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Attribute Substitution in Economic Behavior**

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Abstract: This paper discusses how counterfactual thinking can be incorporated into behavioral economics by relating it to a type of attribution substitution involved in choices people make in conditions of Knightian uncertainty. It draws on Byrne's 'rational imagination' account of counterfactual thinking, evidence from cognitive science regarding the forms it takes, and identifies types of attribution substitution specific to economic behavior. This approach, which elucidates the reflective stage of causal reasoning, is relevant for the explanation of hypothetical causal rules suitable for diverse tasks such as planning, expectations and mental simulations and for behavioural change interventions, which take into account people's social and institutional embeddedness. The paper closes with a discussion of how this implies a specifically social *Homo sapiens* individual conception.

Keywords: counterfactual thinking, attribute substitution, Knightian uncertainty, rational imagination, economic behavior, *Homo sapiens*

JEL codes: A12, A13, B41, D90

1 Introduction: The relationship between counterfactual thinking and attribute substitution

Counterfactual thinking (CFT) has been extensively investigated in cognitive science and psychology, but does not play an important role in behavioral economics. This paper discusses how CFT can be incorporated into behavioral economics by relating CFT to a type of attribution substitution (AS) in which people make choices in highly uncertain circumstances. CFT, also called 'what if' or 'if only' thinking, involves reasoning about alternative possibilities regarding past and future events, or about what might have happened or what might yet happen, had facts been different. AS involves a cognitive

process whereby people attempt to make complex choices by substituting more easily managed heuristic attributes that in some manner represents those choices. We argue that one factor determining how people employ different heuristic attributes is the scope of decision-making involved, where the scope of decision-making can usefully be explained as the difference between ‘small worlds’ in which standard probabilistic thinking applies and ‘large worlds’ associated with Knightian uncertainty (Savage, 1954; Binmore, 2009). CFT becomes particularly important in the latter and actualizes a type of AS specifically appropriate to it that we examine in relation to economic behavior.

Most of mainstream economics in the form of standard rational choice theory restricts its analysis of behavior to ‘small worlds’ that limits the information people have to the facts they know, and assumes that people update the information they have in a Bayesian manner. Suppose however, that decision-makers adopt strategies for how they might construct manageable, small world-like choice scenarios, perhaps by forming analogies to past cases in which in similar situations their choices went well (see Gilboa and Schmeidler, 2007). Then people might be thought to engage in CFT, using the information they employ to go beyond the facts they know in order to conjecture possible facts in imagining what might or could be the case in addition to what is the case. This effectively locates them in ‘large worlds’ of many, complex alternative possibilities. Thus, if AS in ‘small worlds’ settings substitutes more easily managed heuristic attributes for more complex decision-making, in ‘large worlds’ we should also expect decision-making to employ an AS substitution process, though one specific to those less concrete circumstances. In this paper, we seek to characterize AS as it could be applied to economic behavior in ‘large world’ settings in terms of how CFT has been explained in cognitive science and psychology.

The organization of the paper is as follows:

- Section 2 gives two different examples of CFT, and following cognitive scientist Ruth Byrne (Byrne, 2005, 2007, 2016) characterizes CFT as a type of ‘rational’ thinking quite different from that employed in mainstream economics rational choice theory.
- In Section 3 following Kahneman and Tversky (1982) we emphasize the functional nature of CFT, distinguish “preparative” and “affective” types of CFT identified by cognitive psychologists, and connect Byrne’s distinction between how people evaluate opportunities for action and inaction to Kahneman and Varey’s (1990) concept of close counterfactuals.
- Section 4 turns to types of AS specifically connected to CFT and emphasizes the relationship between “prefactuals” and future conditionals. We review the large literature in psychology on this subject, and explain how these types of AS convey hypothetical causal rules suitable for diverse tasks such as planning and finite expectations.

- Section 5 discusses the main advantage of including an analysis of CFT in the AS framework. We characterize these processes as a form of ‘reflectivity’ whereby people assess their behavior and potentially revise it according to those assessments, and distinguish it from standard thinking about rationality.
- In Section 6 we note that behavioral economics’ *Homo sapiens* individual conception does not address CFT, and argue that to do so requires a conception of individuals as socially embedded. By socially embedded we mean a shared social reasoning in which people’s choices are not strictly their own alone, but are ‘co-determined’ according to the circumstances with or against other causal reasoners.
- Section 7 provides brief concluding remarks.

2 CFT as ‘rational imagination’

CFT – ‘what if’ or ‘if only’ thinking – is involved when people imagine alternative possibilities about what might have happened or what might yet happen had facts had been different.¹ Consider the following standard example:

If I had studied more, I would have done better. (1)

Here one imagines something which could have been a fact – a possible fact – namely, that one could have studied more, and then makes an inference about what it might imply about the past and the future, namely that one would have done better and been better off. Note that this example is a fairly simple one in that the implications of this possible fact can be mapped out in a fairly straightforward way. In effect it involves a ‘small worlds’ frame in which we are confident we know the consequences of our actions, the possible states of the world, and the probabilities of events. Indeed, the possible fact that one might have studied more is quite realistic in that under only slightly different circumstances it could have been an actual fact.

