The influence of causal connections between symptoms on the diagnosis of mental disorders: Evidence from on-line and off-line measures

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Abstract

An experiment conducted with students and experienced clinicians demonstrated very fast and on-line causal reasoning in the diagnosis of DSM-IV mental disorders. The experiment also demonstrated that clinicians' causal reasoning is triggered by information that is directly related to the causal structure that explains the symptoms, such as their temporal sequence. The use of causal theories was measured through explicit, verbal diagnostic judgments and through the on-line registration of participants' reading times of clinical reports. To detect both on-line and off-line causal reasoning, the consistency of clinical reports was manipulated. This manipulation was made by varying the temporal order in which different symptoms developed in hypothetical clients, and by providing explicit information about causal connections between symptoms. The temporal order of symptoms affected the clinicians' but not the students' reading times. However, off-line diagnostic judgments in both groups were influenced by the consistency manipulation. Overall, our results suggest that clinicians engage in fast and on-line causal reasoning processes when dealing with diagnostic information concerning mental disorders, and that both clinicians and students engage in causal reasoning in diagnostic judgment tasks.

Key words: causal reasoning, clinical reasoning, inconsistency paradigm, causal status, symptoms temporal sequence.

The DSM-IV-TR[1] (Diagnostic and Statistical Manual of Mental Disorders; 4th ed., American Psychiatric Association, 2000) offers a classification system for mental disorders which is intended to be atheoretical or, at least, neutral regarding the multiple theoretical approaches which clinical psychologists rely on. The classification system is based on lists of diagnostic criteria, most of which are considered as neither necessary nor sufficient in order to diagnose a given client with a mental disorder. For example, the application of the Avoidant Personality Disorder category only requires any combination of four features from the seven defining features of this disorder. It is assumed, therefore, that an appropriate application of the DSM-IV diagnostic criteria entails that clinicians should avoid relying on any theory about how symptoms are causally connected (Kim & Ahn, 2002).

Despite what has been said above, Kim and Ahn (2002) provided evidence suggesting that both clinicians and Psychology students relied on their idiosyncratic causal theories when asked to make diagnostic judgments. Specifically, they found that participants in their experiments were more likely to diagnose a hypothetical client with a given mental disorder when the symptoms present were causally central, according to participants' own causal theory for the disorder, than when the symptoms were causally peripheral or isolated. This occurred even though all the symptoms used in the experimental manipulation formed part of the diagnostic criteria for the disorders according to the DSM-IV. Thus, it is clear that Kim and Ahn's results indicate a sort of causal bias[1] that makes clinicians and non-clinicians depart from the DSM-IV prescriptions. Later studies have shown that the effects of causal reasoning in clinical Psychology contexts are not limited to diagnostic judgments as they have been shown to be involved in a diversity of tasks and processes including judgments of treatment and intervention efficacy (Ahn, Proctor, & Flanagan, 2009; de Kwaadsteniet, Hagmayer, Krol, & Witteman, 2010; Yopchick & Kim, 2009), seeking additional information (de Kwaadsteniet, Kim, & Yopchick, 2013), the perception of patients as being more normal vs pathological (Ahn, Novick, & Kim, 2003), or judgments of the need for psychological treatment (Kim & LoSavio, 2009).

An important question regarding Kim and Ahn's (2002) finding still remains unanswered, namely, the specific nature of the reasoning processes responsible for the causal bias reported. This bias could be the result of intuitive processes that take place very early in time in a fast, automatic, and on-line manner as part of the comprehension processes in which diagnosticians engage as they receive relevant clinical information. In other words, it may be the result of the operation of intuitive reasoning or *Type 1* processes that have been suggested to be a source of biases and errors in different areas of human reasoning (Stanovich, 1999; Evans & Stanovich, 2013; or *System 1,* as in Kahneman & Frederick, 2002, and Kahneman, 2011). On the other hand, in other circumstances, the bias may be the result of the operation of slow, effortful, deliberate or *Type 2* processes (Stanovich, 1999; Evans & Stanovich, 2013; or *System 2*, as in Kahneman & Frederick, 2002, and Kahneman, 2011) that may take place in an off-line manner, after receiving all the relevant information and once participants are asked to make a diagnostic judgment. The results from Kim and Ahn's (2002) study, based on the use of a diagnostic judgment task in which participants had plenty of time to reflect on information that was permanently available about several hypothetical clients, do not allow us to know the extent to which each of these two different kinds of processes are involved in diagnostic tasks.

