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The relationship of counterfactual reasoning and false belief understanding: the role of prediction and explanation tasks

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The relation between the prediction and explanation of the false belief task (FBT) with counterfactual reasoning (CFR) was explored. Fifty eight 3-5 year-olds received a prediction or an explanation FBT, a belief attribution task and some counterfactual questions of increasing difficulty. Linguistic comprehension was also controlled. CFR highly predicted FBT in the explanation version but not in the prediction one. Additionally, results in the explanation version indicate that CFR underlies achievements prior to the understanding of the representational mind and stimulates the explicitness of the mental domain. This study identifies the conditions under which CFR becomes a fundamental cognitive tool for social cognition. The results obtained contribute to the dialog between the two major theoretical approaches: theory-theory and simulation theory.

The "Theory of Mind" (ToM onwards, Carpendale & Lewis, 2015) refers in a general sense to the ability to represent ourselves and others as having mental states. From the beginning, the research in ToM has been focused mainly on the child's comprehension of the belief, particularly, of the false belief (FB, onwards) itself. The False Belief Task (FBT, Wimmer & Perner, 1983) has become a paradigmatic research method in ToM. This task evaluates a child's ability to discover another's mistaken beliefs and thereby make accurate behavioural predictions derived from these very beliefs. What underlies child performance on the FBT? Is it a matter of reasoning? Specifically, is it a matter of counterfactual reasoning (CFR, onwards)? This is the main goal of the study.

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Two theories have traditionally explained performance in mindreading tasks: the "theory-theory" (T-T) perspective (see Gopnik & Wellman, 1994, 2012; Wellman, 1990) and the simulation theory (ST, see Goldman, 2006, 2012). According to the first perspective, solving FBT presumes a developed theory of mind that includes an understanding of mental representations. Consequently, as the child acquires a representational theory of the mind, he is able to perform the FBT successfully. For ST, the mental simulation is the primary process of theory of mind. Mental experiences attributed to the other does not require constructs, inferences or a theory connecting mind and behaviour, as is the case with the T-T. ST implies all minds function at a basic level in the same way, and that we exploit our mental similarity with the others in order to understand them (Doherty, 2009). For example, if I discover my neighbour has been diagnosed with a serious illness, by adopting myself as a model I can simulate I have been given such news and imagine emotions, feelings and worries in myself. Then, I extrapolate them to my neighbour. By contrast, according to T-T, my knowledge about what being seriously ill means in psychological terms such as emotions, thoughts and its relation to behavior will guide my understanding of the situation.

The mental simulations represent alternative versions of the present reality and can be considered the foundation of the imagination (Wong, Galinski & Kray, 2009). Besides, such mental simulations usually constitute conditional propositions that specify an antecedent and a consequent. And in most cases, mental simulations include some mutation of an antecedent that entails a result quite different from the reality (Carroll & Shepperd, 2009). This definition of mental simulation has a lot in common with the definition of a counterfactual (Byrne, 2016), that is, causal conditional structures characterized by the falsity of their antecedent, referring to past or present acts and, in any case, contrary to current events. Actually, simulation underlies capacities for CFR and counterfactuals are incardinated in the broader context of the mental simulations, so that counterfactuals activate a *mental simulation mind-set* (Wong et al., 2009) consisting of producing alternatives. In sum, counterfactuals constitute a form of mental simulation (Epstude, Scholl & Roese, 2016) in that they are linked to the real world (Rafetseder, Schwitalla & Perner, 2013) while still referring to alternative "imagined" worlds that might have happened in place of the current one (Beck, Robinson, Carroll & Apperly, 2006). Counterfactuality in childhood is a topic of interest today and children themselves show "counterfactual curiosity" (FitzGibbon, Moll, Carboni, Lee & Dehghani, 2019). Take one example of the negative emotion a child experiences when it must give up playing in the sandbox because it has begun raining. The child is aware that, if it were not raining (counterfactual antecedent), he would be playing in the sandbox (counterfactual consequent). Or consider a young man who drove an alternative route to work to fill up his car, and arrived punctually to find out that a traffic accident on his usual route led to serious delays. This may incline him to think that had he taken his usual route (counterfactual antecedent), he would not have arrived on time (counterfactual consequent).

FB and CFR tasks share cognitive processes and have potential commonalities (Ferguson, Scheepers & Sanford, 2010) such that involve the simulation of an alternative state of affairs (Van Hoeck, Watson & Barbey, 2015). Accordingly, CFR could be important in testing the ST: “if the simulation account of how we process belief is right, it should also shed light on closely related abilities. One of them is counterfactual reasoning. It is surprisingly easy to transform an unexpected transfer test of false belief into a test of counterfactual reasoning” (Mitchell, Currie & Ziegler, 2009, p. 528). The so-called "counterfactual hypothesis” (see Harris, 1992; Harris & Leevers, 2000) states that CFR underlies the FB. Successfully solving the FBT would require the ability to think about and describe counterfactual substitutes for current reality. Fully in line with this hypothesis, the “modified derivation hypothesis” (Peterson & Riggs, 1999) consists of a process of knowledge-base adaption used to simulate the epistemic perspective of another person as part of a general imaginative reasoning ability. Let us think about the story of Maxi (Wimmer & Perner, 1983)[1] . A successful process of modified derivation requires that one’s working knowledge temporarily adapt to the epistemic situation of the other, a process that necessitates ignoring a fact (an event the other is unaware of, in this case the changed location of the chocolate) in order to simulate and accommodate the other´s point of view. It is from this temporal modification in one’s knowledge base that one can conclude—derive—an answer that indeed reflects the other’s false belief (i.e., that Maxi believes the chocolate is still where he last saw it). The process of modified derivation comes to life counterfactually insofar as a known fact in one’s knowledge base (factual situation) is ignored, while a false belief (counterfactual situation) is supported as truth and from which an answer is derived. Indeed, the reasoning process Peterson and Riggs delineate to explain FBT is identical to what would be required to explicitly convert

[1] “Mother returns from her shopping trip. She bought chocolate for a cake. Maxi may help her put away the things. He asks her: ‘Where should I put the chocolate?’ ‘In the blue cupboard’, says the mother. ‘Wait I´ll lift you up there, because you are too small’. Mother lifts him up. Maxi puts the chocolate into the blue cupboard …. Maxi remembers exactly where he put the chocolate so that he could come back and get some later. He loves chocolate. Then he leaves for the playground …. Mother starts to prepare the cake and takes the chocolate out of the blue but into the green cupboard …. Now she realizes that she forgot to buy eggs. So she goes to her neighbour for some eggs. There comes Maxi back from the playground, hungry, and he wants to get some chocolate …. He still remembers where he had put the chocolate. [BELIEF-question] ‘Where will Maxi look for the chocolate?’” (p. 109).

Maxi's task itself into one of CFR: If Mummy had not baked a cake, where would the chocolate be?"