In contrast, consider the famous Kennedy assassination example used in many discussions of CFT (Adams, 1975; Starr, 2019). One way of expressing this is this:

If Oswald didn’t kill Kennedy, someone else would have killed him. (2)

In this case, the consequences of Oswald not having killed Kennedy, if that were true, are very unclear, the possible states of the world surrounding the assassination are also very unclear, and we have little if any basis for assigning probabilities to (2). This scenario

¹ Philosophers and psychologists use ‘counterfactuals’ and ‘counterfactual thinking’ more or less interchangeably, but we use the latter expression to emphasize psychologists’ emphasis on cognitive processes as opposed to logical relationships.

involves a ‘large worlds’ Knightian uncertainty frame in which many possible facts are in play, it is unclear how many such possible facts there are, and it is unclear how realistic those possible facts might be, because the circumstances surrounding them are not easily linked to the facts we know about the assassination.

Nonetheless, people reason about (2) just as they reason about (1). Their ability to do so is reflected in the complexity and versatility of their use of a tremendous range of modal expressions employed across languages. The difference, for example in English, between how a person would use ‘might’ or ‘could’ in the two cases is a matter of how they would reason counterfactually about the differences between (1) and (2), which in turn reflects how realistic they perceive the possible facts to be in each case.

Ruth Byrne labels CFT and ‘what if thinking as ‘rational imagination’ (Byrne, 2005, 2007, 2016). Her view is that rational thought is “more imaginative than cognitive scientists ... supposed” and that “imaginative thought is more rational than scientists imagined” (2005, xi). That is, she has a more expansive view of what rational thinking involves than mainstream economics, which limits what counts as rational via its axiomatic prior determination of how people’s preferences are defined. In contrast, Byrne’s characterization of rational derives from her own and others’ extensive empirical investigation of how people create mental representations of the alternative possibilities they face, and then draw conclusions about them that are “not just plausible or possible ... [but] must be true, if the factors [they are] based on ... are true” (*Ibid.*, 15, original emphasis). Key here is that people create mental representations² of alternative possibilities they face since these representations take them beyond the actual facts they possess to possible or conjectured facts. Connecting these possible or conjectured facts to actual facts then makes it possible for people to engage in an expanded sort of reasoning, not one easily judged according to the standards of traditional deductive reasoning, but one more reflective of an ecological rationality approach (Berg, 2014; Berg and Gigerenzer, 2008; and Berg, et al., 2018).

From this perspective, the reasoning people employ limited to actual facts constitutes a special case, and the CFT reasoning they employ with the larger domain of actual facts and possible facts is the general case. If, then, in the special case reasoning is restricted to Bayesian updating, what forms of reasoning operate in the general case?

3 Ways in which people engage in CFT

Kahneman and Tversky (1982) noted the importance of CFT, and argued that there is evidence that people tend to think in ‘what if’ or ‘if only’ terms more often in the case of exceptional events than normal ones. Suppose, then, that normal events are those that are generally predictable. In effect, they are events that fit the ‘small worlds’ framework in

² Mental representations are often referred to in cognitive science as mental models (Johnson-Laird, 1983).

which the consequences of actions, states of the world, and the associated probabilities of events are typically well known. Exceptional events, then, may fit the 'large worlds' framework in which these conditions generally do not hold. Drawing motivation from Kahneman and Tversky's observations, that CFT in which people conjecture what might or could happen may concern this domain. Note, however, that exceptional need not mean rare or infrequent. On a 'large worlds' interpretation of exceptional events, they simply involve events that are less predictable.

CFT was initially thought to be a dysfunctional kind of thinking, but Kahneman and Tversky argued it is ought to be seen as psychologically functional. Empirical research on CFT in cognitive science and psychology, then, subsequently distinguished two important psychological functions that CFT serves according to how people represent events.

First, such thoughts may serve a *preparative* function; that is, they may illuminate means by which individuals can prepare for the future and, accordingly, improve their lot (see Roese and Morrison, 2009, p. 20).

Example (1) above regarding studying for an exam represents this case in its emphasis on doing better. However, another way of representing the studying case is to say:

If I hadn't studied as much as I did, I would have done worse. (3)

This type of representation does not exhibit a preparative function because it does not refer to what else a person might subsequently do. Rather, the function of this type of representation is to reconcile the person to what has happened. Thus:

Second, counterfactual thoughts can serve an *affective* function; that is, they may be used to make oneself or another person feel better (*Ibid.*).

Whereas, then, the preparative function orients a person toward future action and what they might do, the affective function orients a person toward *inaction* and acceptance of *status quo* states of affairs.

