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Relevance without existence: Experimenting on blind implicatures with empty domains

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The present paper presents experimental evidence confirming that contextually mismatching scalar implicatures can be generated even when quantifiers range over empty domains. In the literature, this possibility has been interpreted as providing further evidence for a grammatical approach to scalar implicatures. The main result presented here is that scalar sentences with empty domains are judged as more infelicitous when associated with a mismatching implicature than variants with the same empty domains but associated with a non-mismatching implicature. We interpret this result as suggesting that the infelicity judgment associated with the first kind of sentence stems from the cumulative effect of the mismatching implicature and the contextual domain emptiness. Compared to previous literature on blind implicatures, our results indicate that the body of knowledge involved in relevance assignments is restricted to ignoring existential determination while still considering the properties attributed to nonexistent entities. They also show that, while not blocking implicature generation, contextual domain emptiness plays a role in speakers' evaluation of scalar sentences, reflecting the unconscious nature of scalar implicature generation.

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1 Introduction

In the present paper, we discuss experimental results concerning the scalar sentences reported in (1)–(4).

- (1) Some Italians come from a windy city.
- (2) # Some Italians come from a warm country.
- (3) ? Some Italian kings come from a windy city.
- (4) ? Some Italian kings come from a warm country.

Recent research argues that the oddness of (2) is evidence for a grammatical approach to scalar implicatures because it reveals that a scalar implicature can also be derived if the result of the derivation is a contextual contradiction (cf. Magri 2009; 2011; 2016; cf. also Fox 2007; Chierchia et al. 2012). Scalar implicatures give rise to the negation of excludable alternatives; in Magri’s account, it is assumed that alternatives are negated only if relevant and that relevance is assigned to alternatives through an assignment procedure constrained by two (“grammatical”, Magri 2009: 262) axioms. The first of such axioms imposes that the prejacent proposition is always relevant, while the second imposes that whenever a proposition is contextually equivalent to an already relevant proposition, it will also count as relevant. But now note that, given the piece of contextual information that Italians come from the same country, the universal alternative to (2), that is *All Italians come from a warm country*, is equivalent to the prejacent *Some Italians come from a warm country*, which already counts as relevant for the first axiom. Since relevant alternatives are assumed to be negated obligatorily, the account thus shows that the derivation of the conflicting scalar implicature is forced in this case. The oddness asymmetry observed with the felicitous (1) is due to the fact that the potential scalar implicature would not generate a contradiction in this latter case – it could very well be the case that only some Italians come from a windy city. Following the convention adopted in the literature, the odd sentences are marked by a hashtag as in (2).

In other recent research, it is proposed that the oddness of (4) is also evidence for a grammatical approach to scalar implicatures because it reveals that a contradictory scalar implicature can be derived including when quantifiers range over contextually empty domains (cf. Pistoia-Reda 2017; cf. also Magri 2017; Pistoia-Reda 2019; Del Pinal 2021 for discussion). The oddness of (4) raises, however, a puzzle. In order to assume that the universal alternative, that is *All Italian kings come from a warm country*, is relevant and therefore subject to obligatory negation, one has to admit that the mechanism accesses the piece of contextual information that all Italians (irrespective of their occupation or social status) come from the same country, without also accessing the piece of contextual information that Italian kings do not presently exist. If the mechanism accessed the latter piece of information, the universal alternative would come out as true while the

prejacent proposition would come out as false – and we would have no equivalence to ensure the relevance assignment. The most plausible explanation for this puzzling behavior might be that the body of knowledge involved in the relevance assignment process is restricted to ignore existential determination while still considering the properties attributed to nonexistent entities. Allowing for the derivation of an obligatory conflicting implicature in the case of (4) provides a straightforward explanation for the observed asymmetry in oddness with (3), which is perceived as more acceptable: although (3) and (4) involve quantifiers that range over the same set of actual nonexistent entities, (3) can be associated with a non-contradictory scalar implicature. Sentences with questionable acceptability, such as (3) and (4), are marked with a question mark.

