Rapid mimicry and emotional contagion in domestic dogs

Elisabetta Palagi, Velia Nicotra and Giada Cordoni

Article citation details

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Review timeline

<table>
<thead>
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<th>Event</th>
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<tr>
<td>Original submission</td>
<td>27 May 2015</td>
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<tr>
<td>1st revised submission</td>
<td>25 September 2015</td>
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<tr>
<td>2nd revised submission</td>
<td>19 November 2015</td>
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<tr>
<td>Final acceptance</td>
<td>23 November 2015</td>
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Note: This manuscript was transferred from another Royal Society journal without peer review.

Review History

RSOS-150230.R0 (Original submission)

Review form: Reviewer 1 (Jules Panksepp)

Is the manuscript scientifically sound in its present form?
Yes

Are the interpretations and conclusions justified by the results?
No

Is the language acceptable?
Yes

Is it clear how to access all supporting data?
Yes

Do you have any ethical concerns with this paper?
No

Have you any concerns about statistical analyses in this paper?
No

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Recommendation?
Major revision is needed (please make suggestions in comments)

Comments to the Author(s)
The present manuscript of Palagi et al. provides an account of emotional contagion in the
domesticated dog via ethological observations in a natural setting. Specifically, they show that
the play bow and an open mouth gesture are more likely to co-occur in dyads during free social
interaction relative to what they term ‘incongruent’ responses. They also demonstrate congruent
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Review form: Reviewer 2

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Recommendation?
Major revision is needed (please make suggestions in comments)

Comments to the Author(s)

Palagi, Nicotra and Cordoni asserted the following predictions in their study: 1) Domestic dogs are capable of rapidly reproducing behaviours of emotions of conspecifics during play; 2) Rapid behavioural mimicry in play is more frequent among dogs with higher levels of affiliation. Their data revealed a significant difference in the occurrences of congruent behaviours of a matching affective valence relative to incongruent matches, demonstrating that dogs are at least capable of reproducing affectively valenced behaviours. This outcome represents the first empirical evidence of such rapid mimicry in nonprimate species and, consequently, an important contribution to emotion research. In addition, the authors found that the rapid mimicry occurred more among familiar dogs than among less familiar dogs.

Two main concerns as well as a few minor comments are addressed below.

Main Comments

For the second part of the study, the authors extracted data from the same behavioural context (social play) to determine both the level of ‘friendship’ and the occurrence of mimicry in order to evaluate the relationship between the two. Since potentially dependent sets of data were here assessed, it is important that the authors discuss much more carefully these results. Alternative explanations need to be addressed. For instance, the frequent practice of play itself (instead of the social closeness among the dogs) could have affected their play responses/mimicry.

How do the results of this study exactly link to emotional contagion? The studied dogs were playing with one another, so they are already a sharing of positive emotion states. How does mimicry contribute more here? Please also include the recent work by Dezecache, Jacob, & Grezes (2015) as it addresses a number of relevant issues on emotional contagion. In addition, there is no direct metric that would serve as an index as to whether the rapid mimicry was indeed
automatic. How can we be certain that the rapid responses were automatic? Research by Ulf Dimberg might be useful to address this issue.

Minor Comments

Line 34: ‘through’ (not ‘trough’)

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Due to rough play activities it should be expected that the dogs were also showing open-mouth panting expressions during play. How were such expressions treated in this study?

The future research suggestion in line 174 identifies an important comparison group (wolves) that would be useful to assess whether Body-Facial mimicry has been shaped by domestication or social living as social carnivores. This would be very interesting in order to better understand the selection pressures of the domestication process selected for inter-specific communicative capacities (human-dog interactions) rather than intra-specific (dog-dog interactions).

No data detailing the nature of the following interaction between dogs after a congruent/incongruent response was provided, which would provide a stronger indication as to whether a positive affective state had been shared. For example, one might expect play bouts to last a longer period of time where a positive affective state had been shared through congruent rapid mimicry. Since you probably still have access to such data, it would be great to read about such a potential impact in your manuscript.

Decision letter (RSOS-150230)

28-Jul-2015

Dear Dr Palagi:

Manuscript ID RSOS-150230 entitled “RAPID MIMICRY AND EMOTIONAL CONTAGION IN DOGS: FIRST EVIDENCE FROM A NON-PRIMATE MAMMAL” which you submitted to Royal Society Open Science, has been reviewed. The comments from reviewers are included at the bottom of this letter.

In view of the criticisms of the reviewers, the manuscript has been rejected in its current form. However, a new manuscript may be submitted which takes into consideration these comments.

Please note that resubmitting your manuscript does not guarantee eventual acceptance, and that your resubmission will be subject to peer review before a decision is made.

You will be unable to make your revisions on the originally submitted version of your manuscript. Instead, revise your manuscript and upload the files via your author centre.