Byrne makes this focus on action or inaction central to much of her empirical research regarding CFT. For her, CFT is more likely to result in undoing a past action by further action than altering an inaction. Why?

Inactions are mentally represented more economically than actions ... There is no change in state for inactions, and so the preaction and postaction possibilities remain the same ... There are more things to keep in mind when someone does something than when they do nothing ... Because people keep in mind more information for actions than for inactions, they can mentally change actions more easily than inactions ... People can readily imagine a counterfactual alternative to

an intentional action because they have envisaged two possibilities when they understand the action ... (pp. 53-54).

Putting aside inaction, this then leaves us with the question of how people behave when they pursue further courses of action. If CFT is more likely in the case of exceptional events (Kahneman and Tversky, 1982), in what ways might they be seen as exceptional?

On the assumption that people focus on circumstances in which their actions are more likely to have effects on the world, Kahneman and Varey (1990) examine what they call ‘close counterfactuals’ or “cases in which ‘X almost happened’ [and] X could have happened” (1990, p. 1101). In the following section, we examine this sort of case in connection with the role “prefactuals” and anticipatory counterfactuals play in behavior.

4 AS and CFT: “Prefactuals” and counterexamples

Here we discuss how CFT works through AS. We emphasize the particular role that “prefactuals” or anticipatory counterfactuals play as future conditionals in individuals’ causal reasoning and formation of intentions in uncertain circumstances. Reflective reasoning and conditional thinking in the form of counterexamples is valuable for individuals’ diagnostic evaluation of causal reasoning.

4.1 The Relevance of AS to Psychology

A defining moment in the evolution of the heuristics and biases theory of intuitive judgement took place when Frederick and Kahneman (2002) proposed an explicit definition of a generic and all-encompassing heuristic process of attribute substitution (AS). This process was meant to account for the long list of heuristics that were identified and discussed within this program. According to their analysis, a judgment is resolved by a heuristic when people evaluate a definite target attribute of the decision by substituting a connected heuristic attribute, which is more accessible because it appears more easily to mind. A large number of empirical studies report evidence suggesting that AS does indeed take place. The attribute-substitution mechanism includes both automatic and controlled effects. Highly accessible attributes, which are easily recalled without resolve and struggle, have been called natural assessments (Tversky and Kahneman, 1983). Beyond physical attributes, those assessments include intangible qualities such as similarity, causal inclination, fluency, emotional disposition, mood and other factors (see Frederick and Kahneman, 2002) for a non-exhaustive list). In contrast to natural assessments, extensional attributes exhibit low accessibility in information. For this reason, they are utilized as candidates for heuristic substitution in several mental tasks. Those activities include, for example, category prediction, pricing a good and evaluating an experience (Kahneman, 2003). The answer to an easy question substitutes a difficult one (Morewedge and Kahneman, 2010).

Kahneman (2002) admitted that most ideas on the theme of AS were anticipated for a long period in the past. While an example of past analysis on his part is the discussion of the simulation heuristic (Kahneman and Tversky, 1982), an alternative approach is the psychological theory of attributional inference, which makes no reference to the heuristics perspective (see for example, Lieberman, Gaunt, Gilbert and Trope, 2002). This psychological analysis is based on the suggestion by Ross (1977) that the fundamental attribution error constitutes the theoretical foundation for the field of social psychology.

4.2 AS and Heuristics: Fluency and Simulation

While AS is an all-encompassing mechanism, which underlies any heuristic, it is often discussed in terms of specific heuristics. One such heuristic is the fluency heuristic, a type of AS (Kahneman 2003). According to this heuristic, an inference about a target construct depends on a noticeable, but theoretically irrelevant cue. For example, confidence may be based on processes such as affect or ease of processing (Thompson and Morsanyi, 2012). The latter generates optimistic sentiment and produces a feeling of rightness or confidence in a judgment. Another frequently discussed heuristic is the simulation heuristic. There are several occasions, in which questions about incidents are resolved by a psychological process that bears a resemblance to the functioning of a simulation model (Kahneman and Tversky, 1982). Simulation as a mental reaction show how individuals may generate various outcomes through several alternative possible paths in order to respond to specific situations. Within the heuristics and biases research program, counterfactual reasoning was interpreted as a “simulation heuristic”, which was thought to act as impediment to sound judgment (Epstude & Roese, p.169, 2008). As we will see below, this constitutes a misconception because simulation is valuable for causal reasoning.

