth to her young ones after a gestation period of about 110 days.*

Fig. 5: Male and Female Lions in Study 3

Each story was followed by six sentences: two true, two false, one generic based on physical appearance (i.e. *lions have a mane*), and one generic based on reproduction (i.e. *lions give birth to their young ones*). For instance:

1. *Lions currently exist in sub-Saharan Africa* (True)
2. *Lions live mainly in the savannah and the steppe* (True)
3. *Lions are found in Italy* (False)
4. *Lions live more than 20 years* (False)
5. *Lions give birth to their cubs* (Reproductive generic)
6. *Lions have a mane* (Appearance generic)

The order of the stories within the booklets was randomized, as was the order of statements for each story. The form of the sentences was the Definite plural as in Study 2. Thus, *Lions have a mane* was presented as "*I leoni hanno la criniere".* (The stories for the Deer and for the fictional cases from Study 2, may be found in Appendices B and C, along with Italian versions).

Design and Procedure. Participants were randomly divided into two groups of 25, one group first saw the two stories based on real animals and then the two fictional creatures, while the other group saw the stories in the opposite order. Thus, Order was a between-subjects control factor, while the type of creature (real or fictional) and type of generic (reproductive or appearance) were within-subjects. The first page of each booklet

contained a cover sheet with the instructions in Italian:

"*This study is simple and short. You will be shown four pairs of pictures of both fictional and real creatures, and a text that describes them. Then you will be asked to say whether a number of sentences are true or false for the species, based on the information you have been given*".

Participants circled one of two response options (true or false), printed to the right of each sentence.

Results and Discussion

True and False control statements were judged appropriately by all participants (92% correct for True and 97% for False). Fig. 6 shows the mean acceptance rate of the Reproductive-Generic and Appearance-Generic sentences for the Real (striped bars) and Fictional (plain bars) cases. As predicted Reproductive generics (69%) were judged true more often than Appearance generics (47%). This difference was found for both Real and Fictional cases. For Real cases, 17 participants (34%) accepted Reproductive generics more than Appearance generics, and only 3 (6%) accepted Appearance more than Reproductive (χ^2 (1) = 9.8, p = .002), while for Fictional cases the figures were respectively 16 (32%) and 5 (10%), (χ^2 (1) = 5.8, p = .016).

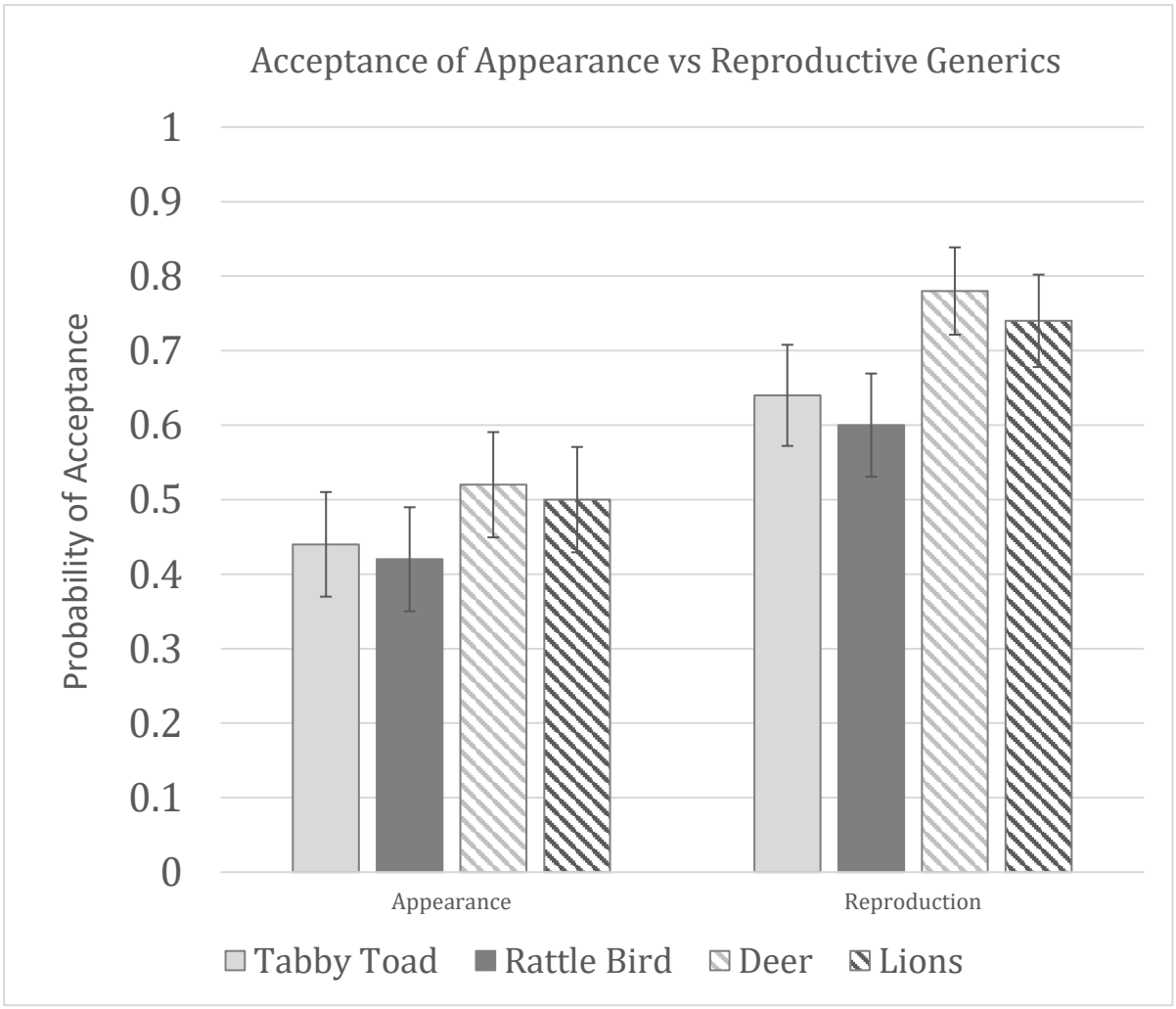


Fig. 6: Mean Acceptance of the Generic Sentences in the Fictional (plain) and Real Animal (striped) Cases in Study 3. Error bars are Standard Errors.

To test for higher-order interaction effects, although the scales were not well-suited to parametric statistics, participants were given a score of 0, 1 or 2 according to the number of generics of a particular kind they accepted, and the data were submitted to 2-way ANOVA with within-subjects factors of Real vs Fictional and Reproductive vs Appearance. There were significant main effects of Reproductive vs. Appearance ($F(1,49) = 18.02$, $p < .001$) and of Fictional vs. Real ($F(1,49) = 8.73$, $p < .005$). There was no interaction, $F < 1$, (see Fig. 6).