Once you have revised your manuscript, go to https://mc.manuscriptcentral.com/rsos and login to your Author Center. Click on "Manuscripts with Decisions," and then click on "Create a Resubmission" located next to the manuscript number. Then, follow the steps for resubmitting your manuscript.
Your resubmitted manuscript should be submitted by 25-Jan-2016. If you are unable to submit by this date please contact the Editorial Office.

I look forward to a resubmission.

Sincerely,
Dr Kevin Padian
Senior Publishing Editor, Royal Society Open Science
openscience@royalsociety.org

Associate Editor Comments to Author:
Associate Editor: 1

Comments to the Author:
Thank you for your submission. We will not be able to publish the manuscript in its current form, and we agree with your reviewers that more work needs to be done. In particular, your reviewers are questioning the use of the term “emotional contagion”, and the extent to which this demonstration, even if achieved by this data, is as novel as stated for non-primates. More generally, they call to question the unqualified use of high order terms such as emotional contagion, mimicry, reciprocity. In this regard, there are two paths for the manuscript: either qualify the use of these terms (although I am uncertain the reviewers are convinced this can be achieved by the data in its current form), or shift the framework within which the data is described. The reviewers further ask for more detail in the second half of the study in particular. I hope the review proves helpful in taking the work forward.

Reviewer: 1

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RSOS-150505.R1 (Revision)

Review form: Reviewer 1 (Jules Panksepp)

Is the manuscript scientifically sound in its present form?
Yes

Are the interpretations and conclusions justified by the results?
No

Is the language acceptable?
Yes

Is it clear how to access all supporting data?
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… suggesting mimicry leads to contagion.

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Decision letter (RSOS-150505)

05-Nov-2015

Dear Dr Palagi,

The Subject Editor assigned to your paper (“MIMIC TO PLAY OR PLAY TO MIMIC? RAPID MIMICRY AND EMOTIONAL CONTAGION IN DOGS”) has now received comments from reviewers. We would like you to revise your paper in accordance with the referee and Subject Editor suggestions which can be found below (not including confidential reports to the Editor). Please note this decision does not guarantee eventual acceptance.

Please submit a copy of your revised paper within three weeks (i.e. by the 28-Nov-2015). If we do not hear from you within this time then it will be assumed that the paper has been withdrawn. In exceptional circumstances, extensions may be possible if agreed with the Editorial Office in advance. We do not allow multiple rounds of revision so we urge you to make every effort to fully address all of the comments at this stage. If deemed necessary by the Editors, your manuscript will be sent back to one or more of the original reviewers for assessment. If the original reviewers are not available we may invite new reviewers.

To revise your manuscript, log into http://mc.manuscriptcentral.com/rsos and enter your Author Centre, where you will find your manuscript title listed under "Manuscripts with Decisions." Under "Actions," click on "Create a Revision." Your manuscript number has been appended to denote a revision. Revise your manuscript and upload a new version through your Author Centre.

When submitting your revised manuscript, you must respond to the comments made by the referees and upload a file "Response to Referees" in "Section 6 - File Upload". Please use this to document how you have responded to each of the comments, and the adjustments you have made. In order to expedite the processing of the revised manuscript, please be as specific as possible in your response.

In addition to addressing all of the reviewers' and editor's comments please also ensure that your revised manuscript contains the following sections before the reference list:

• Ethics statement
If your study uses humans or animals please include details of the ethical approval received, including the name of the committee that granted approval. For human studies please also detail
whether informed consent was obtained. For field studies on animals please include details of all permissions, licences and/or approvals granted to carry out the fieldwork.

• Data accessibility
It is a condition of publication that all supporting data are made available either as supplementary information or preferably in a suitable permanent repository. The data accessibility section should state where the article's supporting data can be accessed. This section should also include details, where possible of where to access other relevant research materials such as statistical tools, protocols, software etc can be accessed. If the data has been deposited in an external repository this section should list the database, accession number and link to the DOI for all data from the article that has been made publicly available. Data sets that have been deposited in an external repository and have a DOI should also be appropriately cited in the manuscript and included in the reference list.

If you wish to submit your supporting data or code to Dryad (http://datadryad.org/), or modify your current submission to dryad, please use the following link: http://datadryad.org/submit?journalID=RSOS&manu=RSOS-150505

• Competing interests
Please declare any financial or non-financial competing interests, or state that you have no competing interests.

• Authors' contributions
All submissions, other than those with a single author, must include an Authors' Contributions section which individually lists the specific contribution of each author. The list of Authors should meet all of the following criteria; 1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) final approval of the version to be published.

All contributors who do not meet all of these criteria should be included in the acknowledgements.

We suggest the following format:
AB carried out the molecular lab work, participated in data analysis, carried out sequence alignments, participated in the design of the study and drafted the manuscript; CD carried out the statistical analyses; EF collected field data; GH conceived of the study, designed the study, coordinated the study and helped draft the manuscript. All authors gave final approval for publication.