4.3 Automatic Cognitive Misery and Reasoning

AS has often been discussed within the activity of rationing cognitive capacity, or else, “cognitive misery”. Individuals who use AS have been labeled as cognitive misers because they tend to rely on fast, effortless, intuitive processing (Evans, 2008; Kahneman, 2011). However, it has been shown that cognitive misers might have more accurate insights as well as hold ambiguous stance about the substitution mechanism (De Neys, Rossi and Houdé, 2013). Despite the fact that a great emphasis in the literature is placed on the relevance of AS for automatic behaviour, we argue that this mechanism is also important for reasoning processes. Because one fundamental aspect of syllogistic reasoning is the use of counterfactual thinking, the process of AS relates also to it. CFT does not involve only arguments about the past in the form of explicit downward or upward manifestations, that is, imagined alternatives about how things could have been worse or better respectively (on the distinction, see Byrne, 2016, p. 138). It also relates to thoughts about the future such as anticipatory counterfactuals or anticipatory regret. Those reactions relate to upward counterfactuals and focus on personal choice, but they are posited in the future. Those anticipatory mental reactions are useful for the improvement of individual performance (see Kray, Galinsky, & Markman, 2009).

4.4 Prefactuals and Future Conditionals

Anticipatory counterfactuals (or “prefactuals”) are not confined only to anticipatory regret because they may not involve the feeling of personal loss that is usually associated with the emotion of regret. For this reason, they constitute essentially two different psychological reactions. This is a major consideration because it demonstrates that future action can be thought as a plan with outcomes based on causation, but without the involvement of regret. Prefactuals bring analysis to a new territory because they involve an understanding of future conditionals. For example, people perceive similarly a prefactual, such as “if I were to become a movie star tomorrow, I would move to Hollywood” as they recognize the equivalent future indicative conditional, “if I become a movie star, tomorrow I will move to Hollywood” (Byrne & Egan, 2004, p.115). Reasoners generate identical inferences based on conditionals, whether those are past or future (Schaeken, Schroyens, & Dieussaert, 2001). Moreover, prefactuals are similar to future indicative conditionals since they imply the same sorts of things and possibilities as well as frequency of inferences (Thompson & Byrne, 2002). Moreover, prefactuals do not assume any events, as for example, from the statement “if I do not become a movie star, I will not move to Hollywood.” For this reason, prefactuals differ from typical counterfactuals and can be used to express a hypothetical causal rule. The feeling of uncertainty by individuals in a future tense conditional is important because it cues thinkers to understand the conjectural nature of the prefactuals. Future tense conditionals exhibit a sense of certainty because stated intentions are known by individuals, while prefactuals are built in the presence of uncertainty. For this reason, future tense conditionals are more adequate for planning, while prefactuals may be suitable to explore alternative possibilities through speculations, simulations and fantasies.

Several “what if...” speculations refer to the “uncertain” subjunctive mood rather than to the future alone. One form of AS the simulation heuristic is relevant to the speculation that relates to both the future tense conditional and the uncertain subjunctive temperament. In essence, conditionals about the future are not perceived in a different way from conditionals about the present or the past, although there are occasions in which variability is involved. For example, in the case of the so-called subjunctive conditionals, which involve uncertainty about alternative options there may be variable responses (Byrne and Egan, 2004).

4.5 Causal Reasoning, Future Prefactuals and AS

Following several studies, Epstude and Roese (2008) conclude that causal awareness is a feature of counterfactual thinking. This happens because a counterfactual embodies a causal rule when it applies to a conditional scheme (i.e., an “if-then” proposition). Conceptionally, the behavioral intention that is involved in a counterfactual, prefactual, or future conditional is a causal inference. When one thinks that he can get a better grade by studying harder (a counterfactual), she assumes that studying results in higher grades. A proposition may be verbalized as a counterfactual (i.e., “should have studied harder”) or as

an intention in a prefactual (i.e., “I will study harder next time”), but causal meanings are equivalent. Therefore, counterfactual conditionals in the future are inferences that link an antecedent to a consequent.

In prefactuals, the causation changes from “if I become a movie star, I will go to Hollywood” to “I will go to Hollywood if I become a movie star” to denote behavioral intention and expectation about the future. This is an important shift because the second type of prefactuals answers questions in an uncertain environment such as “Will I go to Hollywood?” While the first type allows only one possibility regarding antecedents, the alternative form of prefactuals is susceptible to AS that allows speculation and simulation. If chances to progress to a movie star are not high, one may substitute the answer to “I will go to Hollywood if I become a successful scriptwriter”, or “I will go to Hollywood if I become a successful director”, or “I will go to Hollywood if I become a Hollywood celebrity secretary”. While prefactuals allow for speculation, future conditionals are utilized by reasoners, who attempt to plan their actions. They do so by controlling their decision-making in such a way so that to form definite expectations. Here, the process in future conditionals is not speculative but aims at defining the best decision given the capacities of the subject within the planning domain. Therefore, an important question regarding the behaviour of reasoners is whether they will form their reasoning in a speculative, or in a predictable way. This is an issue that we will address below.