Since the judgements about (3) and (4) reported in Pistoia-Reda's discussion were based on pure introspection, the implicature-based account of (4)'s oddness requires further investigation from an empirical point of view, i.e., through a controlled experiment. This is what we contribute in the present paper. In particular, we provide experimental evidence supporting the greater perceived oddness of (4) with respect to (3) – and with respect to (2). We interpret this result as confirming that a mismatching scalar implicature can also be generated when quantifiers range over empty domains; more precisely, we suggest that the infelicity judgment associated with our target sentence (4) stems from the cumulative effect of the mismatching implicature plus the emptiness of the domain.

One of the main challenges in testing empty domains is the fact that domain shifting and encyclopedic knowledge can, in principle, enable speakers to avoid domain emptiness. To give some examples, while, in fact, no king reigns over Italy at present, this information is only available if one knows that Italy is a republic. In addition, even if one knows that Italy is currently a republic, one may have reasons to refer to exiled descendants of old monarchs as Italian kings. Moreover, various figurative modulations are also conceivable such that, for instance, an Italian king is a world-famous opera singer or an autocratic political leader. Consequently, to make sure that speakers generate the implicature while indeed knowing that domains are empty, we need to develop a methodology that blocks or at least minimizes such reinterpretation strategies. A viable solution explored in this paper is to resort to controlled toy scenarios populated with geometric figures in which all the relevant properties are declared at the outset. This move aims at defining the non-existence of given entities (e.g., big squares) regardless of variations in the subjects' encyclopedic knowledge, thus ensuring that implicatures are indeed computed with empty domains.

The paper is organized as follows. In section 2, we present the experimental procedure and its results. In section 3, we discuss the results against the background of the literature on blind implicatures. In section 4, we conclude.

2 The experiment

Here, we provide a description of the scenarios we used as a context for our target sentences. A toy universe of different geometric figures was designed; each scenario was a realization of such a universe, the same as a possible world is a realization of the set of all possible worlds. In the universe, the geometric figures were characterized and varied on the basis of three different properties: color (there could be red squares, green triangles and so forth), size (there could be small green triangles and big green triangles, small red squares and so forth) and what we called ‘dottness’ (figures could have a dot drawn inside them).

The homogeneity of such properties was controlled. The color was always homogeneous in that in all scenarios, for each shape, we had only one color (e.g., red squares only). Size, on the other hand, was homogeneous only in the Target Scenario below, which we used to introduce our experimental conditions. In such a scenario, all the geometric figures were represented as being small (e.g., small squares only). Finally, ‘dottness’ was always not homogeneous, in that in all scenarios only some of the geometric figures had a dot drawn inside of them (e.g., squares with and without a dot).

The Target Scenario thus allowed us to reproduce configurations similar to the ‘Italian kings’ sentences since talking about big squares in that scenario was similar to talking about Italian kings against actual contextual knowledge. It also allowed us to reproduce the computation with Italians coming from the same country since talking about squares being red in that scenario was similar to talking about Italians coming from a warm country – all figures in the universe are homogeneous with respect to color. Finally, talking about squares having a dot drawn inside of them was like talking about Italians coming from a windy city since the property of dottness was non-homogeneous. To make participants aware of the fact that size was homogeneous only in the Target scenario, we contrasted it to an equal number of Context Scenarios in which size was variable. Therefore, “big triangles” do not generate an empty domain in the Context scenario. In the Target Scenario, instead, the existence of “big squares” is excluded based on both the instructions provided within the warm-up and on the visual display. Examples of the two relevant scenarios are given in **Figure 1**.

The sentences provided in the Target Scenario would mimic the relevant examples taken from the literature; in other words, we can assume that sentence (4) is equivalent in our experimental

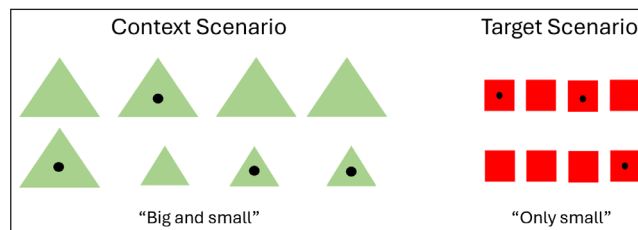


Figure 1: Examples of the scenarios used in the experiment. In the Context Scenario, size was not homogeneous, thus both small and big triangles existed. In the Target Scenario, size was homogeneous, so only small squares existed.

setting to *Some big squares are red*, whereas sentence (3) is equivalent to *Some big squares have a dot*. In the Target Scenario, we could also reproduce the examples in which there is no domain emptiness. Sentence (2) is equivalent to *Some small squares are red* as both are associated with a mismatching implicature. Sentence (1) is equivalent to *Some small squares have a dot* as neither is associated with a mismatching implicature. The conditions are summarized in **Table 1**, together with the predictions about their perceived acceptability drawn from the literature.