A further 3-way ANOVA including Order as a between-subjects factor found a

significant effect of the order of the two conditions ($F(1,48) = 5.82$, $p = .02$), with the generics in the condition presented second ($M = 1.39$, $SD = .64$) accepted more often than those in the condition presented first ($M = 0.93$, $SD = .71$). However Order did not interact significantly with the other factors (interaction with Fictional vs Real, $F < 1$, with Appearance vs Reproductive, $F(1,48) = 1.86$, $p = .18$, three way interaction $F < 1$)).

A comparison can be made between the fictional appearance generics, when seen first, and the rate of their acceptance in Study 2, where the same linguistic form was used. In the present study they were accepted 52% of the time, compared to 12% in Study 2. Given that in Study 1 (in a different form) they were also accepted 52% of the time, it seems probable that the low result in Study 2 was an outlier.

Study 4

In Study 4 we aimed to replicate the results of Study 3. We were also interested in a secondary question, namely whether the preference for reproductive over appearance generics was linked to the female gender per se. In Study 3 the appearance features were all true of the Males, and the reproductive features true of the Females. Thus, the type of feature was confounded with gender, and it could be the case that generics are considered more acceptably true when they describe a minority characteristic possessed by females rather than by males. Accordingly, in Study 4 we crossed the two factors. The study used four real-life creatures (Sticklebacks, Anuras[4], Wild Rabbits, and Ostriches) and two versions of the description of each creature: Version A with the male of the species having the physical appearance feature and the female the reproductive one (as in Study 3), and Version B, with the female having the physical appearance feature while the male had the reproductive one.

Method

[4] Anura are actually a broad classification including toads and frogs. We used images of pool frogs.

Participants. Two hundred and six students (176 female) at "Kore University" of Enna, Italy, participated for no reward. A larger sample size was used with a between-subjects design so that the task for each participant could be much shorter, while maintaining power. Each group had roughly 25 participants as in the previous studies.

Materials. Each booklet contained a descriptive story for only one of the four creatures we used (for example, Sticklebacks) including two pictures. The story was followed by six sentences: two true, two false, one generic based on appearance (i.e. "Sticklebacks are bright red in the throat and belly"), and one generic based on reproduction (i.e. "Sticklebacks protect the eggs until they hatch"). The form of the sentences in Italian was definite plural as in Study 3. Details of the materials (in English) can be seen in Appendix D.

Design and Procedure. Participants were randomly divided into eight groups and did just one task on just one creature. Four groups saw one of the four stories in Version A, with a Male Appearance and a Female Reproductive generic, while the other four groups saw one of the four stories in Version B, with a Male Reproductive and a Female Appearance generic. Thus, the factor of gender-based differentiation of features (Version A or B) was between subjects and the type of generic (reproductive or appearance) was within. The first page of each booklet contained a cover sheet with instructions. Participants circled one of 2 response options (true or false), printed to the right of each sentence.

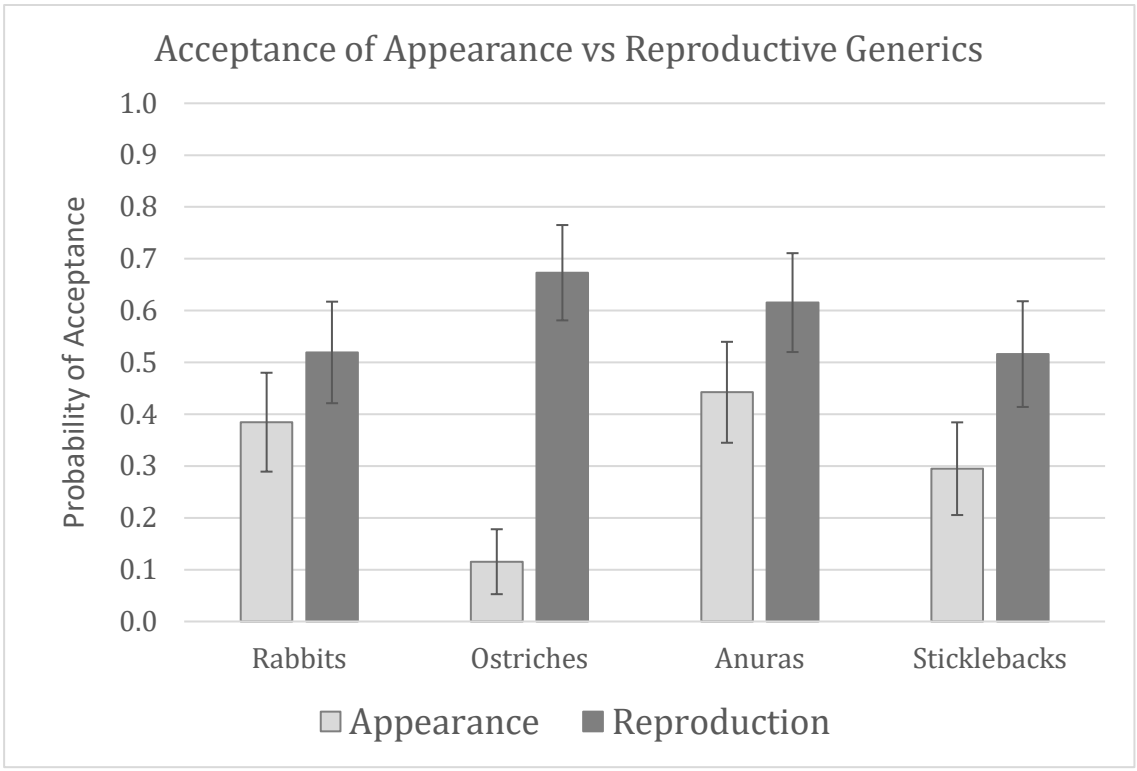


Fig. 7. Acceptance of Appearance versus Reproductive Generics, across the four animals. Error bars are Standard Errors.

Results and Discussion

True and False control statements were judged appropriately by all participants (93% correct for True and 95% for False). Reproductive generic sentences (58%) were more likely to be accepted than Appearance generics (31%). Fig. 7 shows the comparison for each of the four animals, showing that the preference for Reproductive generics was seen in each case. There was also a tendency for the main effect to be stronger when the Reproductive feature was true of the male, and the Appearance feature true of just the female, rather than the converse. Statistical analysis (a loglinear analysis reported below) confirmed that both effects were statistically significant ($\alpha = .01$). Table 1 shows the percentage of true responses for appearance and reproductive generics across the two task conditions.