Ultimately, if CFR is involved in mindreading, this could reveal that any progress in a child's mindreading capacity is a question of a simple activity related to the imagination, and to mental simulation, i.e., CFR. Its theoretical importance is such that a developmental link between CFR and the FBT would support ST to a greater extent than the T-T (Perner, Sprung & Steinkogler, 2004). Although it seems evident that "theory theory has no natural place for counterfactual reasoning" (Rafetseder & Perner, 2018, p. 119), it is highly doubtful to affirm that "neither theory theory nor simulation theory motivates the need for counterfactual reasoning in general" (íbid.). So is theory of mind a special case of counterfactual thinking (Riggs, Peterson, Robinson & Mitchell, 1998)? A number of studies in the context of preschool years (see, for instance, Rasga, Quelhas & Byrne, 2016; Riggs et al. 1998) confirm, with uneven forcefulness, the relationship between CFR and FB. Additionally, from a neuro-imaging perspective, the FBT and CFR activate similar brain areas (Van Hoeck et al., 2014) and engage processes supporting mental simulations. However, others studies (see German & Nichols, 2003; Perner et al., 2004) report a weak confirmation, contradictory, or results even at odds with the counterfactual hypothesis. Age, language, and the complexity level of the counterfactual tasks partially explain these discrepancies (see German & Nichols, 2003; Guajardo, Parker & Turley-Ames, 2009).

There exists a developmental dissociation between FBT and CFR. That is to say, understanding false belief is more difficult than CFR tasks (see German & Nichols, 2003; Müller, Miller, Michalczyk & Karapinka, 2007; Perner et al., 2004; Riggs et al., 1998). It may be logical to suggest that CFR arises first in a general sense (Harris, 1992), and that only later this type of reasoning, as "a domain-general condition" (Müller et al., 2007, p. 629) is applied to more abstract concepts, such as mental states (Guajardo & Turley-Ames, 2004; Riggs et al., 1998). In fact, the traditional evaluation of ToM and CFR involves the mental state element in the first one but not in the latter (except in some cases, see Guajardo et al., 2009; Rasga et al., 2016), such that the ToM task would require extra cognitive processes in comparison to CFR (Ferguson et al., 2010), that is, reasoning about physical facts seems to be easier than mental ones. Nevertheless, Rasga et al's. (2016) results disconfirmed this interpretation and Guajardo et al. (2009) found counterfactuals about physical events accounted for more variance in false belief than did counterfactuals about mental events. Moreover, these results indicate that the content - psychological or physical - of the CFR tasks is probably not a core element in explaining the FB-CFR relation.

Analyzing the FB-CFR relationship as a function of the version used in the FBT (prediction vs. explanation) is worthy. Traditionally, FBT has adopted a format of prediction, that is to say, the child is asked to predict a character's action from his beliefs and desires. On the other hand, in the explanation version, the child apparently finds a particular course of action taken by another character contradictory or anomalous (e.g. a doll looks for a marble in the wrong location). This is because the child is guided by a false belief (e.g. he actually believes the marble to be in the wrong location). The child is then asked to explain the reason for having looked in that location. The explanation version has been used less than that of prediction, despite the fact that over the last few years, various authors have been claiming the importance of the child's capacity to explain human actions (see Atance, Metcalf, Martín-Ordas & Walker, 2014; Wellman, 2011; Legare & Clegg, 2015). In any case, an explicit comparison of both versions — prediction and explanation — has generated interest concerning the extent to which prediction and explanation may follow different developmental paths (Bartsch, 1998). In general terms, research in this field shows that explanation precedes the prediction in the acquisition of mentalist capacities, showing an "explanation advantage" (see Peterson & Wellman, 2019). Prediction seems cognitively more demanding than explanation and the former might not be a measure of child social cognition as sensitive as the latter. Why? In the explanation, "there are more clues to the content of the false belief (…) the belief can be read off the behavior" (Robinson & Mitchell, 1995, p. 1023). In this regard, the explanation could thus provide a window into child reasoning and reflect how children develop the nascent understanding of the belief to a greater extent than the prediction one (Bartsch, Campbell & Troseth, 2007). In the context of FB tasks, while children in a developmental transitional stage between desire-focused and belief-focused psychology fail to predict the action, they are nevertheless able to elicit false belief explanations (Bartsch et al., 2007). Moreover, employing explanation might help combat the risk emphasized by some authors (see Banerjee, Watling & Caputi, 2011; Clements, Rustin & McCallum, 2000) of interpreting the acquisition of mental states in all-or-nothing terms. In fact, requesting explanations might constitute a scaffolding procedure (Astington, 2003) consistent with the predictions of Vygotskyan theory applied to ToM (Guajardo, Petersen & Marshall, 2013) and as such in line with the results obtained in studies focused on the training of explanation (see, for instance, Amsterlaw & Wellman, 2006; Guajardo et al., 2013). By using explanation, the understanding of false belief has actually been shown by various microgenetic studies to develop gradually (see Amsterlaw & Wellman, 2006; Flynn, 2006; Flynn, O´Malley & Wood, 2004; Wellman, 2016), that is, explanation enables a higher level of ontogenetic resolution. In sum, in order to analyze mechanisms involved in understanding false belief (e.g. CFR), the use of the explanation version — above and beyond the prediction one — might be necessary in view of its potential ability to reflect the nascent understanding of the belief.

Very importantly, when children are asked to explain the other´s behavior - the paradoxical action in the FBT - they have to make sense of the event (Guajardo et al., 2013) and make a causal analysis of the situation, which might be a core point of intersection in both FB-explanation and CFR tasks. Taking CFR into account is definitely linked to causal analysis (see Buchsbaum, Bridgers, Weisberg & Gopnik, 2012). In explaining behavior, the child might simulate the character´s epistemic perspective by developing a course of counterfactual reasoning (see Hilton, 2007, p. 249) that would allow him to "make sense" of the behavior, or more generally, to equip himself with an explanation of our world (Legrenzi, 2007). Therefore, CFR might be the basic mechanism underlying the child's growing ability to understand mind evaluated through sensitive tasks (that is, explanation). This is the main aim of our study.

To date, the FB-CFR relationship as a function of the version used in the FBT (prediction vs. explanation) has not been addressed in an explicit and intentional way. This study examines this issue from a quasi-microgenetic perspective. We used an original and genuinely developmental evaluation, sensitive to child competence levels in CFR and FB understanding through our design and coding of the tasks. Thus, with respect to the ToM evaluation, we employed an unexpected location task and employed aids that can be considered to probably act in the Zone of Proximal Development (ZPD) of child social cognition. We used a criterion that consisted of validating the FBT scoring only if the child demonstrated an explicit understanding of false belief through a belief attribution task (BAT, see Atance, Metcalf & Zuijwijk, 2012, for a similar use of such criterion), either at the same time the child successfully solved the FBT or later, specifically after presenting one or two aids which made it easier for him or her to generate the false belief. This criterion was created in order to differentiate real mental responses from others more distant from an imminent understanding of the representational mind (Perner, 1991), that is, generated via other means, e.g. perceptual access reasoning (see Hedger & Fabricius, 2011). This criterion is itself developmental and guarantees that a correct response in the FBT is based on either an explicit understanding of false belief already achieved, or such explicit understanding is in progress by means of our aids. In this latter case, functioning that is initially slightly implicit might have been at work here (see Couchman et al., 2012; Rhodes & Brandon, 2014)[2] .