4.6 Early Stages of Rational Thinking and Reflection

In epistemological terms, perfect rationality takes place in a closed system, in which conditionals are known with certainty and probabilities are assigned. In such a system, contrast conditionals, which come often in the form of counterexamples facilitate evaluation because they prove or disprove a future conditional and, therefore, solve for the true solution. While this may prove an optimal process, some form of elementary rational syllogistic thinking takes places where conditionals are not known with certainty. In this case, they are assessed by the relevant available evidence and automatic processes involving the state of confidence and affect. Those situations involve AS. For example, the fluency heuristic is a mechanism of AS (Kahneman 2003) because it explains the support of fluency as a cue to confidence (Hertwig et al. 2008). The latter involves an inference about a target reaction, which may in turn be supported by cues such as sentiment or ease of processing (Thompson and Morsanyi, 2012). Decisions based on confidence on thinking involve inferences about understandings related to the ease with which the response is recalled (see Koriat 2007 for a review). Although confidence does not tell about measures of objective accuracy in several situations, the fact that a piece of information is recalled fast creates a strong, but sometimes deceptive, sense that it has been appropriately retrieved (see for example, Whittlesea and Leboe 2003). Moreover, feelings are important in influencing counterfactuals inclusive of anticipatory counterfactuals in syllogistic reasoning. Thompson (2009, 2010) has proposed that a feeling of rightness principle (FOR) is similar to judgments of confidence. Besides the information related to a belief in intuitive judgment, FOR about a decision is the experiential confirmation, which related to

confidence as we mentioned above. This experience supports the inference that an original intuition proves to be accurate because of the easiness involved for the individuals (see Koriat 2007; Topolinski and Reber 2010). Finally, as we mentioned above, beyond fluency an alternative mental mechanism is the use of the simulation heuristic. Simulations are processes, which do not inevitably generate a specific definite outcome and can be controlled in several ways through assuming different initial settings, intermediate contingencies and alternative paths to variable goals. The mechanism of mental simulation has been utilized to integrate traditional counterfactual reasoning with decisions concentrating on the present and future (Sanna, Carter, & Small, 2006).

4.7 AS, Assimilation and Contrast in Reflection and Evaluation

Similarity or assimilation plays an important role in AS. Assimilation in modern psychology is a search process to yield similarity judgments. As Tversky (1977) argues, similarity judgments are extensions of directional similarity statements, that is, statements of the form “x is like y.” The use of similarity judgments has been an important field of study for cognitive psychology (see, e.g., Tversky, 1977). In addition, similarity judgments are important when individuals apply heuristics such as, for example, the fundamental heuristics of representativeness, availability and anchoring (see for example, Koutsobinas 2014).

Besides assimilation, contrast is an important consideration for counterfactuals that take place in different types of mental models. Those include the selective accessibility account (Mussweiler, 2003), the inclusion-exclusion framework (Schwarz & Bless, 1992), the interpretation-comparison theory (Stapel & Koomen, 2000) and the reflection-evaluation model (Markman & McMullen, 2003). In the latter model, various types of comparative judgment such as counterfactual comparisons involve both similarity and contrast. In the reflection stage, reactions can be experiential because a speculative simulation of a possible option may be viewed fleetingly as if it were true. On the contrary, the utilization of an alternative result as a benchmark facilitates the evaluation of existing activity. While assimilation considerations are more prevalent during reflection, the use of contrast is important during the evaluation stage. For this reason, contrast is important in the utilization of a counterexample. Moreover, both assimilation and contrast are connected to affect (Epstude and Roese, 2008). Beyond affect, the activation of mental sets facilitate counterfactual thinking on performance (Galinsky & Moskowitz, 2000; Galinsky, Moskowitz, & Skurnik, 2000).

4.8 Contrast, Counterexamples and Perfect Rationality

Standard counterfactuals are usually used to analyze how a given mental state represents reality. However, counterfactuals are also used when a mental state counts as knowledge, held with certainty. This is a special form of counterfactuals, which is called counterexamples. A counterexample, contrasts a proposed inference regarding the antecedent or the consequent. As such it expresses an exemption to a proposed inference,

which is assumed to be valid. For this reason, the counterexample is used to refute a general argument. Counterexamples use the help of knowledge to render inferences (whether valid or not) problematic. As such, they constitute specific demonstrations of the inaccuracy of a general quantification (such as a statement that holds "for all" members of a sample). A valuable use of counterexamples is to identify new conditions that must be addressed successfully in causal reasoning (Starr, 2019).

Counterexamples are frequently used for evaluation purposes in causal reasoning. This process involves a logical argument where the conditional sentence is presented in alternative ways giving rise to affirmation or contrast of premises and conclusion. For example, we have the following valid statements: 1. If the price of gas rises then traffic will diminish (modus ponens; MP); 2. Traffic does not diminish, therefore the price of gas does not rise (modus tollens; MT). In addition, we have the following two invalid arguments: 3. Traffic diminishes, therefore the price of gas rises (affirmation of the consequent; AC); and, 4. The price of gas does not rise, therefore, traffic does not diminish (denial of the antecedent; DA) (for a similar example, see Evans et al., 2010).