Version of the task

Version A		Version B	
Male Appearance	35%	Female Appearance	27%
Female Reproductive	50%	Male Reproductive	67%

Table 1: Overall Acceptance of the Sentences in Study 4 as a Function of Gender and Type of Generic

Because the Male/Female factor was within-subjects, and each participant only judged one animal, we needed to use a different method for statistical analysis. Each person gave us two relevant data points – Yes or No to the appearance generic (A+ or A-), and Yes or No to the reproductive generic (R+ or R-). On this basis participants were classified into four groups – A+R+ (accepting both), A+R- (accepting only appearance), A-R+ (accepting only reproductive), and A-R- (rejecting both). Since our primary hypothesis was that gender-specific reproductive features provided a stronger basis for generic acceptance than gender-specific appearance, we expected more A-R+ than A+R- response combinations. Table 2 provides the full cross-tabulation of frequencies.

In the condition where the male had the appearance feature, and the female the reproductive feature, 31% accepted both generics as true (A+R+), and 46% rejected both generics as false (A-R-). For the remaining 23% who accepted just one as true, 19% (N=20) judged the reproductive statement as true (A-R+) and only 4% (N=4) chose the appearance statement (A+R-), ($\chi^2(1) = 10.67$, $p < .001$). For the condition with a male reproductive and a female appearance statement, 27% accepted both as true, and 34% rejected both as false. For those 39% choosing just one as true, all 40 participants chose the male reproductive statement and rejected the female appearance statement ($\chi^2(1) = 40.0$, $p < .001$). Taking both groups together, the preference for the reproductive statements was highly significant

($\chi^2(1) = 49.0$, $p < .001$).

		Reproductive Generic	
	Appearance Generic	Accepted	Rejected
Male appearance, Female reproductive	Accepted	32	4
	Rejected	20	48
Female appearance, Male reproductive	Accepted	28	0
	Rejected	40	34

Table 2: Frequencies of accepting or rejecting the two generics as a function of which generic went with which gender. Shading indicates the [A+R-] and [A-R+] cells.

For a more detailed analysis of the results, loglinear analysis of the 3-way frequency shown in Table 2 was run, with factors of A) whether the male had the appearance and the female the reproductive feature or vice versa, B) whether the reproductive generic was accepted or not and C) whether the appearance generic was accepted or not.

A backward elimination procedure was used. Once the 3-way interaction was eliminated as non-significant ($\chi^2(1) = 1.19$, $p = .27$), all three 2-way interactions were found to be significant ($\alpha = .01$), and are shown in the following tables, which collapse in turn over one of the three factors. Table 3A shows that appearance generics were more likely to be accepted for a male (36/104 = 35%) than for a female (28/102 = 27%) (χ^2 (1) = 7.02, $p = .008$). Table 3B shows that reproductive generics were also more likely to be accepted for a male (68/102 = 67%) than for a female (52/104 = 50%) (χ^2 (1) = 11.7, $p = .001$). Table 3C shows that only 4 people accepted the appearance generic without also accepting the reproductive generic (χ^2 (1) = 62.4, $p < .001$).

Table 3A

Gender	Appearance: Accepted	Appearance: Rejected
Male	36 (17%)	68 (33%)
Female	28 (14%)	74 (36%)

Table 3B

Gender	Reproductive: Accepted	Reproductive: Rejected
Male	68 (33%)	34 (17%)
Female	52 (25%)	52 (25%)

Table 3C

Appearance	Reproductive: Accepted	Reproductive: Rejected
Accepted	60 (29%)	4 (2%)
Rejected	60 (29%)	82 (40%)

Table 3: Breakdown of the full frequency table to show the three significant 2-way interactions from the loglinear analysis involving acceptance of the appearance and reproductive generics, and the acceptance of each when assigned to male or female creatures.

Table 3A. Acceptance of Appearance features by Gender.

Table 3B. Acceptance of Reproductive features by Gender.

Table 3C. Acceptance of Appearance versus Reproductive features.

In conclusion we have strong evidence that almost everyone took one of three positions in regard to these gender specific generic statements. Either they accepted both (29%) or rejected both (40%) or they accepted a gender-specific statement connected with reproduction and care of offspring, but rejected a statement describing a gender-specific appearance feature (29%). Only 2% made the remaining possible choice of accepting the appearance feature but rejecting the reproductive one. There was also a general bias towards accepting either type of generic as being more likely to be true of the class when it was possessed by males than by females.

One explanation for the bias towards accepting generics that are true only of males is that in Italian, the four creatures that we used all had masculine grammatical gender (*gli anuri, gli spinarelli, gli struzzi,* and *i conigli selvatici*. To remove the confounding factor of gender, and (more importantly) to provide a partial replication of the result of Study 4, a final study was done, with an English translation of the materials, conducted in the UK.

Study 5

English lacks grammatical gender in the case of most common nouns, and in particular in the case of the four creatures used in Study 4. Accordingly, the descriptions and statements were translated into British English and tested on an online panel sample in the UK. The aim was, first, to replicate the preference for reproductive over appearance generics, and second to test whether a bias towards males would persist in a language without grammatical gender.

Method

Participants. A sample of 92 participants were recruited through Prolific Academic, an online participant panel in the UK.

Materials and Design. The same four scenarios were used as in Study 4. Translation into English used the bare plural form for the descriptive text and for all the true/false

statements (see Appendix D).

Design and Procedure. In a change from Study 4, each participant gave responses to all four creatures, making a total of 24 truth judgments from each participant. Participants were randomly divided into two groups of 46. For one group males had the reproductive feature and females the appearance feature, and for the other group the features were swapped. Each group saw the four descriptions and made the associated truth judgments in the same order – anura, ostrich, stickleback, wild rabbit. The order of the six statements was randomized for each of the four descriptions, but was the same for all participants. As before, for each creature there were two True and two False statements, one Generic which asserted that an appearance feature specific to one sex was true of the class of creatures, and one Generic which asserted that a reproductive behaviour specific to the other sex was true of the class. As before, participants clicked on a binary choice of True or False buttons. Assignment of reproductive or appearance features to males or females was balanced across the two groups of participants and the four types of creature.

To avoid unnecessary deception of participants, for ethical reasons the following statement was included at the instruction stage:

> *To achieve balance in the design of the study, some parts of the descriptions of creatures may be fictional. Please just respond on the assumption that all the descriptions are factually correct. Please select an answer for every sentence. If you are in doubt, just choose the answer that you think is best.*

At the end of the survey participants had an opportunity to describe how they did the task, and to state whether they spotted any parts of the descriptions of the anurans, sticklebacks, ostriches or wild rabbits which were "fictional" or incorrect.