With respect to the evaluation of CFR, German and Nichols (2003) employed counterfactual questions requiring the elaboration of inferences of various lengths[3]. By using a between-participants design, they found that children completed the counterfactual tasks with short inference lengths better than with medium or long lengths. Other studies (e.g. Beck, Riggs & Gorniak, 2009, 2010), however, were unable to replicate German and Nichols´ results using a within-participants design, which would have strengthened the comparisons between counterfactual measures (Beck et al., 2009). In other words, perhaps asking a child think counterfactually introduces him into a counterfactual *mind-set*, which in turn may have homogenized his performance in tasks having different difficulty levels. From this perspective, an initial counterfactual activity could facilitate another later and theoretically more difficult (longer-chain) demand of CFR. Accordingly, we adopted a fine and potential assessment of child counterfactual competence by using a within-participants design with questions of increasing difficulty with regard to the length of the causal chain. That is, we employed a gradualist evaluation of CFR, in which each counterfactual question was a departure point or "facilitator" for the next one such that responses to the following ones were somehow scaffolded.

Traditionally, research has calculated the success or failure in child counterfactual performance only in a dichotomous manner, attending exclusively to the initial responses not requiring justification. These responses might not necessarily constitute false positives (Beck & Riggs, 2014) but may constitute a more implicit measure of CFR (Weisberg & Gopnik, 2016). On the contrary, a sign of counterfactual maturity implies not only a level of spontaneity, but also a minimal ability to justify the

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[2] We are not interested in BAT itself but in its relationship to FBT, which is focused on the prediction/explanation of action. Our interest is located on the children´s ability to employ ToM in the real world (Hughes, 2011; Samson & Apperly, 2010). In this line, we employed BAT as a control measure of the understanding of the representational mind.

[3] One of the two stories created describes the emotional positive state of a woman after planting a new flower in her garden. Upon calling her husband to have a look, the dog escaped, ran around the garden, jumped on the flower and squashed it, causing quite a sadness in the woman. From this story, counterfactual consequent questions were posed. The answers to these counterfactual questions require the elaboration of counterfactual inferences from causal chains of different lengths. While in some cases, the questions required the inhibition of practically all one knew about the events in the story ("What if Mrs. Rosy hadn´t called her husband, would Mrs. Rosy be happy or sad?") -long chain inferences-, in other cases, the counterfactual questions required reasoning from a point more towards the end of the story, making one ignore fewer factual elements ("What if the dog had not escaped from the house, would Mrs. Rosy be happy or sad?"—a medium chain inference; "What if the dog had not squashed the flower, would Mrs. Rosy be happy or sad?"—a short chain inference).

counterfactual responses, which notes a degree of conscience about the cognitive process deployed. In fact, research indicates that metacognitive experiences must not be misunderstood if we want to understand counterfactual imagination (see Sanna, 2007). In our study, we validated the scoring assigned to a correct counterfactual response only if child offered a minimally correct justification (see method).

Lastly, some authors (see German & Nichols, 2003) maintain the advantage of using different scenarios for FB and CFR tasks, because of the dangers of similarities at a superficial level. However, the use of the diverse scenarios could be more of a disadvantage. In this sense, if modified derivation is indeed the mechanism responsible for FBT and CFR, it is fitting to combine both tasks using a common scenario and which make use of the same demands required of modified derivation (Perner et al., 2004). We employed a design of the FB and CFR tasks including the same scenario as employed by other authors (see, for instance, Rafetseder & Perner, 2018).

In this theoretical context, we hypothesize that CFR underlies the FBT, specifically, it does in the child´s growing ability to understand mind evaluated through explanation tasks. Therefore, we predict that, on the one hand, counterfactual hypothesis will be confirmed in the explanation version especially. On the other hand, CFR will underlie the child´s progresses in understanding of belief, that is, when either a totally representational understanding is not yet achieved, or such an understanding of belief is mediated by the aids facilitated.

METHOD

Participants. Fifty-eight 3-5 years old children participated in this study. They were distributed in the following manner: 20 three year olds (12 male and 8 female; M=41.90; SD=3.18); 24 four year olds (13 male and 11 female; M=51.79; SD=3.61); 14 five year olds (10 male and 4 female; M=65.14; SD=2.71). The study was carried out in a Spanish state pre-school and primary school in the city of Leganés (Comunidad de Madrid). The children belonged to an average socioeconomic context.

Design. Four tasks were administered to participants: one test of false belief (FBT), one measure of belief attribution (BAT), one test of counterfactual reasoning (CFR), and one measure of the comprehension of grammatical structures (CEG, Mendoza, Carballo, Muñoz & Fresneda, 2005). The first three tasks (FBT, BAT and CFR, always in this order) were presented as a block and the measure of CEG was administered either after this block, or in another session as a function of child fatigue.

In relation to the FBT and BAT, a between-participants design was used: 31 children were assigned to the prediction version and 27 to the explanation version. In each age group, the subjects were randomly assigned to the prediction (9, 13 and 9 three, four and five year olds, respectively) or explanation (11, 11 and 5 three, four and five year olds, respectively) version. There were no reliable differences in age (in months) between prediction and explanation conditions (52.23 and 50.89, respectively, $t(56) = .54$, $p = .594$, two tailed), nor there was a reliable association between sex and FBT version (prediction or explanation): $\chi 2\ (1) = .48$, $p = .593$, two tailed. On the other hand, CFR was evaluated through three questions. A within-participants design was used and all the subjects were administered the three questions in the same order.

Procedure and material. All the children´s parents in each of the 3 early childhood classes (3, 4, and 5 years) were notified of the possibility their children to participate in the study. The nature of the study was explained in a letter and the possibility of contacting the main researcher in case of doubt or clarification was offered. The children´s involvement in the study was subject to the parent´s authorization. The tests were applied individually in a quiet room in the children´s school. The child's answers to the FBT, BAT and CFR task were recorded on a cassette tape recorder. These tasks were administered by acting out a story with Playmobile dolls.

The scenario as a whole was characterized by simplicity using only a basic setup in order not to divert the attention of the child from the course of events narrated. It contained a door, a dining room and a bedroom. The dining room contained a cabinet whose doors could be opened, a TV, a table and two chairs. These objects allowed children to identify this space as a dining room. Paul's bedroom, on the other hand, contained only a bed and a shelf (see Appendix A).

The characters in the story were girls or boys as a function of the sex of the participant. In the story for boys, Paul is in his bedroom with his friend John. Paul has been given an Ernie doll that sings and plays the guitar as a present, and Paul and John are going to play with it in the bedroom. The doll works with batteries, but they are not included, so Paul is going to buy them. Then, he says to John: "John, don't play with Ernie until I come back". But, when Paul goes, John takes Ernie and plays with it all over the house. When he is playing in the dining room, he accidentally lets Ernie fall and the doll is broken. Then, John hides it in the cabinet of the dining room.

In this moment, some control-questions are formulated: "Where has Paul gone?" "Why? "What does John do while Paul is buying the batteries?" "What happens to Ernie now?" "Where is Ernie now?" When a child failed a question, the experimenter would repeat the story (or some part of it) and question again. When the child demonstrated misunderstanding of the story, the interview would stop at that moment. This situation only occurred in one case. Next, mental and counterfactual tasks were formulated.

FBT and BAT. The story continues differently according to the FBT version (see Appendix B). In the prediction version: “Paul has already purchased the batteries, has come to the door and is climbing the stairs of his house. Paul is about to enter his house”. At this point, children are asked the following questions:

False Belief: Where will Paul look for his doll? Why?

