GRAMMATICAL ATTRACTION ERROR DETECTION IN CHILDREN AND ADOLESCENTS

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ABSTRACT

Children and adolescents often make grammatical errors in sentences such as saying "the friend of our neighbors smile" instead of "the friend of our neighbor smiles". Recent research suggests that these attraction errors arise because they fail to inhibit an automated but inappropriate heuristic strategy that makes them blindly agree the verb with the immediately preceding word. However, it is unclear whether these errors predominantly result from a failure to complete the inhibition or from a failure to detect that the strategy is erroneous and needs to be inhibited in the first place. The present study focuses on a test of the critical error detection sensitivity issue. Children and adolescents were asked to solve grammatical problems and indicated their response confidence. Adolescents showed a clear confidence decrease after having committed an attraction error which was less pronounced in the group of children. This indicates that although children might not detect the inappropriate nature of their answer, adolescents have a better grammatical understanding than their errors seem to suggest.

Teaching children to write properly without grammatical mistakes is one of the primary goals of the elementary and secondary school curriculum. A key grammatical ability that children need to master in this respect is learning how to inflect verbs to agree with the number of the subject (singular vs plural) in a sentence (Beers, & Beers, 1992; Fayol et al., 1999; Frisson, & Sandra, 2002; Kemp, & Bryant, 2003; Largy, 2001; Nunes, Bryant, & Bindman, 1997a Nunes, Bryant, & Bindman, 1997b; Totereau, Thevenin, & Fayol, 1997). For example, children need to learn that we write "the cat comes" but "the cats come". By the fifth grade, children have largely automatized the verb inflection rule (Fayol, Hupet, & Largy, 1999) and no longer make errors when they have to use plural inflections in simple cases of subject-verb agreement. However, children, adolescents, and sometimes even adults continue to make systematic verb inflection errors in more complex linguistic contexts in print and speech (Bock, 1995; Bock & Cutting, 1992; Bock & Eberhard, 1993; Bock & Miller, 1991; Nunes, Bryant, & Bindman, 1997c; Vigliocco, Butterworth, & Semenza, 1996). For example, in languages such as English and French, verb inflection errors typically occur in so-called noun phrases of the type "Noun 1 + Noun 2 + Verb" (e.g., "the friend of the neighbors smile" instead of "the friend of the neighbors smiles") because one makes the verb agree with the immediately preceding noun ("neighbors") especially when this noun is in its plural form (Bock, 1995; Bock & Cutting, 1992; Bock & Eberhard, 1993; Bock & Miller, 1991; Fayol et al., 1994; Fayol et al., 1999 Largy et al., 1996). In French similar verb

inflection errors can also be observed in sentences of the type "Singular subject pronoun + Plural pronoun + Verb" (e.g., "*Il les mange*" in English *"He eats them"*). In French the plural pronoun (e.g., *"les"*) is placed before the verb (*"mange"*) and consequently participants can be tempted to make the verb agree with the preceding plural pronoun ("*les*") instead of the singular subject of the sentence (e.g., Chanquoy & Negro, 1996; Fayol et al., 1994; Hupet, Fayol, & Schelstraete 1998; Largy, Dédéyan, & Hupet, 2004; Largy, Fayol, & Lemaire 1996).

The inflection errors in complex linguistic context in which the verb is erroneously made to agree with the preceding noun or pronoun are known as "attraction" errors (Bock & Miller, 1991). These attraction errors have been shown to result from the automatization of *the verb* inflection rules in simple contexts (Fayol et al., 1999; Lanoë et al., 2016). That is, when children enter elementary school they learn that certain marks are frequently associated with plurality. For example, in English and French plural nouns (and pronouns in French) are inflected with −s (e.g., "the book" but "two books", in French "le livre" and "les livres"). Through repeated exposure children will learn to use this plurality marker to use the plural verbal inflection. Over time this will develop into an automated strategy or heuristic to quickly and effortlessly determine the inflection of the verb (e.g., "use plural inflection of the verb after plurality marker −s"). This heuristic works well in most linguistic contexts. It will help writers arrive at the correct spelling in simple sentences such as "the cat runs" and "the plants grow". However, blindly applying it in complex contexts such as the "Noun 1 + Noun 2 + Verb" or "Singular subject pronoun + Plural pronoun + Verb" will lead to attraction errors.