Results and Discussion

True and False control statements were judged appropriately by all participants

(98% correct for True and 97% for False). Reproductive features were accepted 97% of the time when true of females and 95% of the time when true of males ($\chi^2(1) = 0.09$, $p = .76$). The Appearance features were accepted 60% of the time for females and 64% of the time for males ($\chi^2(1) = 0.17$, $p = .68$). Since there was clearly no effect of which generics were assigned to male or female creatures, the analysis was much simpler. Of those participants who preferred one type of generic over the other, 59 preferred the reproductive feature and only 1 the appearance feature. No statistical test is needed here. There were an additional 30 who found all 8 generic sentences acceptable. Fig. 8 shows the results for each of the four creatures, collapsed over gender. Interestingly the rate of acceptance of reproductive generics (96%) was much greater in the British sample than for the Italian samples (76% for the real kinds in Study 3, and 57% in Study 4). The acceptance of appearance generics was also somewhat higher than found in the earlier studies with Italian (around 50%). The reasons for these differences are unclear, as there are many possibly relevant differences between the studies. Possible differences would include the language and culture of the two nations, and the difference between a student sample taking the test in the classroom, and a sample from an online survey panel taking the test in Qualtrics.

The appearance feature for Ostriches had particularly low acceptance rates in both Study 4 and Study 5 relative to the other creatures. Looking in detail at the story, it is possible this happened because a direct contrast was made between male's and female's appearance, naming an alternative colour for the females: *The feathers of males are mostly black, while females are mostly brown.* A possible explanation follows Leslie's (2007) proposal that generics are rejected if two subclasses are contrasted by two equally salient properties (e.g. left-handed vs right-handed people) rather than by the presence vs absence of a property. Interestingly, a similar statement was made about the colour of Anuras:

Males are bright green, while females are a dull colour. But this did not have the same effect, perhaps because "a dull colour" is not an equally salient colour. This example highlights how sensitive intuitions of semantic acceptability may be to small changes in language.

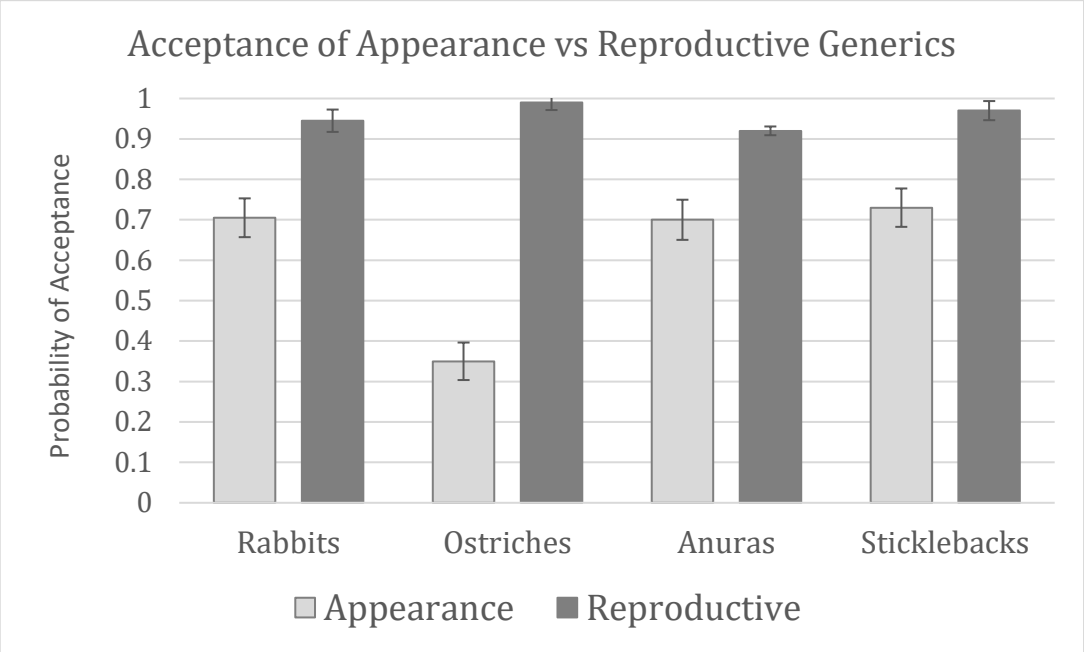


Fig. 8. Percent Acceptance of Appearance and Reproductive Generics in Study 5.

The results of Study 5 clearly supported the conclusions of Study 4, and suggested that the bias towards male-assigned generics (whether appearance or reproductive) seen in that study may well have been an influence of grammatical gender.

General discussion

Past research (Khemlani et al., 2007) has demonstrated that individuals agree with generic sentences which are only true of a minority of a class. However, all the sentences of this kind in their study were related to gender-specific properties such as *deer have antlers* or *ducks lay eggs*. Our first set of studies investigated how important it is that these minorities sharing a feature are based on gender per se. Perhaps surprisingly, we obtained no evidence that people think along these lines. Identifying a minority of a class on the

basis of appearance and behaviour unlinked to sexual differentiation provided no worse a basis for the acceptability of a minority characteristic generic than a minority based on sex.

The results of our second set of studies provide some further understanding of this interesting result, by asking whether gender-based features that relate to reproduction may be more acceptable than those that refer to appearance. In Leslie et al.'s data (2011), the overgeneralisation to universally quantified sentences (e.g. *All ducks lay eggs*) was more convincing with reproductive features than with appearance (e.g. *All goats have horns*), possibly because some participants may be ignorant of some of the appearance features. To avoid this problem, we provided our participants with the relevant information in a short text, and then tested the acceptability of the generics. In Study 3, with both real and fictitious animals we found that reproductive features were indeed significantly better accepted. Studies 4 and 5 showed that the effect was present regardless of whether the male or the female of the species had the reproductive responsibility. Thus, when told that a male stickleback fish fans his eggs to keep them oxygenated, this property was accepted as a generic feature of sticklebacks by a majority of respondents.

Leslie (2015) discusses a suggestion by Liebesman (2011) to the effect that bare plural generic statements such as *Tigers are striped*, *Ducks lay eggs*, or *Mosquitoes carry malaria* are sentences more easily interpreted as referring to a kind rather than to a set of individual members. Similarly, Hampton (2012a; 2012b) argues that generics are considered true when they convey characteristic information that is a part of the intensional prototype that represents the kind. That proposal could explain why very rare but striking properties (e.g. *Pit bulls maul children*) are also commonly accepted as true (Cimpian, Brandone & Gelman, 2010). They are a part of our knowledge base about the kind, because they signify something it is important to know. Individuals' acceptance of both characteristic and striking predicates in generic form is not based on their beliefs

about the number of category members that have the property, but relies on the core prototypical information they possess about the kind. Given this framework, it is understandable why gender-based reproductive features are more easily attributed to the kind than are appearance features. Ducks laying eggs is important information to know about both male and female ducks because ducks as a kind are oviparous animals, in contrast to species in other classes such as mammals.