A causal contrast is a contrast in a target rather than in a substitute. For this reason, it serves as an evaluation measure of causal impact in the outcome. Causal contrasts must be given accurate descriptions. One of the arguments needed for a causal contrast is that it must be counterfactual because it describes situations under a hypothetical alternative to actual circumstances or to stated premises. Contrasts as in cases 2 and 4 may be utilized as the background to build counterexamples. For example, a counterexample may be that traffic does not diminish because of better quality of gas rather than because the price of gas does not rise.

Empirical evidence shows the counterexample model is more useful in denial inferences. A prominent model in causal reasoning is the so-called counterexample model (see Evans et al., 2010). This model relates to the mental model theory (see Johnson-Laird and Byrne (2002) and the dual-mode mode of causal reasoning (see Verschueren et al. (2005)). In the counterexample model, "the only relevant consideration is whether a counterexample comes to mind, either to a valid or to a fallacious inference" (Evans et al., 2010, p. 901). Counterexamples are also important because through them reasoners can form specific evaluations and plan better their actions as they become more cautious or pursue alternatives.. It has been shown that intelligent individuals seem resist AC inferences when counterexamples are recalled. This finding is compatible with empirical evidence, according to which, causal reasoners who display a better ability to use their active memory tend to use counterexamples in order to avoid misleading inferences in their thinking (see De Neys, Schaeken, and d'Ydewalle (2005a, 2005b).

The counterexample model is also appropriate for planning because it empirically furnishes the best framework for certain types of inferences in reasoning. Those include DA and MT inferences, which take place with the help of pragmatic directions and AC for intelligent individuals (Evans et al., 2010). It has been argued that those results are consistent with the

hypothesis that the use of contrast requires obvious, analytic processing (see Deutsch, Gawronski, & Strack, 2006). This guides DA and MT reasoning because the less important idea and conclusion in an inference include the use of contrasts and negations. However, although it involves a lot of energy, this mechanism does not inevitably imply always logical consistency (Evans, 2008). Opposite effects on logical reliability can be produced because the retrieval of counterexamples will tend to block both fallacious DA and valid MT inferences (Evans et. al., 2010, p. 905).

4.9 Attribute Substitution, Simulation and Causal Reasoning

Beyond the counterexample model, a dual-mode analysis of causal reasoning was supported by Verschueren et al. (2005). In this model, beliefs impact conditional reasoning through two alternative processes. One way is reasoning through counterexamples, in an all-or-none manner. Another route is the development of probabilistic belief relations. According to this approach, belief bias and conditional probability models are processes, which belong to the first type of the dual-process system, while the counterexample model corresponds to the second category.

Although little attention has been paid on the relation between AS and counterexamples, there is definitely a connection between those two mechanisms. The framework of the general mental model describes ordinary processes of reasoning based on causal conditional inferences (see for example, Markovits and Barrouillet, 2002). In their framework, the automatic recall of pertinent evidence is a substantive function (see for example, Barrouillet, Markovits, & Quinn, 2001). In a situation which involves a causal rule such as a prefactual or a future conditional, for example, “If you water a plant well, then the plant stays green”, reasoners build a plain model that involves the aid of a conditional or causal rule as an option. While fundamental ultimate solutions are generated in terms of this explicit model, there are cases in which additional information is sought through disablers or alternatives. For example, for causations such as the MP and MT, the fundamental hypothesis helps to recall one or more disablers, which help reasoners to reject the inference, for example, that the existence of water results in a green plant. AS as per the simulative heuristic helps identify disabling causes or forces such as the sunlight or the quality of plant. The disabling mechanism induces the use of counterexamples, which are important in reasoning. Similarly, alternative causes are automatically sought in AC and DA, such as alternative technologies or activities (i.e., the use of a fertilizer) to explain why the inference is validated in the absence of the premise. In this case, AS and the simulative heuristic generate an inductive search for an alternative cause in order to understand that the default inference in causal reasoning does not constitute the only possible outcome. Moreover, distinct long-term memory structures facilitate the retrieval of either disablers or alternatives.

To sum up, AS is an important force in counterfactual thinking such as in the operation of prefactuals in causal reasoning through the operation of heuristics. For example, the simulation heuristic is important in the reflection stage, in which alternatives and disablers

are sought in a prefactual. While alternatives are discovered through assimilation effects, disablers are activated through contrast effects. The menu of contrast effects is heavily influenced by the recall of assimilation effects so that contrast inferences are built. In turn, contrasts are used in counterexamples, which are a special case of counterfactuals in which an instance of a conditional is rejected. While AS through heuristics such as assimilation, simulation and fluency support the reflective-inductive stage of causal reasoning, it also facilitates the evaluation process that uses an analytic processing through its impact on the building of counterexamples. Therefore, besides reflective reasoning, conditional thinking in the form of counterexamples is valuable for evaluation and an essential mechanism of rational thought. This consideration is often overlooked relatively to the more well-known mechanism of the value of forecasting/statistical strategies through probabilistic analysis in rational thought. But, as we see in the next section, even this latter type of analysis regarding the exercise of rational thought can be susceptible to the impact of AS.