The intuitive process account may be especially pertinent in the case of expert clinicians as there is evidence that expert clinicians' knowledge is represented via structurally organized units (or scripts). Once such structured representation is activated, it would participate in the production of inferences as well as in the developing of a coherent mental model of the clinical information provided (see, for example, Charlin, Boshuizen, Custers, & Feltovich, 2007; Charlin, Tardif, & Boshuizen, 2000; Schmidt, Norman, & Boshuizen, 1990; Smith, 1989). Furthermore, the clinicians' knowledge can be represented as dynamic neural networks (Berrios & Chen, 1993). Both ways of representation allow automatic and efficient inferences and access from memory through fast activation processes.

A relevant question, then, is whether people engage in this intuitive form of causal reasoning when confronted with the diagnosis of mental disorders. In other words, it would be interesting to know whether the causal bias is associated with the engagement of fast, automatic, and on-line causal reasoning processes.

Previous studies have already shown that clinicians' diagnostic decisions can take a few minutes, with only slight variations in these decisions if more time is allowed (Kendell, 1973; Sandifer, Myron, Hordern, & Green, 1970). However, a few minutes and judgmental responses leave plenty of opportunities for slow, reflective and resource demanding processes to take place. We are interested in processes that take place in a few tenths of a second and that demand very few cognitive resources to operate. For example, there is recent evidence that the activation of causal information may appear under speeded conditions when participants are confronted to categorization tasks (Luhmann, Ahn, & Palmieri, 2006). This is the sort of evidence that we aim to find when people confront the diagnosis of mental disorders.

Kim and Ahn's (2002) previous demonstration of causal reasoning in the diagnosis of mental disorders have focused on manipulations of the presence or absence of symptoms. However, causal reasoning should also be tapped by providing information with clear implications about causal connections between symptoms without altering the presence or absence of such symptoms. After all, relevant clinical information such as that included in clinical reports does not only consist of mere lists of symptoms from the DSM-IV. They frequently include additional information such as the temporal sequence of symptoms, or statements making explicit the causal connections between symptoms inferred from the clinical assessment process. Imagine, for example, that a clinician is provided with information about a client who has been previously diagnosed with a specific disorder. If the clinician has a causal theory of the disorder, they would expect some symptoms to have occurred according to a specific temporal sequence as a consequence of the specific causal connections between such symptoms. Consequently, additional information consistent or inconsistent with the expected temporal order and causal connections should have an impact both on on-line causal reasoning processes, and on the extent to which the clinician agrees on the diagnosis received by the client, despite that neither the temporal order of symptoms nor the causal connections between them form part of the diagnostic criteria established by the DSM-IV. Additionally, the manipulation of the causal information provided through clinical reports without altering the symptoms suffered by the hypothetical clients has several interesting advantages. First, as this manipulation is not based on variations in the symptoms, we can avoid any confound between the causal role of the symptoms and their weights in the diagnostic process. Note that such weights may not necessarily (or exclusively) be based on causal theories. Second, this approach allows us to know the impact of causal information that goes beyond the diagnostic criteria. A strict application of the DSM-IV criteria and prescriptions should lead clinicians to ignore those aspects that are not considered as diagnostic criteria. Therefore, an effect of the inclusion of causal information on participants' performance while holding the symptoms constant may contribute to find strong compelling evidence of the use of causal theories in the diagnosis of mental disorders.

Therefore, our main objective was two-fold. On the one hand, we assessed the implication of on-line, intuitive reasoning as a source of the causal bias in the diagnosis of mental disorders. On the other hand, our aim was to test whether clinical reasoning is sensitive to aspects that go beyond the presence or absence of symptoms. Specifically, we assessed whether reasoning processes and diagnostic judgments were biased by the temporal order of the symptoms, which is a fundamental defining feature of causal relationships.