Another explanation could invoke the idea of "restricted domain" (Asher & Pelletier, 2012). Since reproduction is a joint endeavour, involving both male and female, it may be more acceptable to generalise the reproductive behaviour of either sex to the class as a whole, while the same is not as true for sex-differentiating appearance features.

Our results suggest that reproductive behaviours support generic acceptance. Alternatively, it is possible that any minority behavioural trait, and not just those relating to reproduction, may be considered more acceptable than appearance features as a generic. This suggestion remains a possibility, although we have some limited evidence against it. In Studies 1 and 2, three of the 16 generic statements involved behaviours (*has a cooing call, has a poisonous bite, releases a foul smell when touched).* Item analysis showed that their rate of acceptance was no greater than for the appearance features (61% vs 59% in Study 1, and 33% vs 35% in Study 2).

Relation to accounts of generics.

One possible difference between appearance and reproductive features relates to mutability. Generic properties related to appearance could be argued *prima facie* to be more mutable than features related to reproduction. A mutable property is one that a person can easily imagine being different, without dramatic changes for the concept itself (Hampton, 2012a; 2012b; Hampton, Passanisi, & Jönsson, 2011; Sloman, Love, & Ahn, 1998). For instance, there is a feasible world in which flamingos are black rather than pink,

but otherwise everything about them is the same, whereas flamingos not laying eggs would require changes to the biological theory of the flamingos' functioning that would lead to other important adjustments in their properties and make-up. Nevertheless, the reproductive properties used in the last two studies were in fact about building nests and protecting the eggs – so they were not immutable in this case (for example cuckoos do neither). It is easy to imagine fish not protecting their eggs (many do not), or ostriches incubating them by day rather than by night. This suggests that it is not mutability itself that matters –but the fact that reproductive behaviour is more tightly associated with the kind.

Another difference between appearance and reproductive features may relate to psychological essentialism (Gelman, 2003; Gelman & Bloom, 2007; Hampton, Estes, & Simmons, 2007; Prasada & Gillingham, 2006; Rips, 1989). People commonly believe that biological kinds have a deeper "essence", probably linked to whatever is inherited from progenitors, which is responsible for the characteristic properties of the kind. Gelman and Bloom (2007) showed that adults are more willing to continue to accept generics about an innate rather than an acquired property, when that property is then lost. The focus on essences as inherited might see reproductive behaviour as more strongly associated with the kind than appearance features, even if the latter are distinctive of the kind, and clearly of genetic origin.

One account that fits less well with our results is that of Cohen (2004). Cohen proposes that a property should not be true (or false) of only a salient subset of the class, if it is to be generically true of the class. Our examples of two varieties of a bird or beetle species would seem to break his homogeneity requirement, so our results are not consistent with his suggestion, without a further account of just what constitutes a salient subset in his theory. Another account, offered by Tessler and Goodman addresses the

contrast of cases where a majority *does not* support a generic statement (e.g. *ducks are female),* with cases where a minority *does* support a generic (e.g. *sharks attack bathers).* The first is not acceptable by their view because the immediate superordinate (animal) also has females at around the same prevalence. *Ducks lay eggs*, on the other hand refers to something that is not equally prevalent in animals. In a similar way, sharks may not attack bathers often, but animals (or perhaps aquatic animals) attack bathers much less often. There are clearly difficulties here – for example why is the superordinate of *ducks* taken to be *animals* rather than *birds?* Neither is it clear why reproductive features should be more acceptable than appearance in this case, since many other creatures incubate eggs or protect their young, but few have antlers or red bellies.

As described above, the notion of a restricted domain (Asher & Pelletier, 2012) may be able to explain our results if it is proposed that reproductive behaviour is a joint enterprise engaging both males and females, and that this particularly warrants acceptance of sex-linked generics about reproduction. This idea deserves further exploration.

Finally, we consider the most convincing explanation for our result relates to a hypothesis suggested by Cimpian (Cimpian & Markman, 2011) that generics are more likely to be acceptable when they convey essential or deep causal properties of a kind. According to Cimpian, from preschool ages onwards, children display a set of essentialist beliefs. That is, we consider, implicitly or explicitly, that each biological individual has an underlying nature or essence pervading its insides, that causally grounds its more enduring and stable features. Reproductive features seem to be of this type. They are part of a network of intensely related properties of a kind, embedded in theories of the rearing of offspring and sexual reproduction of the species. They would therefore be more confidently considered true as generics than gender-differentiating appearance characteristics.

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Appendices

Appendix A

Examples of Materials used in Study 1. The Bird is already described in the main text. The remaining three creatures were a Beetle, a Fish and a Toad.

Examples included are the Gender-differentiated story about the Beetle, and the Neutral story about the Fish. The Toad's properties can be seen in Appendix B.

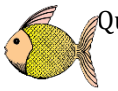
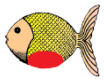
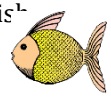
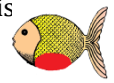
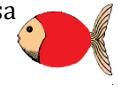
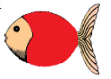
Each creature had 3 True, 3 False and 4 Generic statements to verify. Two were true of one form and two were true of the other.

The expected response is underlined for True and False statements. Generic statements have no expected response.