Belief Attribution: Does Paul think Ernie is in the dining room or in his own bedroom?

In the explanation version, the story continues like this: “Paul has already entered his house, and goes to his bedroom to look for Ernie to put in the batteries”. At this point, children are asked the following questions:

False Belief: Why is Paul looking for Ernie in his bedroom?

According to Wimmer and Mayringer (1998), by making the unsaid motive explicit (“to put in the batteries”) you focus the child’s attention on the apparently anomalous option adopted by Paul, not on his motivation. However, if the child’s answer focused on the reason why Paul went to his bedroom (his motivation), the child was confronted with two factual events: Where is Ernie now? Why did Paul go to the bedroom and not to the cabinet? Like Wimmer and Mayringer, we emphasized “in his bedroom” to be the key issue.

Belief Attribution: Does Paul think Ernie is in the dining room or in his own bedroom?

Help-questions (aids): When the child answers to the FBT (prediction or explanation version) or the BAT were wrong, children were given one or two aids. These aids consisted of reminding the child of relevant facts which make it easier for him or her to generate the false belief. Accordingly, the researcher could confirm the child’s correct answer and correct his or her incorrect ones. The first help-question consisted of reminding the child the location of Ernie before the protagonist had left the house: "Where was Ernie before Paul left to buy batteries?" After providing this assistance, children were provided with the question-test of the corresponding version followed by the justification (if prediction) and belief attribution question. If children were not successful after the first aid, a second one was provided: “When Paul was buying batteries, did he realize John had taken Ernie?” Next, false belief, justification (if it was the case) and belief attribution questions were again formulated.

Counterfactual Reasoning. Evaluation of CFR took place following the belief questions (FBT and BAT). In the story, once Paul is in his bedroom, the researcher would say: "Neither Ernie nor John is in the bedroom. Then, Paul goes to the dining room and sees John. Paul asks John where Ernie is, and John pulls the doll out of the cabinet and shows it to Paul. Paul sees Ernie is broken".

Then, children are asked three questions. Before formulating the first question, we remind children that Ernie was broken. Next, three counterfactual questions were formulated, always in the same order:

If John had not played with Ernie, how would Ernie be now: broken or new? Why?

If Paul had not left his bedroom, how would Ernie be now: broken or new? Why?

If Ernie had had batteries, how would Ernie be now: broken or new? Why?

The order of the options (broken and new) was counterbalanced.

Language. The evaluation of language by means of CEG is inserted into a paradigm of multiple choice; it does not require verbal responses. The CEG test encloses 20 blocks or types of grammar constructions in Spanish. Each block contains four items regarding the linguistic description of some vignette drawings. The test shows a high reliability (Cronbach alfa = 0.91). The child has to point to the drawing (amongst four possible drawings) which corresponds to a specific phrase. Our objective was not to conduct an exhaustive assessment of linguistic understanding, but to get a measure of language control[4] . We made a careful selection of the items by choosing 2 items in 12 blocks of grammatical constructions directly related to the grammatical construction of the sentences employed in the Ernie story. Finally, two items were removed because they showed comprehension problems for children of 3 and 4 years of age (see Appendix C for description of blocks and items selected). The range of scores in CEG was between 0 and 1 because the total number of correct responses was divided between the total items selected.

[4] In relation to our language measure, a meta-analysis by Milligan, Astington and Dack (2007) showed a significant relation between FBT and five types of language ability, with syntax accounting for 29% of the variance in false-belief understanding (average effect size: M = .66, $p < .001$).

RESULTS

Coding and scores in the FBT, BAT and CFR task. In relation to FBT, categories of correct and incorrect responses were extracted from the explanation version, in which children were asked to explain the protagonist's course of action. These categories are explained in Appendix D and always were the result of prior agreement between both experimenters. The category system is partially based on the existing literature (Perner, Lang & Kloo, 2002; Rafetseder & Perner, 2018; Wimmer & Mayringer, 1998), but other additional categories were created in order to register all the variability in the child responses.

Correct answers were coded differently depending on whether or not the child made use of the help aids. In the FBT, the child obtained 3 points with an initial correct response if no aids were needed. If the correct answer was offered after the first aid, the score obtained was 2; and 1 point was given if the correct answer was offered after the second aid. If the child did not give a correct answer despite two aids offered, his score was 0. In the BAT, the score ranged from 0 to 3 according to the same cases described above.

Initial scores obtained in FBT (3, 2 or 1 points) in both prediction and explanation versions were accepted only if the child correctly solved the BAT (at least with 1 point). Otherwise, if the child did not solve the BAT, 0 points were assigned to the FBT.

It is worth noting that in the prediction version, the child's answer was coded as correct by experimenters just by being successful in predicting the protagonist´s action ("bedroom" being the correct answer). Although the child's justifications of the protagonist´s course of action, as proposed by the children themselves, were also coded, such justifications were not decisive in deciding a prediction given as correct or incorrect. That is to say, if prediction was successful, the child was awarded, even though the justification was not entirely satisfactory, i.e. the belief was not explicit[5]. Ultimately, we agree with Wimmer and Mayringer's (1998) observation: it is difficult to suppose the child is lucky when he identifies the correct place where the target is not, and consequently the protagonist´s desire will not be satisfied.

In the CFR task, the score assigned to every response was 0, 0.5 or 1 point. Because of the three counterfactual questions, the scores ranged between 0 and 3 points. 1 point was obtained if the correct answer was accompanied by a justification consistent with the response. However, receiving 1 point did not require the use of complex counterfactual structures,

[5] However, if the child did not solve BAT after he second aid at the most, he was not considered to be successful.

nor the reference to all the factual events that were altered in the course of the CFR. Responses received 1 point that came with justifications related to the modification of some fact of the story that would have avoided the factual outcome. The same score to the same question would obtain when the child answered with an allusion to the counterfactual antecedent formulated.

When the initial response was either incorrect (Ernie would be “broken"), or correct with an incorrect justification, the child received 0 points. The latter was also obtained when the child, despite giving an initial correct response, did not justify it, neither in that specific question, nor in any of the two remaining counterfactual questions.

The score of 0.5 was awarded to the correct answers not justified but preceded or followed by other correct and justified answers from the block of CFR questions. For example, the child responded “new” to the first question (“If John had not played with Ernie, how would Ernie be now: broken or new?”) but he or she did not explain it. Then, in the second question (If Paul had not left his bedroom, how would Ernie be now: broken or new?), the child again responded in a successful way (“new”) and additionally was able to correctly reason why (e.g. “because John had not taken Ernie”). In this case, the child demonstrates his ability to cognitively undo events and reason about an alternative sequence of events. This avoids, to a significant extent, the possibility of another correct yet unjustified answer belonging to the same block of CFR producing a false positive. From a conservative approach, justifying the correct answer to any of the three questions maximizes the likelihood that another correct but an unjustified answer is the result of a counterfactual reasoning process. Bear in mind that, on the one hand, our within-participants design strengthens comparisons between counterfactual measures (see Beck, Riggs & Gorniak, 2009, 2010) maybe introducing the child into a counterfactual *mind-set*. On the other hand, prior to the formulation of counterfactual questions, the child is reminded -and must also confirm- that the toy is broken. Therefore, a correct answer indicating a counterfactual state (the toy would have been new), reveals in principle a capacity to cognitively undo a state of things given and reason in a consistent manner.