C(ondition)	Empty Domain	Mismatching SI	Target Sentences	Expected Acceptability
C1	–	–	Some small squares have a dot	Fully appropriate
C2	–	+	Some small squares are red	<u>Mismatching SI</u> : degraded
C3	+	–	Some big squares have a dot	<u>Empty Domain</u> : degraded
C4	+	+	Some big squares are red	<u>Empty Domain & Mismatching SI</u> : More degraded than C3 if SI is computed.

Table 1: Target sentences with expectations.

The first condition C1 is expected to be fully felicitous in the Target Scenario. The second C2 condition and third condition C3 are expected to be associated with an infelicity effect either due to a mismatching implicature in C2 or due to domain emptiness in C3. One question concerning these two conditions is whether the infelicity effects produced will be quantitatively similar. The fourth condition C4, which is also expected to sound infelicitous, directly addresses our research question, namely whether a mismatching implicature can be generated including when quantifiers range over empty domains. We expect this condition to be infelicitous, but we want to test whether the effect is the same as that observed in C3, as one should indeed expect if no mismatching implicature can be generated with empty domains. Alternatively, since domain emptiness also produces an infelicity effect, if the mismatching implicature can be generated, a cumulative effect should be expected, as in this condition we have both domain emptiness and a mismatching implicature.

2.1 Method

We adopted a 2*2 within-subject design, manipulating two factors: Domain (empty, nonempty) and Scalar Implicature (match, mismatch). The four experimental conditions are presented in **Table 1**. Subjects were asked to judge sentences in the four conditions using a 7-point Likert scale.

2.2 Participants

The participants were 25 adult Italian native speakers, 25–60 years old (mean age: 31 years). The experiment was conducted in the lab of Experimental Linguistics at the University of Siena.

2.3 Materials and Procedure

The participants were told that they had to play a game with geometric figures. They had to rate the sentences that described the Context and Target Scenarios, in which the following three properties held:

- i. Homogeneous property: Figures of the same shape are of the same color.
- ii. Non-homogeneous property: Some figures have a dot, others do not.
- iii. A variable property across scenarios. In some scenarios, all the figures have the same small size (homogeneous property: leading to an empty domain in the Target scenario); in other scenarios, figures may vary in size and can be big and small (non-homogeneous: Context Scenario).

The experiment included a preliminary familiarization procedure in which the participants were explicitly instructed about the three rules. They were reported on the screen together with a corresponding visual example: the property of color was represented by coloring the same figures in the same color; the property of dottiness was represented by placing big dark dots randomly inside some of the figures; to ensure that participants understood the differences in sizes expressed by “big” and “small”, the scale was drawn on the left of the figures. **Figure 2** illustrates the familiarization procedure.

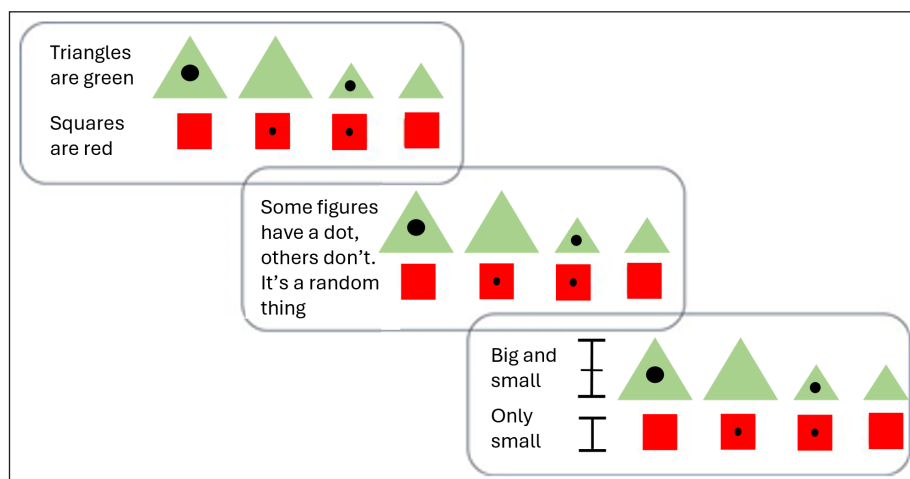


Figure 2: Visual examples illustrating the properties of the entities in the experimental scenarios.