4.10 Attribute Substitution, Probabilistic Reasoning and Cognitive Misery

The mental model framework (Byrne, 1997, 2002, 2005; Byrne & McEleney, 2000; Feeney & Handley, 2006) has offered an analysis of the standard counterfactual and prefactual processes within the framework of reasoning. In this structure, specific parts of information are brought together to develop inferences. This framework is considered as a diagnostic counterpart of judgments based on probability (Verschueren et al., 2005). First, reasoners are at a stage when they are certain and conscious of the specific counterexamples, which they retrieve such as “fertilisers” or “technologies”. Moreover, the process is sequential because the conclusion phase follows the prototypical construction stage. The reasoning mechanism works through the choice of a specific counterexample, which was initially recalled because of the existing capacity of memory (see also Barrouillet & Lecas, 1999; Verschueren, De Neys, Schaeken, & d’Ydewalle, 2002) and transforms to an analytic counterpart in a dual-mode framework where the analytic conclusion is capable to prevail over the initial heuristic conclusion.

AS has been widely connected to cognitive misery because it is broadly thought to retrieve heuristics in an automatic fashion rather than to support sequential processes. This constitutes a misconception because the utilization of a statistical strategy can also be the outcome of heuristic choice. According to studies of predictions related to the dual-process perspective of reasoning (i.e., Stupple et al., 2011; Stupple & Ball, 2014; Stupple, Pitchford, Ball, Hunt, & Steel, 2017) reasoners who react faster because they utilize a statistical strategy may be expected to act as cognitive misers with weaker working memory capacities (Stupple, Gale, & Richmond, 2013). Therefore, the use of statistical strategies may represent a failure or absence of ‘decoupling’ the problem from the fruitful mental simulation of its solution (Toplak & Stanovich, 2012). In this situation, which is representative of the analytic type in the dual-process system of reasoning reasoners skip real, circumstantial and belief-driven aspects of a problem to make hypothetical thinking in terms of its abstract qualities.

5 The relevance of CFT to behavioral economic explanations of economic behavior

The main advantage of including an analysis of CFT in the AS framework is that it provides an explanation of individual behavior alternative to using perfect rationality as a benchmark and as a further expansion of an ecological rationality ‘fast and frugal’ understanding of decision-making (Berg 2014; Berg and Gigerenzer, 2010). If the standard AS framework emphasizes ease of substitution, fluency, and scope for reducing ‘cognitive misery,’ the analysis of CFT emphasizes individuals’ engagement with causal reasoning both in the formation of their intentions and in their evaluation of their mental models this reasoning involves.

We characterize these processes as a form of ‘reflectivity’ whereby people assess their behavior and potentially revise it according to those assessments (Davis, 2018). In effect, they are ‘rational’ in a different way than standard choice theory imagines people to be. They are rational in the way social scientists are rational who seek to explain behavior in a detached, objective way. We do not see this as inconsistent with the heuristics and biases program, but as rather an extension of it. People also still rely on ‘fast and frugal’ decision-making through AS, but they also exercise capacities for judgment connected to their understanding of causal reasoning.

We believe this also has important implications for behavioral policy. Nudge and choice architecture strategies work, as it were, behind the backs of individuals by influencing their fast, automatic adjustment systems. At best they pay lip service to people’s reflective capacities. In contrast, in a CFT-AS approach choice architects need to involve people in the activity of assessing how they understand their choices. They presuppose people are causal reasoners, who need to constantly investigate complex uncertain environments. This shifts the focus of behavioral policy from nudges to ‘boosts’ (Grüne-Yanoff and Hertwig, 2016; Hertwig and Grüne-Yanoff, 2017), and makes people’s learning central to the effectiveness of behavioral policies. It also accords greater respect to people’s autonomy and agency, thus responding to critiques of paternalism associated with the nudge program.

Another related framework to “boost” (see Hertwig, 2017) is the “think” approach, which acknowledges the institutional aspect of the formation of preferences approach (Jones, Smith and Stoker, 2011). This policy proposal encourages exchange of views in an environment in which there is a strong motivation to consider the public good through deliberation in a more civic way. The strong point of “think” is its emphasis on large-scale acknowledgment on the part of community residents that significant shifts in lifestyle are perhaps vital. Think may produce changes that are genuinely innovative partly because of the amount of effort and the degree of reflection involved. Overall, there is a growing field of behavioural policy frameworks which, contrary to “nudge”, incorporate the “reflective” nature of behavioural change. A full analysis of this literature is beyond the boundaries of the present article.

6 A socially embedded *Homo sapiens*

Although we cannot review this growing field of behavioral policy, in light of our arguments regarding CFT-AS this section does make brief comments about the social dimensions of our analysis. This takes us beyond much current thinking about behavioral economics which sees it as essentially providing improved explanations of individual decision-making. Our view is that one important thing that CFT-AS adds to those explanations are the social aspects of individual decision-making that often go neglected in behavioral economics.