All coding and scoring decisions in the FBT, BAT and CFR task were taken jointly for both experimenters by applying prior criteria. There were not practically disagreements provided that these criteria were precise, objective and clearly made operative. The very few initial disagreements were finally solved after discussion.

Relationships between ToM and CFR.

Developmental patterns and difficulty levels in ToM and CFR tasks. In Table 1, means and standard deviations of mental and counterfactual tasks in the overall sample and in each age group are presented. Scores increase from 3 to 4 year-old and from 4 to 5 year-old children.

Table 1. Means (and standard deviations) and confidence intervals of FBT, CFR and language scores.

	Overall sample			3 years old			4 years old			5 years old		
	n	***M(SD)***	**95%CI**	***n***	***M(SD)***	**95%CI**	***n***	***M(SD)***	**95%CI**	***n***	***M(SD)***	**95%CI**
FBT	**57**	1.25 (1.45)	[.86, 1.63]	20	0.60 (1.23)	[.02, 1.18]	24	1.40 (1.47)	[.78, 2.02]	13	1.96 (1.42)	[1.10, 2.82]
CFR	**57**	1.41 (1.38)	[1.05, 1.78]	20	0.65 (1.14)	[.12, 1.18]	23	1.52 (1.32)	[1.52, .95]	14	2.32 (1.27)	[1.59, 3.05]
CEG	**55**	0.65 (0.17)	[.60, .69]	18	0.54 (0.17)	[.46, .62]	23	0.64 (0.11)	[.60, .69]	14	0.80 (0.14)	[.72, .88]

Note. CI = Confidence interval; FBT = False belief task; CFR = Counterfactual reasoning; CEG = Comprehension of grammatical structures.

In relation to FBT and CFR measures, there were reliable developmental differences (Kruskal-Wallis tests: FBT: $H(2) = 7.51$, $p = .023$; CFR: $H(2) = 11.83$, $p = .003$). The particular differences between 3-4, 4-5 and 3-5 years old children are presented in Table 2, using the Bonferroni correction (0.05/3: $p = .0167$). FBT showed a gradual improvement in development and there were only significant differences between 3 and 5 years-old age groups. In CFR, developmental differences appeared between both 3-4 and 3-5 years-old age groups.

Table 2. Differences between groups of age in FB and CFR tasks. Mann-Whitney test.

	Groups of age comparisons	**U**	***p*[a]**	***r***
FBT	3 – 4	172	.039	-.29
	4 – 5	123.5	.156	-.19
	3 – 5	68	**.007**	-.47
CFR	3 – 4	145	**.013**	-.34
	4 – 5	105.5	.030	-.31
	3 – 5	57	**.001**	-.55

Note. FBT = False belief task; CFR = Counterfactual reasoning.

[a] One-tailed exact significance; significant results as a function of the Bonferroni correction are shown in boldface.

In Table 3 comparisons of the difficulty level between counterfactual and mental tasks[6] are exposed. As we can see, CFR is clearly easier than FBT ($p < .001$). Looking at age groups, 4 year-olds found CFR reliably easier than FBT; and 3 year-olds found CFR marginally easier than FBT.

Table 3. Differences in difficulty between FB and CFR tasks. McNemar test

	FBT=0 CFR=1	FBT=1 CFR=0	p^a
Overall	14	0	**.000**
3 year-olds	4	0	.063
4 year-olds	7	0	**.008**
5 year-olds	3	0	.125

Note. FBT = False belief task; CFR = Counterfactual reasoning. [a] Significant results as a function of the Bonferroni correction are shown in boldface.

Correlations and Regression Analyses between FBT and CFR. Because of the high correlations between the FBT and language ($r[54] = .58$, $p < .001$), as well as between the CFR and language ($r[54] =.61$, $p < .001$, one-tailed in both cases), partial correlations between FBT and CFR, while controlling language and age, were performed (see Table 4). The correlation between FBT and CFR with the overall sample of children was of medium-high size.

Table 4. Partial correlations (controlling for age and language) between false belief and counterfactual tasks.

	Overall sample (n=54; n_p=28 ;n_e=25)	**3 years old** (n=19; n_p=7 ;n_e=11)	**4 years old** (n=22; n_p=12 ;n_e=10)	**5 years old** (n=13; n_p=9 ;n_e=4)
Prediction + explanation	.53***	.79***	.24	.48††
Prediction	.28†††	.51	.11	.15
Explanation	.83***	.88***	.61†	-

Note. †$p < .06$. ††$p < .07$. †††$p < .09$. ***$p < .001$, one-tailed.

[6] In order to make comparable both CFR and FB tasks, we only considered the initial answer to FBT, not the answers facilitated with aids. We adopted this decision because CFR tasks did not have aids. In addition, provided that each CFR question was a little more difficult than the previous one, any correct answer to whatever CFR question was coded as a correct performance.

Partial correlations between FB and CFR tasks for the prediction and explanation versions were performed. The correlation was clearly higher with the explanation version than prediction one. When age group is considered (Table 4), independently of the explanation/prediction version, the relation between CFR and FBT is especially robust at 3 years of age. From 4 years of age, there is no relation or it is smaller. However, if we consider 4 and 5 year olds jointly the correlation between FBT and CFR in explanation task continues being high: $r(14) = .78$, $p = .002$, one-tailed in both cases.

Two additional sets of analyses were carried ultimately referred to the role of CFR in the ToM progresses. One of them only with the children who obtained a score between 1 and 2 points in the FBT. These children´s CFR was highly and positively correlated to FBT-explanation ($r[15] = .82$, $p < .001$), but negatively to FBT-prediction ($r[15] = -.40$, $p = .086$, one-tailed in both cases).

Other analyses consisted of FBT-CFR correlations as a function of the nascent or implicit understanding of false belief. When FBT is solved before BAT along the story, that is, a correct answer occurs before explicitly understanding belief[7] and therefore the score in FBT is higher than in the BAT, a positive correlation between CFR and FBT is obtained in the explanation version ($r[7] = .98$, $p = .002$) and a correlation of 0 is obtained in the prediction one ($r[6] = .01$, $p = .49$, one-tailed in both cases). If FBT is solved at the same time or after BAT and therefore the score in the FBT is the same or smaller than in the BAT, the correlation between CFR and FBT is high and reliable in the explanation version ($r[18] = .82$, $p < .001$) and moderate and reliable in the prediction one ($r[21] = .43$, $p = .035$, one-tailed in both cases).

In order to examine the predictive capacity of CFR for the false belief understanding, some hierarchical regressions were performed. We controlled for age and language in our regression analyses so that age and language measures were entered in the first step and CFR measures in the second step.

As Table 5 shows, in the overall sample the three independent variables age, language and CFR were able to explain the 52% of the variance of FBT. CFR produced a significant R^2 change of 18% for the dependent

[7]Overall mean scores in the FBT were significantly higher than in the BAT (1.45 and 1.27, respectively, $t(53) = -1.75$, $p = .043$, one tailed, $r = .22$). The lag identified in our study is specifically located from 4 years of age when children are asked to explain an *anomalous* action (explanation version): Mean scores in the FBT were significantly higher (that is to say, children were able to solve *first*) than in the BAT (Wilcoxon test: 1.93 and 1.57, respectively, $T = 0$, $p = .02$, one tailed, $r = -.55$). In these cases, the kind of explanations given were based on *ignorance* (e.g. “because Paul did not know”, “because he does not know where Paul has placed Ernie”, “because he does not know his toy Ernie was in there”) and the *prior location* of the doll (“because it was there [in the bedroom]” “because he left Ernie here”).

variable. This result confirms our prediction about CFR as an important predictor of the FBT.