After this preliminary part, two scenarios of each kind followed in order to familiarize participants with the procedure and train them to recognize the properties of the figures. Once the familiarization was over, the instructions coupled with the visual aids were repeated, including the description of the properties the figures could have, i.e., size, color and dottness. After the instructions, the main experiment began.

In both familiarization and experiment rounds, the image appeared first and then the sentences were presented in two chunks: the subject and successively the predicate. The participants used the space key to move forward, and the two chunks appeared one after another below the image that stayed on the screen. After one read the second chunk and pressed space, the sentence disappeared from the screen, whereas the image remained. Under the image, the 7-point Likert scale appeared with 1 as the least and 7 as the most appropriate. The order of the stimuli presentation is illustrated in **Figure 3**. The participants were asked how appropriate the sentence was as a description of the image.

The participants had to judge 8 sentences in each scenario. Of these, in the Target Scenario, 4 belonged to the experimental conditions, whereas the other 4 were fillers without the scalar items (e.g., *Small squares could have a dot*). There were 4 Target Scenarios so we collected a total of 16 judgments for each participant, 4 in each condition in **Table 1**. The 4 target scenarios were interspersed with 4 Context Scenarios and the sentences appeared in random order.

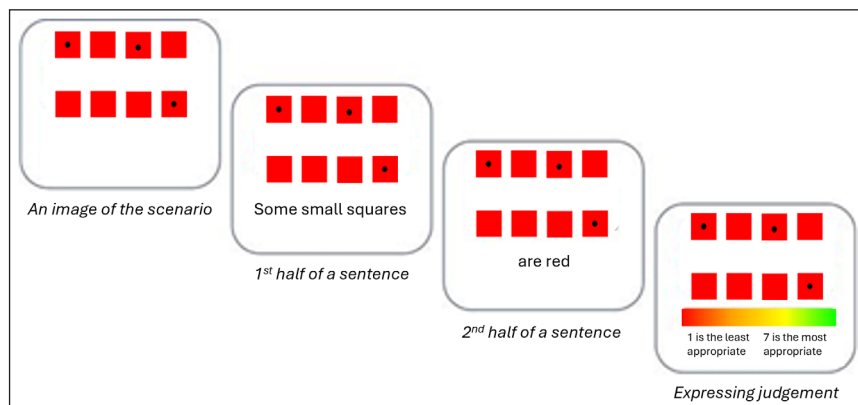


Figure 3: Target Scenario (stimulus) presentation.

2.4 Results

Figure 4 reports the mean rating of sentences in the four experimental conditions. In Condition 1, the one in which domains were nonempty and no mismatching implicature arose (e.g., *Some small squares have a dot*), judgments were almost at ceiling (C1, Mean = 6.8). Conversely, in Condition 2, in which domains were nonempty but a mismatching implicature arose (e.g.,

Some small squares are red), sentences received a much lower rating (C2, Mean = 2.8). This degradation is arguably due to the effect of the mismatching implicature.

We now turn to the sentences in which there was an empty domain. The judgments confirmed their overall infelicity. However, a difference also emerged with respect to the mismatching implicature in the predicate. When the domain was empty in isolation, without a mismatching implicature (e.g., *Some big squares have a dot*), the mean rating (C3, Mean = 3.3) was higher than when it was combined with a mismatching implicature (e.g., *Some big squares are red*) (C4, Mean = 2.0). Notably, sentences in this latter condition received the lowest rating.