LO SCARAFAGGIO BALLO - THE DANCE BEETLE

Original Italian	English translation
Lo Scarafaggio Ballo è disponibile in due forme secondo il genere della specie. Il maschio e la femmina differiscono in diversi modi.	The Dance Beetle occurs in two forms, according to the genus of the species. Male and female differ in several ways.
Questo è lo Scarafaggio Ballo maschio  Questo è lo Scarafaggio Ballo femmina 	This is the male Dance Beetle  This is the female Dance Beetle 
Durante i mesi estivi, lo Scarafaggio Ballo femmina diventa completamente ros 	During the summer months, the female Dance Beetle turns completely red. 
Lo Scarafaggio Ballo si trova in Africa meridionale. Il maschio dello Scarafaggio Ballo ha un morso velenoso e le zampe pelose, mentre la femmina no. Lo Scarafaggio Ballo vive in aree poco luminose e umide come laghi, foreste e vicino ai fiumi. Vive in media per due anni e mangia solo mosche e formiche.	The Dance Beetle is found in southern Africa. The male of the Dance Beetle has a poisonous bite and hairy legs, while the female does not. The Dance Beetle lives in low light and humid areas such as lakes, forests and near rivers. It lives on average for two years and eats only flies and ants.
Quali delle seguenti affermazioni sullo Scarafaggio Ballo sono vere o false?	Which of the following statements about the Dance Beetle are true or false?
1) Viene dall'Australia Vero / <u>Falso</u>	1) It comes from Australia True / <u>False</u>
2) Vive per circa due anni <u>Vero</u> / Falso	2) It lives for about two years <u>True</u> / False
3) Ha le zampe pelose Vero / Falso	3) It has hairy legs True / False
4) Ha sei zampe Vero / Falso	4) It has six legs <u>True</u> / False
5) Si può trovare nelle aree poco luminose e umide <u>Vero</u> / Falso	5) It can be found in low light and humid areas <u>True</u> / False
6) Ha due cerchi rossi sul corpo <u>Vero</u> / Falso	6) It has two red circles on the body True / False
7) Ha un morso velenoso Vero / Falso	7) It has a poisonous bite True / False
8) Si nutre di lumache e vermi Vero / <u>Falso</u>	8) It feeds on snails and worms True / <u>False</u>
9) Ha antenne velenose Vero / <u>Falso</u>	9) It has poisonous antennae True / <u>False</u>
10) Diventa completamente rosso d'estate Vero / Falso	10) It becomes completely red in summer True / False

IL PESCE DIDO - THE DIDO FISH

Original Italian	English translation
Il Pesce Dido è una specie con due forme altrettanto comuni con piccole differenze. Sia i maschi che le femmine possono assumere entrambe le forme, e le due forme si accoppiano liberamente.	The Dido Fish is a species with two equally common forms with small differences. Both males and females can take either form, and the two forms mate freely.
Questo è il Pesce Dido semplice  Questo è il Pesce Dido colorato 	This is the simple Dido Fis  This is the coloured Dido Fis 
In primavera, la forma colorata del Pesce Dido diventa completamente rossa 	In spring, the coloured form of the Dido Fish becomes completely r 
Il Pesce Dido si trova solo in Australia. La forma semplice ha denti affilati, mentre quella colorata no. A differenza della forma colorata, la forma semplice ha anche una pinna verticale sul dorso. La forma colorata tende ad ospitare un parassita nell'intestino, ma la forma semplice no. Il Pesce Dido vive sulle barriere coralline e in acque poco profonde; mangia solo alghe e larve di insetti che si possono trovare sulla barriera corallina. E'un alimento comune per gli squali.	The Dido Fish is only found in Australia. The simple form has sharp teeth, while the coloured one does not. Unlike the coloured form, the simple form also has a vertical fin on its back. The coloured form tends to harbour a parasite in the intestine, but the simple form does not. The Dido Fish lives on coral reefs and in shallow waters; it eats only algae and insect larvae that can be found on the coral reef. It is a common food for sharks.
Quali delle seguenti affermazioni sul Pesce Dido sono vere o false?	Which of the following statements about the Dido Fish are true or false?
1) Mangia ragni Vero / Falso	1) It eats spiders True / False
2) Ha denti affilati Vero / Falso	2) It has sharp teeth True / False
3) Il suo corpo diventa completamente rosso in primavera Vero / Falso	3) Its body becomes completely red in spring True / False
4) Ha una pinna caudale Vero / Falso	4) It has a tail fin True / False
5) Tende ad ospitare un parassita nel suo sistema digestivo Vero / Falso	5) It tends to harbour a parasite in its digestive system True / False
6) Ha una pinna sul dorso Vero / Falso	6) It has a fin on its back True / False
7) Vive sulle barriere coralline Vero / Falso	7) It lives on coral reefs True / False
8) Vive in stagni Vero / Falso	8) It lives in ponds True / False
9) Si trova nelle Amazzoni Vero / Falso	9) It is found in the Amazon True / False
10) Viene mangiato dagli squali Vero / Falso	10) It is eaten by sharks True / False

APPENDIX B

Examples of Materials used in Study 2. Examples included are the Gender-differentiated story about the Toad, and the Neutral story about the Bird.

Each creature had 3 True, 3 False and 4 Generic statements to verify. Two were true of one form and two were true of the other.

The expected response is underlined for True and False statements. Generic statements have no expected response.

I BUFOTES – BUFOTES (A TYPE OF TOAD)

Original Italian	English translation
I Bufotes sono un tipo di rospo con due forme aventi piccole differenze, che corrispondono al maschio e alla femmina della specie.	Bufotes are a type of toad with two forms having small differences, which correspond to the male and female of the species.
Questo è il maschio  Questo è la femmina 	This is the male  This is the female 
In inverno la femmina diventa arancione. 	In winter, the female becomes orange. 
I Bufotes si trovano in Nord America. Il maschio ha artigli affilati e una lingua velenosa, mentre la femmina non ha nessuna delle due caratteristiche. L'esemplare femmina può rilasciare un cattivo odore quando viene toccata, ma il maschio no. I Bufotes vivono in laghi d'acqua dolce, stagni e corsi d'acqua. Mangiano solo mosche e altri insetti che possono essere trovati nei pressi dei laghi, ruscelli e stagni.	Bufotes are found in North America. The male has sharp claws and a poisonous tongue, while the female has neither of the two properties. The female specimen can release a bad smell when touched, but the male cannot. Bufotes live in freshwater lakes, ponds and streams. They only eat flies and other insects that can be found near lakes, streams and ponds.
Quali delle seguenti affermazioni sui Bufotes sono vere o false?	Which of the following statements about Bufotes are true or false?
1) I Bufotes diventano arancioni in inverno Vero / Falso	1) Bufotes become orange in winter True / False
2) I Bufotes i trovano in Nuova Zelanda Vero / <u>Falso</u>	2) Bufotes are found in New Zealand True / <u>False</u>
3) I Bufotes si nutrono di vermi Vero / <u>Falso</u>	3) Bufotes eat worms True / <u>False</u>
4) I Bufotes hanno tre dita in ciascuna zampa <u>Vero</u> / Falso	4) Bufotes have three toes on each foot <u>True</u> / False
5) I Bufotes hanno corna sulla testa Vero / <u>Falso</u>	5) Bufotes have horns on their heads True / <u>False</u>
6) I Bufotes rilasciano un odore ripugnante quando vengono toccati Vero / Falso	6) Bufotes release a repulsive smell when touched True / False
7) I Bufotes hanno artigli affilati Vero / Falso	7) Bufotes have sharp claws True / False
8) I Bufotes hanno macchie rosse sul dorso <u>Vero</u> / Falso	8) Bufotes have red spots on the back <u>True</u> / False
9) I Bufotes hanno una lingua velenosa Vero / Falso	9) Bufotes have a poisonous tongue True / False
10) I Bufotes si possono trovare in stagni e laghi <u>Vero</u> / Falso	10) Bufotes can be found in ponds and lakes <u>True</u> / False