In the rest of the analyses, age was not entered because of its non-significant role in comparison to language.

In the explanation version, the final model predicting FBT accounted for 78%. CFR accounted for an important and significant amount of variance beyond language. It produced a significant R^2 change of 47%.

In the prediction version, the final model accounted for 39% of the variance of FBT. Language made a significant contribution in the final model. CFR accounted only for 4% of the variance and was not a significant predictor in the final model. Thus, CFR does not become a core factor in explaining the variance of FBT-prediction. Therefore, as we hypothesized, the counterfactual hypothesis is especially confirmed in the explanation version of the FBT, but not in the prediction one.

Table 5. Summary of hierarchical regression analyses predicting performance in the false belief task.

	False belief task version					
	Overall sample (explanation + prediction)		**Explanation version**		**Prediction version**	
Predictor	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.34***		.32**		.35***	
Age[a]		.12		-		-
Language		.50**		.57**		.59***
Step 2	.18***		.47***		.04	
Age		.01		-		-
Language		.26†		.15		.42*
CFR		.53***		.80***		.27
Total R^2	.52***		.78***		.39**	
n	53		25		28	

Note. CFR = Counterfactual reasoning.

[a] Age was only entered in the model predicting performance in the false belief task with the overall sample.

†$p < .09$. *$p < .05$. **$p < .01$. ***$p < .001$

DISCUSSION

Our main objective has consisted in analyzing the proposal that counterfactual thought is critical to performance on false belief tasks (Peterson & Riggs, 1999).

While developmental changes in CFR emerged between closer age groups (3-4 and not only 3-5 year olds), development in ToM showed a more conservative pattern; that is, ToM develops progressively and slowly. This result is in consonance with the higher difficulty of FBT in comparison to CFR found in our study, especially at 4 years of age. These results would at least initially seem favorable to a developmental precedence of CFR in relation to FB. Our results support the counterfactual substrate of ToM, in consonance with arguments defending the more basic or general nature of CFR versus ToM (see Guajardo & Turley-Ames, 2004; Harris, 1992; however, see Perner et al., 2004) and they validate cross-sectional designs, like ours, as a useful tool to analyze the counterfactual activity that underlies the performance in mindreading tasks. Accordingly, though some studies have detected false belief understanding in very early ages (see Onishi & Baillargeon, 2005), counterfactual ability might be detected much earlier in infants (Hilton, 2007; Legare & Clegg, 2015) than typically established (see Beck & Riggs, 2014 for a review).

CFR significantly contributed to explain the FBT. The percentage of ToM variance explained by CFR is 18% given the total sample, beyond maturation factors or linguistic understanding. In comparison to some studies that control for age and language, the explanatory capacity of CFR in our study is similar to that capacity obtained in other studies (Guajardo & Turley-Ames, 2004, counterfactuals tasks of antecedent, experiment 1; Riggs et al., 1998), and is even higher than that of others (Drayton, Turley-Ames & Guajardo, 2011; Guajardo et al., 2009; Perner et al., 2004). Our results might be especially relevant because CFR seems to underlie belief-based actions beyond agents´ beliefs, which is a possible weakness in some theoretical perspectives as the teleological one (Rafetseder & Perner, 2018). Some strengths in our study might have contributed to the robust CFR-ToM relation. First, the content type of counterfactual and mental tasks coincided; in particular, physically (search behavior/state of the doll). Second, we built our counterfactual task so that it did not require the use of mere basic conditional reasoning but a counterfactual one, that is, children hardly would have been able to answer correctly by merely recovering knowledge about general regularities (see Rafetseder et al., 2013). When the connection with current events is considered, demands of CFR make it more similar to the FBT (Perner, 2000). Third, we used the same scenario to evaluate CFR and

FB, and thus we homogenized modified derivation demands (Perner et al., 2004). Fourth, we employed a mishap with negative consequences that has probably facilitated the generation of counterfactual possibilities (Harris, German & Mills, 1996; Guajardo, McNally & Wright, 2016), which especially occurs if -as we did- the event takes place in a narrative frame in which the sign of the events changes (see German, 1999, compared to studies as Legare & Gelman, 2014).

Our hypothesis related to the contribution of CFR in ToM is confirmed but, most importantly, its contribution is as predicted by far higher in the explanation version. CFR becomes a very important predictor in the explanation version and it does not demonstrate explanatory capacity in predicting behavior based in false belief. CFR would constitute the raw material of ToM in the explanation version of FBT.

Why does CFR involve a substantially more powerful relation with the FBT-explanation version than with the prediction one? Is metacognition a feasible hypothesis in relation to this fact? Explaining implies a deeper processing of the information, more advanced thinking and reasoning (Siegler & Lin, 2010; Wellman, 2011). Although the standard unexpected location task (a prediction one) requires an *explicit* response to a direct question (San Juan & Astington, 2017), as does ours, this kind of tasks hardly requires expressive verbal ability, and thus implicit metacognitive mental abilities might be more easily demonstrated (Papaleontiou-Louca & Thoma, 2014). Even if we asked children to justify their predictions and these justifications are explicit measures, "rather than evidence of explicit and/or conscious and/or meta-representational processing, these could be, and probably often are, *post hoc* rationalizations and explanations for behaviors that may have occurred much more implicitly" (Couchman et al., 2012, p. 8). These observations along with the that fact that we employed a CFR measure more mature than traditionally used (and that considered child competence to minimally justify his correct counterfactual response, see introduction), make us wonder whether the relation found in our study between CFR and FBT-explanation could be adequately explained in terms of child´s awareness regarding mental processes. We do not think so. The child´s correct answer in FBT was only validated if he or she was also successful in BAT (at the same time or with a lag between them). While in the explanation version children solved FBT significantly earlier than BAT, that is, they first correctly explained an *anomalous* action and afterwards understood the protagonist´ false belief, in the prediction version children did not make a prediction significantly prior to explicitly understanding the belief underlying such a prediction. This result is not in line with supporting a greater awareness underlying solving FBT-explanation than FBT-prediction.

Another result is relevant. If metacognition were the cause of the high relation between CFR and FBT-explanation but not with FBT-prediction, then a traditional counterfactual measure which calculates only the success or failure in a dichotomous manner, independent of the justification given, should show a similar relation with both FBT-explanation and FBT-prediction. What is more, the very relation should be even higher than the FBT-prediction provided that, on the one hand, such a mental measure is supposed to be a more implicit one and, on the other hand, such counterfactual measure could be a more *implicit* measure of CFR (Weisberg & Gopnik, 2016). Nevertheless, even with this traditional CFR criterion, partial correlation (controlling for age and language) is higher between CFR and FBT-explanation (r[25] = .56, p = .003) than between CFR and FBT-prediction (r[29] = .28, p = .084, one-tailed in both cases). Consequently, there are diverse reasons in favor of exploring other possibilities.