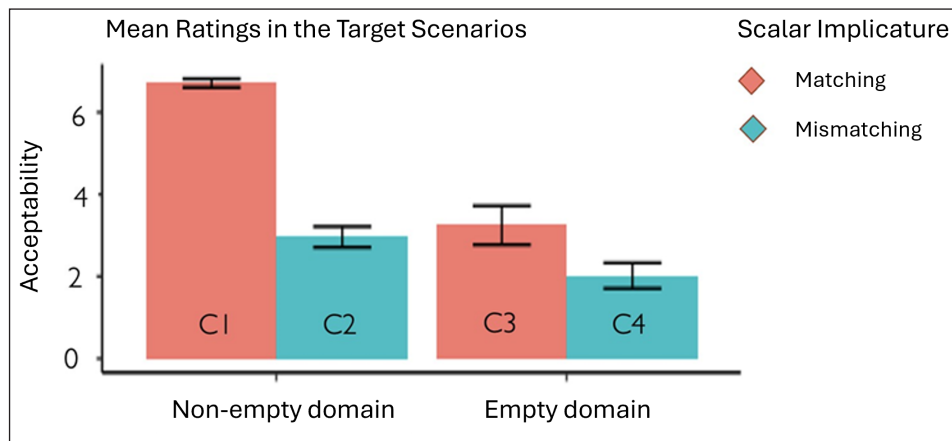


Figure 4: Mean ratings of sentences in the experimental conditions. Error judgments = 2* S.E.

We ran a Generalized linear mixed-effect model (glmer) to assess the effects of our two predictors and their interaction: Empty Domain and Mismatching Implicature. The model (Table 2) revealed the main effects of domain emptiness and mismatching scalar implicature. Moreover, their interaction was also significant, indicating that the degradation introduced by the computation of a mismatching scalar implicature was significant, at least for conditions C1 and C2 with nonempty domains.

Fixed effects	SE	Wald's z	P-value
Domain	0.07	10.85	p < 0.001
S.I.	0.09	-5.3	p < 0.001
D*S.I.	0.11	-3.64	p < 0.001

Table 2: Fixed effects of domain emptiness, mismatching SI, and their interaction.

To verify whether the degradation due to the mismatching implicature was significant in C4 with respect to C3, which are the two conditions with empty domains, the Tukey HSD pairwise comparison was run. It revealed that judgments in C4 were significantly lower than in C3 ($p < 0.001$), confirming the significant difference between the two conditions with empty domains.

3 Discussion

The present experiment provides the first empirical measurement of oddness in scalar implicatures. As a preliminary observation, the contrast in acceptability between C1 and C2 (i.e., representing Magrian oddness) replicates the much-discussed oddness effect of mismatching scalar implicatures, indicating that the task and the toy scenarios we introduced successfully replicated real-world judgments.

Turning to our research question, namely the possible generation of a contradictory scalar implicature when quantifiers range over empty domains, the difference in acceptability between C3 and C4 suggests that the oddness effect of a contradictory scalar implicature is indeed also observable with empty restrictors once the scenario is experimentally controlled. This provides empirical support to the introspective judgment reported in Pistoia-Reda (2017) and to the claim that the computation of an implicature is possible when the restrictors of quantifiers are contextually known to be empty. As in ecological environments, we are aware that it is perhaps impossible to completely exclude that subjects could accommodate empty domains by switching to interpretations where “Italian kings” or “big red squares” could be imagined. Our design aimed at replicating the pattern of graded judgments through a controlled environment that excludes or at least minimizes re-interpretation strategies.

Before we conclude, we would like to focus a bit more on the general implications of our experiment for the theory of scalar implicature. Let us first discuss how mismatching alternatives (i.e., alternatives whose negation gives rise to a contextual contradiction) are made available for negation. Recall that in Magri’s proposal, scalar alternatives are negated only if relevant and, if relevant, they are negated obligatorily. The crucial observation is that sometimes relevance can be imposed on scalar alternatives via two linguistically driven relevance axioms. According to the first axiom, the prejacent proposition is automatically relevant, being the object of an utterance. According to the second axiom, if two propositions are contextually equivalent, and one of them is relevant, the other one is relevant as well. It can be shown – and Magri indeed shows – that this relevance assignment mechanism imposes relevance and thus induces the obligatory negation of the mismatching alternatives in the case of (2), which here we reproduced as the second condition of the experiment.