• Acknowledgements
Please acknowledge anyone who contributed to the study but did not meet the authorship criteria.

• Funding statement
Please list the source of funding for each author.

Once again, thank you for submitting your manuscript to Royal Society Open Science and I look forward to receiving your revision. If you have any questions at all, please do not hesitate to get in touch.

Yours sincerely,
Emilie Aime
Senior Publishing Editor, Royal Society Open Science
openscience@royalsociety.org
Comments to Author:

Associate Editor’s comments (Dr Anastasia Christakou):
Thank you for the opportunity to consider your manuscript.

We invite you to revise the manuscript, in light of further advise from the reviewer. Although you should respond to all of the reviewer’s comments, two key areas to consider are the conceptual streamlining that the reviewer is advising, and to explain data acquisition and analysis more clearly.

Reviewers’ Comments to Author:
Reviewer: 1

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Abstract: Emotional contagion is a basic form of empathy that makes individuals able to experience others’ emotions. In human and non-human primates emotional contagion is closely linked to facial mimicry, an automatic and fast response (< 1 sec) in which individuals involuntary mimic others’ expressions. Here, we tested whether body (play bow, PBOW) and facial (relaxed open-mouth, ROM) rapid mimicry is present in domestic dogs (Canis lupus familiaris) during dyadic intra-specific play. During their free playful interactions, dogs showed a stronger and rapid mimicry response (< 1 sec) after perceiving PBOW and ROM (two signals typical of play in dogs) than after perceiving JUMP and BITE (two play patterns resembling PBOW and ROM in motor performance). Playful sessions punctuated by rapid mimicry lasted longer that those sessions punctuated only by signals. Moreover, the distribution of rapid
mimicry was strongly affected by the familiarity linking the subjects involved: the stronger the social bonding, the higher the level of rapid mimicry. In conclusion, our results demonstrate the presence of rapid mimicry in dogs, the involvement of mimicry in sharing playful motivation, and the social modulation of the phenomenon. All these findings concur in supporting the idea that a possible linkage between rapid mimicry and emotional contagion (a building-block of empathy) exists also in dogs.

Author's Response to Decision Letter for (RSOS-150505)

See Appendix A.
Appendix A

Dear Editor,

below you can find our responses to the concerns made by the reviewer. As you can see we addressed all the points raised by him/her. Some of the concerns were extremely useful to better interpret our results.

We hope that our paper is now suitable to be published in Royal Society Open Science.

All the best,

Elisabetta Palagi

In addition to addressing all of the reviewers' and editor's comments please also ensure that your revised manuscript contains the following sections before the reference list:

• Ethics statement

If your study uses humans or animals please include details of the ethical approval received, including the name of the committee that granted approval. For human studies please also detail whether informed consent was obtained. For field studies on animals please include details of all permissions, licences and/or approvals granted to carry out the fieldwork.

ANSWER: We added the information in the text.

• Data accessibility

It is a condition of publication that all supporting data are made available either as supplementary information or preferably in a suitable permanent repository. The data accessibility section should state where the article's supporting data can be accessed. This section should also include details, where possible of where to access other relevant research materials such as statistical tools, protocols, software etc can be accessed. If the data has been deposited in an external repository this section should list the database, accession number and link to the DOI for all data from the article that has been made publicly available. Data sets that have been deposited in an external repository and have a DOI should also be appropriately cited in the manuscript and included in the reference list.

If you wish to submit your supporting data or code to Dryad (http://datadryad.org/), or modify your current submission to dryad, please use the following link:

http://datadryad.org/submit?journalID=RSOS&manu=RSOS-150505
• Competing interests

Please declare any financial or non-financial competing interests, or state that you have no competing interests.

• Authors’ contributions

All submissions, other than those with a single author, must include an Authors’ Contributions section which individually lists the specific contribution of each author. The list of Authors should meet all of the following criteria: 1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) final approval of the version to be published.

All contributors who do not meet all of these criteria should be included in the acknowledgements.

We suggest the following format: AB carried out the molecular lab work, participated in data analysis, carried out sequence alignments, participated in the design of the study and drafted the manuscript; CD carried out the statistical analyses; EF collected field data; GH conceived of the study, designed the study, coordinated the study and helped draft the manuscript. All authors gave final approval for publication.

• Acknowledgements

Please acknowledge anyone who contributed to the study but did not meet the authorship criteria.