CFR might also play a more predominant role in the prediction version than assumed. The meta-analysis by Devine and Hughes (2014) showed there is a genuine relation between individual differences in executive function (EF) and FB understanding. In particular, early EF predicted later FB understanding more strongly than the reverse. Among other executive demands, the FBT employed by us requires the children to override their own correct knowledge. Otherwise, children would not be able to attribute a false belief to the character. That is, inhibitory control is needed to solve FBT (see Hughes, 2011) as well as counterfactual tasks (see Drayton et al., 2011; Weisberg & Gopnik, 2016). What is more important, prediction and explanation tasks would theoretically pose distinguishing demand levels of such control, the prediction one being higher in comparison to the explanation one (Devine & Hughes, 2014; nevertheless, EF has not always been associated with the prediction version to a greater extent than to the explanation one, see Perner et al., 2002). In our study the genuine CFR-FBT relation in the prediction version might be masked by the inhibitory control effect that was not controlled for. Nevertheless, to a certain point our system of providing aids might have indirectly turned into a control measure, in a way that such *training* through the use of aids would have reduced the effect of reality salience.

Let us consider other possibilities. If there are both shared and non-shared processing demands between CFR and FB tasks (Mitchell et al., 2009), our results could indicate CFR shares more processing demands with the explanation version than with the prediction one. Both tasks, FBT-explanation and CFR, imply the use of backwards reasoning, as opposed to the use of forward reasoning in the prediction version. In CFR, the antecedent (“not-F assumption”) is suggested as being part of the problem here, as well as in the FBT-explanation. However, in the FBT-prediction, or even in the false belief question (Rasga et al., 2016, p. 48) this assumption must be generated (Peterson & Bowler, 2000). The counterfactual consequent and the false belief are virtual states related to the causal sequences of events, and thus explaining the *paradoxical* action would require a causal analysis of the situation and a search for meaning given the facts (Guajardo et al., 2013). It is well-known that presenting unexpected or anomalous stimuli or ones inconsistent with the knowledge-base stimulates the explanation and thus the generation of hypotheses, and the learning and discovery (Legare, 2012; Legare & Gelman, 2014). Thus, confronting the child with a protagonist's *paradoxical* actions that cannot be explained given the child's current conceptions about mental states might bring the child closer to the concept of belief (Bartsch et al., 2007). Ultimately, explaining makes it easy to understand the causal structure of our world and such understand might be directly linked to CFR. Maybe "there are no special cognitive resources that are required to explain imaginative acts. Instead, reasoning counterfactually is simply the process of making an assumption" (Walker & Gopnik, 2013).

Our study makes it possible to analyze the role of CFR in performing the FBT beyond just considering ToM in all-or-nothing terms. Our original and genuinely developmental evaluation employed stimuli probably located in the social-cognitive ZPD in children unable to solve the FBT in their first trial. In these children with scaffolding needs CFR seems to underlie the child's growing ability to understand false belief if requested to explain the behaviour, but undoubtedly does not if requested to predict the behaviour.

Other additional and finer (in terms of a more implicit understanding of false belief) results also reinforce the role of CFR in ToM progresses when explanation is requested of a child. The correlations obtained between FBT and CFR as a function of having solved FBT before BAT or not revealed that CFR seems to underlie the performance in the explanation version of both whoever has acquired the belief and whoever is in the process of acquiring it. On the contrary, in the prediction version, the children who have reached representational understanding would hardly employ the simulation route but would a different one with a lower cognitive cost; while children who have not yet obtained a representational understanding of the mind would not undoubtedly do so via simulation. In fact, the lag found in the explanation version from 4 years of age (some children reliably and successfully explained the paradoxical behavior before explicitly understanding false belief) does not necessarily imply a lack of sensitivity toward the representational mental states, in line with the existence of different explicitness levels in ToM (see Low, Apperly, Butterfill & Rakoczy, 2016). Our subjects showing the lag explained behavior with arguments from ignorance ("because he did not know"), which are different from belief and both show a different ontogenetic timetable -first ignorance and afterwards false belief- (Hogrefe, Wimmer & Perner, 1986; Wellman & Liu, 2004; but disconfirmed by Deneault, 2015 –both milestones develop in parallel-). The children also employed "situational" answers (previous location of the target-object: "Because Ernie was in the bedroom"), which "could be based on rules (…) that give an implicit sensitivity to actions without an explicit representation of the mental mediation (…) from the situation to action" (Low & Perner, 2012, p. 4). In sum, on the one hand, these two kinds of responses elucidate the gradual nature of ToM acquisition; on the other hand, the role of explanation –and its counterfactual roots- in the appropriate description of socio-cognitive progress (see Guajardo et al., 2013) is emphasized.

Our results invite the question whether the simulation exclusively focuses on the attribution, and not on the explanation (Wellman, 2014). They could lead towards a hybrid proposal in relation to the theory-theory/simulation theory debate. If simulation is not the mechanism employed to predict behavior based on belief –particularly from 4 years of age-, how do children solve this task? 4 year olds children acquire rules (e.g. see entails believe) in line with rule theorists (Mitchell et al., 2009). Our date could be in favor of the use of a *shortcut* (Núñez & Rivière, 2007). Children might have used perceptual access reasoning (Hedger & Fabricius, 2011) instead of reasoning based on beliefs. Chen, Su & Wang (2015) have confirmed this result with 4-6 year olds. Attending to the content of our aids, these latter could have become as such *shortcuts*, so that children in the prediction version would have taken advantage of them.

Our work has some limitations that deserve to be mentioned. First, the sample size of our study was limited, especially given the existence of three age groups and two versions of the false belief tasks. In future studies it would be very useful replicating these results with a larger sample size.

A second limitation comes from the lack of a wider range of measures of mental and counterfactual abilities. However, we consider our mental measures are ecologically valid and precise enough. The coding criterion used in the two versions of FBT and the system of aids generated could compensate, unless partially, for the absence of a wider battery of mental tasks. Something similar can be said with regards to the CFR measure.

Our study is not a longitudinal one, so in a strict sense we cannot analyze the developmental course in ToM or CFR. However, our aids seemed to yield improvements in false belief understanding. Despite we don´t know if such aids did it in a permanent manner, they might have stimulated cognitive processes (e.g. executive ones) compatible with the broader context of the ZPD. These results should be confirmed by means of providing genuine evidence of intra-individual changes using longitudinal studies.

Finally, FB and CFR tasks were always presented in the same order (first FBT). This limitation is related to the use of the same scenario for both tasks: we can't use the opposite order if the same scenario is going to be used. Besides, this is the only and the best possible order in the context of our story. According to the involvement of CFR in the FBT, presenting the counterfactual task would explicitly stimulate this component in solving the FBT, that is, it would probably overly facilitate it. Nevertheless, when presenting FBT first, children are not requested to explicitly reason in a counterfactual manner. The counterfactual mechanism underlying FB task is activated by the child on his own. Yet, a replication study using different scenarios for CFR and FB tasks (see Müller et al., 2007) or even a between-participants design with both conditions: FB and CFR task; and only CFR tasks, should be employed.