Pistoia-Reda (2017) submits that in the case of (4), relevance is imposed through a similar procedure. The mismatching alternative *All Italian kings come from a warm country* is assigned

relevance and therefore obligatorily negated because it is equivalent to the prejacent *Some Italian kings come from a warm country*, which is relevant based on the first axiom. Note that to derive the desired equivalence relation, the scalar implicature mechanism must be blind to the piece of information that domains are contextually empty, as otherwise, the universal alternative would count as true, and the existential prejacent would count as false. But, at the same time, the mechanism needs access to the contextual information that all Italians come from the same country, irrespective of their occupation or social status, as otherwise, there would be no reason to expect that the two propositions have the same truth-value, even with nonempty domains. A possible solution we would like to suggest involves assuming that quantifiers in scalar implicatures range over what we might define as Meinongian objects, i.e., nonexistent entities endowed with properties.¹

A second important implication of our experiment is that contextual domain emptiness, while being irrelevant for (and therefore not blocking) the generation of the scalar implicature, certainly plays a role in speakers' evaluation of sentences. This is demonstrated by our reported result that cases like (3) involving empty domains are not as natural as their variants in (1) involving nonempty domains, and that cases like (4) involving a contradictory implicature and empty domains are judged as even less acceptable than their variants in (2) involving a contradictory implicature and nonempty domains, which presumably reveals the presence in (4) of a cumulative effect between the contradiction and precisely the contextual domain emptiness. More generally, we take these facts as suggesting that the body of knowledge against which scalar implicatures are generated is not the same as the body of knowledge against which speakers concretely evaluate scalar sentences, and thus as possibly confirming the unconscious ("automatic", Magri 2011, p. 13) nature of the scalar implicature mechanism.

¹ In this regard, note that a fundamental principle of a Meinongian natural language ontology (cf. Moltmann 2020; cf. also Priest 2016) is the neat separation between the properties that an object is described as having (this is Meinong's Characterization Principle) and its existence: "the *Sosein* ['suchness'] of an object is not affected by its *Nichtsein* ['non-being']". The fact is sufficiently important to be explicitly formulated as the principle of the independence of *Sosein* from *Sein* ['being'] [...]. The principle applies not only to Objects which do not exist in fact but also to Objects which could not exist because they are impossible. Not only is the much-heralded gold mountain made of gold, but the round square is as surely round as it is square" (Meinong 1981: 20). Therefore, just as Spanish matadors are Spanish, and round squares are round, Italian kings can be assumed to be Italian on this view; if one further assumes—as seems reasonable—that the principle extends to also include that any object has the properties entailed by the properties it is described as having, then the desired conclusion can be drawn that Italian kings, while not existing, come from the same country (cf. Mally 1904 and Routley 2018 for further discussion). It is important to emphasize, however, as noted by an anonymous reviewer, that nothing in principle excludes an explanation based on domain shifting rather than existential indifference, where speakers move to the closest worlds in which the domain is nonempty. One possible way to choose between the two alternative explanations is to check whether scalar implicatures are also generated with quantifiers ranging over impossible objects (as in *Some female Italian kings come from a warm country*), but we have no data on these kinds of examples at the moment and thus cannot comment.

4 Conclusion

In this paper, we provided experimental evidence for contextually mismatching implicatures being generated including when quantifiers range over empty domains. The main challenge to establishing this result was to exclude that the observed oddness in cases like (4) is just due to the contextual domain emptiness. What we observed in the experiment, however, was that conditions associated both with a mismatching implicature and with contextual domain emptiness are consistently judged to be less appropriate than conditions associated with a compatible implicature and contextual domain emptiness. We then concluded that in our target cases, a cumulative oddness effect obtains, showing that mismatching implicatures are possible with domain emptiness. After presenting the experiment, we briefly discussed its general implications for the theory of scalar implicature. We suggested that our results might constitute evidence that quantifiers in scalar implicature range over what we defined as Meinongian objects, that is, nonexistent entities endowed with properties. We also observed that our results would seem to require a sharp division between the (linguistically driven) level of implicature computation and the (contextually driven) level of the evaluation of sentences. Contextual domain emptiness was shown to be irrelevant for implicature generation but to contribute to the oddness effect observed in speakers' judgments, which could be taken as further evidence of the unconscious nature of scalar implicatures.

Data Accessibility Statement

Experimental materials and data can be found on OSF: https://osf.io/g5rnt/?view_only=7c01a9934a8e456da94af661b66581de

Ethics and Consent

The study was reviewed and approved by the Ethics Committee for Research in the Human and Social Sciences (CAREUS) at the University of Siena where the experiment was conducted. All participants provided their informed consent to participate in this study.

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Competing interests

The authors have no competing interests to declare.

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