I CARPILLINI – CARPILLINIES (A TYPE OF BIRD)

Original Italian	English translation
I Carpillini sono un tipo di Uccello. Essi sono disponibili in due versioni strettamente correlate con alcune piccole differenze. Sia il maschio che la femmina della specie possono avere entrambe le apparenze, e le due forme, che sono ugualmente comuni, si accoppiano liberamente.	Carpillinies are a type of bird. They occur in two closely related versions with some small differences. Both the male and female of the species can have both appearances, and the two forms, which are equally common, mate freely.
Questa è la versione marrone  Questa è la versione gialla 	This is the brown versio  This is the yellow versio 
In primavera, il Carpillino giallo sviluppa delle macchie sulle ali. 	In spring, the yellow Carpillinie develops spots on the wing 
I Carpillini si trovano in Francia. La versione marrone ha un becco appuntito e una cresta sulla testa, mentre la versione gialla non possiede nè l'uno, nè l'altra. La versione gialla emette un fischio di richiamo simile al tubare, mentre la versione marrone è afona. I Carpillini vivono in foreste e boschi fittissimi e sono imparentato alla colomba; mangiano solo vermi, coleotteri e piccoli pesci che si possono trovare nei piccoli laghi e nei fiumi.	Carpillinies are found in France. The brown version has a pointed beak and a crest on its head, while the yellow version has neither one nor the other. The yellow version emits a cooing-like whistle, while the brown version is soundless. Carpillinies live in forests and thick woods and are related to the dove; they only eat worms, beetles and small fish that can be found in small lakes and rivers.
1) I Carpillini si trova solo in Asia Vero / <u>Falso</u>	1) Carpillinies are only found in Asia True / <u>False</u>
2) I Carpillini sono imparentato alla colomba <u>Vero</u> / Falso	2) Carpillinies are related to the dove <u>True</u> / False
3) I Carpillini vivono nelle foreste <u>Vero</u> / Falso	3) Carpillinies live in forests <u>True</u> / False
4) I Carpillini sviluppano delle macchie sulle ali in primavera Vero / Falso	4) Carpillinies develop spots on the wings in spring True / False
5) I Carpillini hanno una cresta sulla testa Vero / Falso	5) Carpillinies have a crest on the head True / False
6) I Carpillini si nutrono di noci e semi Vero / <u>Falso</u>	6) Carpillinies eat nuts and seeds True / <u>False</u>
7) I Carpillini hanno una coda gialla Vero / <u>Falso</u>	7) Carpillinies have a yellow tail True / <u>False</u>
8) I Carpillini si nutrono di piccoli pesci <u>Vero</u> / Falso	8) Carpillinies eat small fish <u>True</u> / False
9) I Carpillini hanno un becco appuntito Vero / Falso	9) Carpillinies have a pointed beak True / False
10) I Carpillini emettono un fischio di richiamo simile al tubare Vero / Falso	10) Carpillinies emit a coo-ing like whistle True / False

Appendix C

The Deer scenario from Study 3. One generic relates to appearance (Deer have antlers) and one to reproduction (Deer suckle their little ones).

Original Italian	English translation
I cervi possiedono due diverse forme corrispondenti al maschio e alla femmina della specie.	Deer possess two different forms corresponding to the male and to the female of the species.
Questo e' il maschio 	This is the male 
Questa e' la femmina 	This is the female 
I cervi abitano gran parte dell'Europa, dove sebbene un tempo fossero rari in qualche zona, non furono mai vicini all'estinzione. I cervi sono ruminanti, mangiano il loro cibo in due fasi ed hanno un numero pari di dita su ogni zampa, come cammelli, capre e bovini. Solo il maschio ha le corna, che iniziano a crescere in primavera e cadono ogni anno, di solito alla fine dell'inverno. La femmina allatta i suoi piccoli dopo il parto.	Deer inhabit much of Europe, where although they were once rare in some areas, they were never close to extinction. Deer are ruminants, they eat their food in two stages and have an even number of toes on each leg, like camels, goats and cattle. Only the male has antlers, which begin to grow in the spring and fall off each year, usually in late winter. The female suckles her little ones after childbirth.
Quali delle seguenti affermazioni sui cervi sono vere o false?	Which of the following statements about deer are true or false?
1) I cervi allattano il loro piccoli Vero/Falso	1) Deer suckle their little ones True / False
2) I cervi abitano gran parte dell'Europa <u>Vero/</u>Falso	2) Deer inhabit much of Europe <u>True</u> / False
3) I cervi erano vicini all'estinzione Vero/<u>Falso</u>	3) Deer were close to extinction True / <u>False</u>
4) I cervi diventano bianchi in inverno Vero/<u>Falso</u>	4) Deer become white in winter True / <u>False</u>
5) I cervi sono ruminanti <u>Vero</u>/Falso	5) Deer are ruminants <u>True</u> / False
6) I cervi hanno le corna Vero/Falso	6) Deer have antlers True / False

Appendix D
Materials for Study 4 (in Italian, shown in *italic)* and Study 5 in English. Versions shown have the male with the appearance feature, and the female with the reproductive feature. For the alternative condition, the gender roles were reversed.

The statements have been annotated:
(T = True, F = False, G-A = Generic Appearance, G-R = Generic Reproductive).

ANURI/TOADS

Gli Anuri sono un tipo di rane presenti su tutto il territorio, ma una maggiore concentrazione della specie si trova nella foresta tropicale. Sono generalmente carnivori, nutrendosi soprattutto di piccoli vertebrati. La loro pelle è semi-permeabile, possono quindi vivere sia in luoghi umidi che asciutti. I maschi sono di colore verde brillante, mentre le femmine hanno un colore spento. Le femmine proteggono le uova dai predatori.

Anuras are a type of frog widely distributed but the greatest concentration of the species is found in tropical rainforests. They have a carnivorous diet consisting of small invertebrates. The skin is semi-permeable, making them susceptible to dehydration, so they either live in moist places or have special adaptations to deal with dry habitats. Males are bright green, while females are a dull colour. Females protect eggs from the predators.

Questo è l'Anura maschio

This is the male Anura

Questo è l'Anura femmina

This is the female Anura

Quali delle seguenti affermazioni sugli Anurisono vere o false?

Which of the following statements are true or false of Anuras?