• Funding statement - Please list the source of funding for each author.
I still think that the authors are using the terms ‘emotional contagion’ and ‘rapid mimicry’ uncritically. As an example they state that…“This process involves two steps. Firstly, the perception of others' expressive behaviour automatically induces the observer to mimic such behaviour. Secondly, the mimicry of the others' behaviour automatically induces the observer to share the emotional state underpinning such behaviour.” … suggesting mimicry leads to contagion. They then state that “...we expect that mimicry, if it is an expression of an emotional contagion phenomenon...” … suggesting contagion leads to mimicry. Personally, I feel that authors should select one of the terms and stick with it. No doubt contagion and mimicry are distinct concepts that may interact with each other. But each can also occur without the other. I refer the authors to Nakahashi, W., & Ohtsuki, H. (2015). When is emotional contagion adaptive? Journal of Theoretical Biology, 380, 480-488. For instance, “infectious crying among babies” likely does not involve mimicry and there are other instances in the animal literature (some of which are cited) where emotional contagion takes place without mimicry.

**ANSWER:** Thank you for your comments. We understood your concern and re-thought the conceptual framework. We used and cited the reference suggested and explained that the two phenomena "emotional contagion" and "mimicry" can occur independently but that they can also interact each other.

In this respect, the first part of the title is very confusing and frankly inappropriate.

**ANSWER:** We changed the title.

The relationship between contagion and mimicry would be better considered in a review-type article and certainly is not confirmed here. That being said, I still think the authors provide some quite interesting findings. The remaining comments are focused on the results:

The authors assessed 26 females and 23 males. Shouldn’t the overall N be an even number as all encounters were dyadic?

**ANSWER:** No, it is not important. Because we considered all possible playing dyads independently of the sex of the playmates (the variable SEX was included in the model, GLMM). For example, if we have 5 dogs who play (A,B,C,D,E) we consider a-b; a-c; a-d; a-e; b-c; b-d; b-e; c-d; c-e; d-e. So 5 N dogs but 10 dyads.

I don’t understand what is meant by “ties” in the statistical outcomes.

**ANSWER:** If you have two identical values in your dataset, these are called ties. Wilcoxon test takes ties into account when calculating the sum of ranks for statistical differences. We know that many authors omit to give the value of ties, but we think it is useful to better understand the statistical results.

Also, many of the N’s reported equal 21. Is this for the number of dogs included in the analysis after exclusions?
ANSWER: Yes, as we reported in the text, due to the high individual variability in performance of signals and in order to be conservative as much as possible, we restricted the analyses only to the subjects (n=21) who perceived at least two stimulus events per each condition.

Shouldn’t the N’s pertain to the number of behavioral exchanges, which would presumably be much higher?

ANSWER: We do prefer to analyse data at individual level because it is extremely important to take into account the strong individual variability, not emerging when performing analyses focussing on the events. Via an individual analysis we can have a clear and valuable overview on the real distribution of the phenomenon at group level.

The authors state “Play sessions always began and ended spontaneously because the owners never interfered or tried to interrupt the session.” The authors should describe where their observations were taken. I assumed it was some sort of dog-park.

ANSWER: "We collected data in a dog-park located in a public green area in Palermo"

If so, I find it highly unlikely that an owner never intervened.

ANSWER: We explained better in the text that we asked the owners not to intervene when animals were engaging in play. "Play sessions always began and ended spontaneously because the owners were asked to never interfere or try to interrupt the playful session. If an aggression occurred outside playful context, obviously the owner could freely interrupt the conflict. However, it is worth to note that we never observed any playful sessions escalating into serious aggression." On the other hand, aggression could occur outside playful context. When animals were engaging in other activities such as social assessment, sniffing each other, exploring the environment, ect.

“The kind of social relationships shared by dogs within each dyad was determined by interviewing each owner separately. We divided the quality of the social bond in three classes: “friends” (the dogs which lived together or regularly exchanged playful, affiliative, aggressive interactions - also exploring together the environment - at least three times per week)....”. Aggression is mentioned here with respect to how the authors categorized social bonds. It is also hard to believe that instances of aggression were not observed during the dyadic interactions.

ANSWER: Obviously aggression occurred but what we want to say is that we never observed conflicts during dyadic playful sessions. We never observed an escalation from play to aggression.

Would the authors please illustrate the data for Jump/Jump, Bite/Bite, Jump/PBow, and Bite/ROM in a figure, as they do in Figure 1 for the other combinations.

ANSWER: We added the figure as requested and the relative legend.
Figure 2. How are Bite and ROM significantly different with such a larger degree of overlap between the respective standard error bars?

**ANSWER:** The nonparametric statistical test, the only one we can apply due to the non normality of data, clearly gives this result. Anyway, you can check the original dataset submitted.

The authors state “In humans the observation of facial expressions activates, similarly to monkeys, not only shared motor representations in premotor and parietal areas but also in insular and cingulate cortices, being these latter directly involved in processing visceromotor sensations: a sort of same face-same emotion process [7-9].” The authors should also be careful with their citations. For instance, citation 8, a classic study by Tania Singer, does not involve facial mimicry at all.

**ANSWER:** We removed the citation.