Our study is the first one that focuses on analyzing the role of CFR in FBT as a function of the mental task version. Therefore, the results might shed light on the empirical inconsistency in this field by demarcating the more specific context in which CFR seems to be a key element for ToM development. The relations found between FBT and CFR have been strengthened by other two elements jointly employed in our study for the first time. On the one hand, our quasi-microgenetic perspective in the evaluation of ToM by providing mediation when needed is suitable in capturing a more nascent understanding of the representational mind. On the other hand, it seems extremely appropriate to adopt a criterion of a minimum maturity in CFR when the cognitive substrate of such understanding is intending to analyze. In this way, our study is in line with continuing research into reliable and genuine ways of evaluating CFR in children (Beck, Carroll, Brunsdon & Gryg, 2011).

In conclusion, our study clearly states the importance of CFR in building sensitive responses to the belief. If the explanation is considered to be a window into child reasoning (Bartsch et al., 2007), CFR seems to have a decisive role in the acquisition of ToM such that it facilitates not only an implicit understanding but even the explicitness of the mental domain. CFR becomes a main tool in promoting child socio-cognitive development. Our results may contribute to the dialog between the theoretical positions discussed, especially if the FBT is understood as a theoretical enterprise in which "the counterfactuality, as it were, is hidden in the contents of belief statements" (Perner, 2000, p. 388).

In future studies, prior mentioned methodological limitations should be overcome. Likewise, there should be included not only physical but also emotional contents (e.g. German & Nichols, 2003) as well as different evaluation scenarios with both related and unrelated CFR and FB measures. Finally, it would be of great interest to analyze the link between CFR and ToM as a function of its application to social adaptation in childhood.

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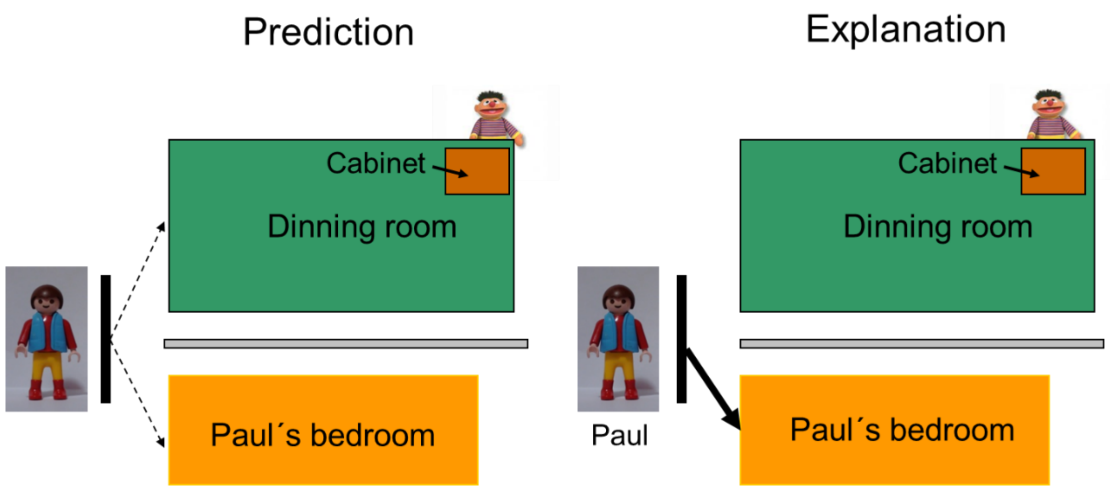
APPENDICES

Appendix A. Materials employed in the Ernie´s story

Appendix B. Procedure followed in the prediction and explanation version



Appendix C. The CEG test

CEG test encloses 20 blocks of types of grammar constructions in Spanish. Each block contains four items about the linguistic description of some vignette drawings. We included two items in each of the following blocks (sentences are in bold that include an unknown adjective, "fair", for 3 and 4 years old children).

1. Predicative sentences of SVO not reversible
   -The boy is playing with the ball.
   -The girl watches TV.
2. Attributive sentences
   -The girl is fair.
   -The pencil is long.
3. Negative predicative sentences
   -The boy is not eating.
   -The woman is not reading.
4. Pronominal (reflexive and not reflexive) predicative sentences
   -The girl is washing her hands.
   -The woman is putting on the man's shoes.
5. Reversible SVO predicative sentences
   -The mouse is pursuing the cat.
   -The bicycle is pursuing the car.
6. Predicative sentences of SVO with plural subject (reversible and not reversible)
   -The boys watch TV.
   -The girls are looking at the boys.
7. Disjunctive coordinated sentences (with coordinated either subject or object)
   -Neither the cat nor the dog is black.
   -The ball is not red or small.
8. SO-type relative sentences
   -The pencil is above the book which is red.
   -The square is inside the circle which is blue.
9. SVO sentences with divided subject
   -It is the car which has hit the truck.
   -It is the man who kisses the woman.
10. SS-type relative sentences
   -The boy who is looking at the girl is eating.
   -The dog which is pursuing the cat is small.

11. Adversative coordinated sentences (with coordinated either subject or object)
    -The dog is small but the cat is not.
    -The girl is thin but she is not fair.
12. Sentences with pronominal object (contrast of gender and number)
    -The boy is looking at him.
    -The cat is pursuing them.

Appendix D. Correct and incorrect categories in the False Belief Task (directly extracted from the explanation version)

Correct categories:

1. False belief: "because he thinks Ernie and John are in John´s bedroom".
2. Ignorance: "because he did not know Ernie was in the dining room".
3. Relevant facts in the story referring to a past situation. Mental states are easily inferred from those facts:

   -Lack of perceptual access to the critical event: "Because he has not seen it".

   -Prior location of the critical object: "Because Ernie was in the bedroom", "because Paul left it there [in the bedroom]".

   -Responses referred to the protagonist´s instruction whose failure to fulfill caused the later events: "Because Paul told John no to move out of the bedroom".

Incorrect categories:

1. Responses that objectify the situation, referring to a relevant past or present fact or to a logical and imminent consequence according to the objective facts:

   -Realist responses: Absurd explanations about the paradoxical action of the protagonist. The child indicates the current location of the doll, the imminent consequence of such location or the absence of the doll in the place where it is searched for (e.g. "Because he does not find it").

   -Responses that anticipate behaviors to be expected in the characters: "In order for Paul to see that John has broken Ernie".

2. Reasonable solutions in the context of the story but clearly unsatisfactory in order to solve the false belief task:

   -Realist responses with a perceptual egocentrism form: "Because he thinks Ernie is under the bed"; "in order to look for it and see if it is under the bed", "because if [Ernie] is hidden [under the bed] then he will not see it".

   -Non realist responses unrelated to the events of the story. Sometimes, children build volitional states consistent with the paradoxical action:

“Because he does not want to enter his bedroom”; “because he is going to sleep before looking for Ernie”; “because this girl wants to sit down here [pointing to the bed]”.

3. Responses focused on an internal need of rebuilding the story. Sometimes, children attribute to the protagonist the knowledge of the factual events. Anyway, the assimilatory activity is very evident: “At the beginning, Paul came there [dining room], ok?” “

4. The child either does not know or respond.

5. Irrelevant or absurd responses:

-Responses that reproduce the motivation of the protagonist already explicated by the experimenter or extend the question made by the latter: “Because he is going to look for Ernie”; “because maybe he wants to play with it”.

-Responses with no information.