Given the early automatization of verb inflection rules, Lanoë et al. [2016] recently suggested that attraction errors result from an executive failure to inhibit the automated heuristic strategy. There is indeed some evidence suggesting that both children and adults who score higher on general executive functioning tests (e.g., working memory or fluid intelligence tests) commit fewer attraction errors (Bock & Cutting, 1992; Hartsuiker & Barkhuysen, 2006; Veenstra et al., 2017). To directly validate their claim about the specific role of inhibitory processing, Lanoë et al. adopted a negative priming paradigm (Tipper, 1985).

The basic idea behind the negative priming paradigm is simple: if you inhibit a specific strategy on one trial, then activation of this same strategy on a subsequent trial should be hampered (Borst, Moutier, & Houdé, 2013). Simply put, when you block a strategy at Time 1, you will pay a price when trying to reactivate it again immediately afterwards. In their critical test items Lanoë et al. [2016] asked participants to evaluate the correctness of a simple sentence in which applying the automated *"use plural inflection after plurality marker −s"* strategy resulted in the correct response (e.g., *"The horses run"*). For completeness, note that Lanoë et al. tested French-speaking participants and focused on attraction errors with "Singular Subject + Plural Pronoun + Verb" sentences. To keep the exposition as accessible as possible for non-French speaking scientists we use English examples based on the related "Noun 1 + Noun 2 +Verb" case to illustrate the experimental rationale here.

Immediately before presentation of the critical test item, participants in (2016) study were presented with either an incongruent or congruent problem. In incongruent problems participants had to evaluate the correctness of a sentence in which applying the automated '*use plural inflection after plurality marker −s*" heuristic resulted in an attraction error and would need to be inhibited (e.*g.,* *"The friend of our neighbors smile"*). In congruent problems, participants evaluated control sentences in which correct responding did not require inhibition of the heuristic (e.g., *"The friend of our neighbor smiles"*). Results showed that for children, adolescents, and adults responding to the simple test sentence took longer after participants had solved an incongruent problem than after they had solved a congruent problem. Hence, a typical negative priming effect was observed. Solving the incongruent problems in which correct responding required inhibiting the heuristic strategy, hampered activation of this same strategy on the subsequent trial, resulting in increased response times.

In general, accounts that have stressed the importance of inhibition in human cognition and development have received wide support and have become increasingly popular (e.g., Dempster & Brainerd, 1995; De Neys & Everaerts, 2008; De Neys & Van Gelder, 2008; Harnishfeger & Bjorklund, 1994; Houdé, 1997, 2007; Reyna et al., 2003; Simoneau & Markovits, 2003). The results of Lanoë et al. (2016) also directly underscore the role of inhibitory processing in avoiding grammatical attraction errors. However, the precise nature of the inhibition failure that results in an attraction error is still open to different interpretations. A key question is whether developing writers typically make attraction errors because they lack the executive resources to complete inhibiting the automated heuristic strategy or because they fail to detect that they need to inhibit the strategy in the first place.

To clarify the key point, it is important to stress that inhibitory accounts do not posit that people need to block heuristic strategies in all situations (e.g., Brainerd & Reyna, 2001; De Neys & Franssens, 2009 ; De Neys & Vanderputte, 2011 ; Houdé & Guichart, 2001; Jacobs & Klaczynski, 2002; Klaczynski et al., 2001; Stanovich, West, & Toplak, 2011). In many situations automatized heuristic strategies can provide us with correct problem solutions. The automatization is highly beneficial in these cases because it allows us to decide fast without a need to engage in extensive deliberation (Kahneman, 2011). As we noted, when deciding on verb inflection, for example, the heuristic *"use plural inflection after plurality marker −s"* is useful in most linguistic contexts. The problem is simply that in some contexts it will conflict with the correct grammatical rule and needs to be avoided in these specific cases. Hence, inhibitory accounts typically postulate some kind of elementary monitoring process that signals whether the use of the heuristic is appropriate or not (De Neys, Lubin, & Houdé, 2014; Reyna et al., 2003; De Neys & Glumicic, 2008; Evans and Stanovich, 2013; Pennycook, Fugelsang, & Koehler, 2015; Simon, Lubin, Houdé, & De Neys, 2015). This implies that an efficient inhibition requires that one monitors for attraction errors first and inhibits the heuristic strategy whenever it is detected. Hence, what we need to know is whether developing individuals who commit an attraction error mainly fail at this initial monitoring stage or at the subsequent inhibition per se. Unfortunately, the efficiency of the attraction error monitoring or detection process has not been examined. The present study starts to address this shortcoming and presents a first direct test of the attraction error sensitivity question.

To answer our research question we presented participants in the preadolescent to adolescent age range with the congruent and incongruent verb inflection problems that were introduced by Lanoë et al. (2016) . To recap, in incongruent problems, applying the