A central claim of behavioral economics, then, is that the standard *Homo economicus* individual ought to be replaced by a *Homo sapiens* individual (Thaler, 2000). Yet because the former treats individuals as atomistic beings, it may be thought that the latter does as well. A more appropriate understanding in our view is that a *Homo sapiens* individual is a social being whose decision-making is influenced more or less by socially shared methods of thinking about many choice opportunities that people commonly face. An advantage of employing an analysis of CFT in a AS framework is thus that it makes easier a case for the relevance of a social *Homo sapiens* as against the atomistic *Homo economicus* specifically in connection with this role reflectivity plays in individuals' social interaction with others. Ultimately, AS with its roots in attribution theory and social psychology stresses the variable impact of situational factors, which apparently exist in social milieu.

We have emphasized how AS is linked to individuals' CFT where that is strongly associated with their causal reasoning. CFT is particularly important in 'large worlds' associated with Knightian uncertainty because those circumstances are less predictable and require more extensive assessment than Bayesian updating methods allow. Thus if in 'small worlds' individuals often have sufficient cognitive resources to make decisions on their own, in more intractable 'large worlds' they are likely to use AS including to draw upon the reasoning of others in like choice scenarios. Moreover, our interpretation of CFT as specifically a method of assessing causal relationships in contrast to Bayesian updating means it entails significant types of shared social reasoning.

We characterize this shared social reasoning as a socially embedded type of thinking, and accordingly interpret behavioral economics *Homo sapiens* individual as a socially embedded individual. For us, the expression 'socially embedded' has a stronger meaning than saying decision-makers are influenced or affected by their social relationships.

That weaker meaning is employed in many *Homo economicus* individual explanations that allow people's social relationships influence or affect their choices but do not in any way, as it were, 'co-determine' their choices. By a socially embedded shared social reasoning, we mean that people's choices are not strictly their own alone, but are 'co-determined' in several occasions with or against other causal reasoners. If 'small worlds' decision-making is often individualistic, the more difficult 'large worlds' decision-making people engage in

is unavoidably socially embedded in this sense. Even reflective reasoning, which is creative and innovative uses as its benchmark observed social relationships and social reasoning.

Savage allowed that his distinction between ‘small worlds’ and ‘large worlds’ was not sharp (Savage, 1954, p. 16). Bayesian reasoning that is used to explain decision-making in the former is usually taken to be a more or less ‘natural’ way people process information. Yet most people have no idea what ‘Bayesianism’ is, and may well learn how to process information by observing others. If so, then there is always at least a degree, small or substantive, to which that thinking is socially embedded in our sense as well. However, we leave this essentially unexamined issue to future discussion.

7. Concluding Remarks

We close with a general comment about the relationship between AS and CFT and its impact on behavioral economics and behavioral change policy. AS is a means by which people psychologically produce more manageable representations of the choices they face, CFT-AS is a kind of causal reasoning that invokes rationality, as is proposed by Byrne and her colleagues. Their combination brings out dimensions to people’s decision-making that we believe have received insufficient attention in behavioral economics, mainly because it has been heavily influenced by the fact that AS was thought to apply more to automatic rather than to reflective responses. Further, if behavioural policy frameworks that have emphasized “nudge” were then to incorporate the “reflective” nature of decision-making CFT-AS involves, we believe this would open up new perspectives for those policy frameworks.

To show this, we first argued that CFT expressions such as prefactuals and future conditionals convey hypothetical causal rules suitable for diverse tasks such as planning and finite expectations as well as mental simulations via the disabling character of AS. While AS through heuristics such as assimilation, simulation and fluency support the reflective-inductive stage of causal reasoning, it also facilitates an evaluation process that uses analytic processing through the building of counterexamples. As a special form of CFT, counterexamples are a disabling mechanism, which is frequently used for evaluation purposes in causal reasoning. Moreover, even if proponents of the standard heuristics approach do not wish to say AS involves reflective judgment, it is an idea that is supported within social psychology and its attribution theory upon which AS is based. For this reason, the alternative framework of human psychology of AS does not depend on a pathological interpretation of behaviour, as it is the case with the standard program of fixed heuristics and biases, which are typically examined against the benchmark of perfect rationality stressed in standard neoclassical economics (see Berg et al., 2016).

Second, we argued that the analysis of CFT and AS points to the possibility of choice architecture beyond the automatic system, which is stressed by nudge theorists. For this reason, it is relevant for alternative behavioural change approaches in social marketing and community based social relations, which take into account people’s social and institutional embeddedness. Considerable research must be further undertaken not only for the purpose

to clarify further the relation between AS, CFT, cues and heuristics, mental models and social embeddedness, but also to develop further behavioural and culture change policies.

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