1) Anuras eat fruit (F) 2) Anuras have a semi-permeable skin (T) 3) Anuras are mainly concentrated in deserts (F) 4) Anuras are bright green (G-A) 5) Anuras are widely distributed (T) 6) Anuras protect their eggs from predators (G-R)	*1) Gli Anuri si nutrono di frutta* *2) Gli Anuri hanno una pelle semi-permeabile* *3) Gli Anuri sono maggiormente presenti nei deserti* *4) Gli Anuri sono di colore verde brillante* *5) Gli Anuri sono piuttosto comuni* *6) Gli Anuri proteggono le uova dai predatori*

STRUZZI/OSTRICHES

Gli struzzi (Struthiocamelus) sono una specie di grandi uccelli non volatili nativi dell'Africa. Contrariamente alle credenze popolari, gli struzzi non seppelliscono la testa sotto la sabbia per evitare il pericolo. Essi generalmente pesano quanto due soggetti umani adulti. Le penne dei maschi sono soprattutto nere, mentre quelle delle femmine sono per la maggior parte marroni. All'incubazione si dedica solo la femmina soprattutto durante la notte. Mentre durante il giorno le uova vengono ricoperte di sabbia perché il loro processo di sviluppo ha bisogno del calore naturale del sole.

Ostriches (Struthio camelus) are a species of large flightless birds native to Africa. They live in nomadic groups of 5 to 50 birds. Contrary to popular belief, ostriches do not bury their heads in sand to avoid danger. Ostriches usually weigh as much as two adult humans. The feathers of males are mostly black, while females are mostly brown. Females are in charge of incubating eggs. They do it mainly at night, while during daytime the eggs are covered with sand and abandoned because their development process requires the natural heat of the sun.

Questo è lo struzzo maschio
This is the male ostrich

Questo è lo struzzo femmina
This is the female ostrich

Quali delle seguenti affermazioni sugli struzzi sono vere o false?
Which of the following statements are true or false of ostriches?

1) Ostriches incubate eggs mainly at night (G-R) 2) Ostriches weigh as much as two adult humans (T) 3) Ostriches are mostly black (G-A) 4) Ostriches bury their heads in sand to avoid danger (F) 5) Ostriches are native to Italy (F) 6) Ostriches are flightless birds (T)	*1) Gli struzzi si dedicano all'incubazione soprattutto la notte* *2) Gli struzzi pesano quanto due soggetti umani adulti* *3) Gli struzzi sono soprattutto neri* *4) Gli struzzi seppelliscono la testa sotto la sabbia per evitare il pericolo* *5) Gli struzzi sono nativi dell'Italia* 6) *Gli struzzi sono uccelli non-volatili*

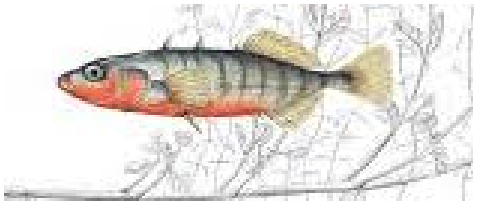
SPINARELLI/STICKLEBACKS

Gli spinarelli sono una famiglia di pesci con molte varietà più comunemente presenti negli oceani, ma si possono trovare anche in acqua dolce. Gli spinarelli sono carnivori, si nutrono di piccoli animali come insetti, crostacei e larve di pesci. Essi sono caratterizzati dalla presenza di tre isolate spine acuminate sul dorso davanti alla pinna dorsale. I maschi hanno la gola e lo stomaco di un rosso brillante. Le femmine fanno la guardia alle uova fin quando non si schiudono.

Sticklebacks are a family of fish with many varieties most commonly found in the ocean, but some can be found in fresh water. Sticklebacks are carnivorous, feeding on small animals such as insects, crustaceans and fish larvae. Sticklebacks are characterised by the presence of strong and clearly isolated spines in their dorsal fins. The males are bright red in the throat and belly. The females guard the eggs until they hatch.

Questo è lo spinarello maschio

This is the male stickleback



Questo è lo spinarello femmina

This is the female stickleback

Quali delle seguenti affermazioni sugli spinarelli sono vere o false?

Which of the following statements are true or false of Sticklebacks?

1) Sticklebacks feed on insects (T) 2) Sticklebacks are bright red in the throat and belly (G-A) 3) Sticklebacks are only found in the ocean (F) 4) Sticklebacks protect the eggs until they hatch (G-R) 5) Sticklebacks are characterised by clearly isolated spines in their dorsal fins (T) 6) Sticklebacks are vegetarians (F)	*1) Gli spinarelli si nutrono di insetti* *2) Gli spinarelli hanno la gola e lo stomaco di un rosso brillante* *3) Gli spinarelli si trovano soltanto nell'oceano* *4)Gli spinarelli fanno la guardia alle uova fin quando non si schiudono* *5) Gli spinarelli sono caratterizzati dalla presenza di spine isolate sul dorso* *6) Gli spinarelli sono vegetariani*

CONIGLI SELVATICI/WILD RABBITS

I conigli selvatici sono una specie di conigli nativi dell'Europa meridionale (Spagna e Portogallo) e dell'Africa nord-occidentale (Morocco e Algeria). Sono considerati una specie "infestante". L'Australia ha maggiori problemi con i conigli selvatici a causa della mancanza di predatori naturali. I conigli selvatici hanno lunghe orecchie, grandi zampe posteriori, e una corta e soffice coda. I maschi sviluppano una caratteristica tasca di pelle posizionata sotto il mento. Dopo l'accoppiamento le femmine costruiscono il nido per i loro cuccioli.

Wild rabbits (Oryctolagus cuniculus) are a species of rabbit native to southwestern Europe (Spain and Portugal) and northwest Africa (Morocco and Algeria). It is known as an invasive species. Australia has the most problems with wild rabbits, due to the lack of natural predators there. Rabbits have long ears, large hind legs, and short, fluffy tails. Males develop a characteristic pocket of skin positioned under the chin. After mating females build the nest for their offspring.

Questo è il coniglio selvatico maschio

This is the male wild rabbit

Questo è il coniglio selvatico femmina

This is the female wild rabbit

Quali delle seguenti affermazioni sui conigli selvatici sono vere o false?

Which of the following statements are true or false of wild rabbits?

1) Wild rabbits have a short, fluffy tail (T)	*1) I conigli selvatici hanno una corta e soffice coda*
2) Wild rabbits are only found in southwestern Europe (F)	*2) I conigli selvatici sono nativi dell'Europa sud-occidentale*
3) Wild rabbits develop a characteristic pocket of skin under the chin (G-A)	*3) I conigli selvatici sviluppano una caratteristica tasca di pelle sotto il mento*
4) Wild rabbits build the nest for their offspring (G-R)	*4) I conigli selvatici costruiscono il nido per i loro cuccioli*
5) Wild rabbits are rare (F)	*5) I conigli selvatici sono rari*
6) Wild rabbits have long ears (T)	*6) I conigli selvatici hanno lunghe orecchie*