An interesting situation in which early, fast, and on-line causal reasoning can be detected is the reading of clinical reports. All of the major accounts of text comprehension assume that readers make on-line inferences during reading (Graesser, Singer, & Trabasso, 1994; McKoon & Ratcliff, 1992; van Dijk & Kintsch, 1983; Zwaan & Radvansky, 1998). One of the purposes of on-line inference making is to maintain the coherence of a text on both global and local levels. Maintaining coherence of the text occasionally requires the search and discovery of causal links that connect different portions of the text (Black & Bower, 1980; Kendeou, Smith, & O'Brian, 2013; Schank, 1975; Trabasso & Sperry, 1985; Trabasso & van den Broek, 1985). According to this, if reasoners carry out the reading of clinical reports for a later diagnostic judgment task, they should engage in comprehension processes involving the making of on-line inferences to link different parts of the text to preserve coherence. Thus, imagine that a clinical report provides some preliminary information consistent with a specific mental disorder. Later on, a target sentence provides information about a relevant symptom. To maintain coherence, a bridging inference should be made to link the preliminary information to the target sentence. Note, however, that, if reasoners are instructed to make a fluent reading, a series of processes have to operate in a fast and on-line manner. For example, reasoners should quickly activate previous domain specific knowledge consistent with both the target sentence and the preliminary information. Also, a fast diagnostic inference from the symptom referred to in the target sentence (via activation processes) should be made. If the inference is consistent with the preliminary information, a link would be formed between this part of the text and the target sentence to build up a unified structure containing both parts (Ericsson & Kintsch, 1995; Kintsch, Patel, & Ericsson, 1999).

A particularly interesting experimental strategy to detect the reasoning processes just mentioned is the so-called inconsistency paradigm, which has been used within the reading comprehension research field (Albrecht & O'Brien, 1993; Long & Chong, 2001; Peracchi & O'Brien, 2004). According to previous results obtained with this strategy, the reading of an inconsistent text (i.e., a text in which an inconsistency between two or more sentences is detected) occurs less rapidly than the reading of a consistent (i.e., a text in which coherence is facilitated) or a neutral text. As readers attempt to maintain the coherence of a text, finding inconsistent information demands time and cognitive resources to resolve the conflict. In this study, we created inconsistent and consistent conditions by manipulating the temporal order of symptoms. Assume, for example, that, according to a clinician's causal theory of Disorder X, Symptom S1 causes S2, which in turn causes S3. Note that Symptom S1 would be a high causal status symptom as it may be regarded as the causal origin of the two remaining symptoms S2 and S3, whereas S3 would be the lowest causal status symptom as it does not produce further symptoms. A clinical report stating that a client who is diagnosed with Disorder X developed S1 followed by S2, and then S3 would be consistent with the clinician's expectations based on her/his causal theory. Conversely, a clinical report stating that the client first developed S3, then S2, and then S1 would be inconsistent with the clinician's causal theory. In such a case, clinicians should spend more time reading the clinical report to solve the inconsistency. It should be noted that the detection of an inconsistency during fluent reading entails the following processes: a) fast activation of domain specific representations and theories; b) rapid inference making from the target sentence based on prior knowledge and/or theories; and c) detection of a contradiction between an inference and the information conveyed by a sentence (Long, Seely, & Oppy, 1996). Consequently, this paradigm allows for a direct detection of automatic, fast activation processes and inference making in an on-line manner during reading, which could be regarded as intuitive reasoning. An additional advantage of the inconsistency paradigm is that there is a good amount of neuroscientific evidence showing that both local- and discourse-level inconsistencies are detected in a few more than 250 ms (see Hagoort & Berkum, 2007, for a review). Such evidence suggests that comprehension processes are based on fast activation processes searching for coherent and unified representations, which reinforces the characterization of such processes as intuitive or Type 1 processes.

Additionally, and given our objectives, it would be advantageous to include explicit information regarding the presence or absence of causal links between the symptoms within the inconsistency paradigm. Consider, for example, that participants are informed that S1 produced S2, which in turn caused S3. If this information is provided together with consistent information regarding the temporal sequence of symptoms, participants should agree to a greater extent with the diagnosis that is stated in the preliminary information. Correspondingly, if participants are informed explicitly that no causal connection between the symptoms has been detected together with inconsistent information regarding the temporal sequence of symptoms –i.e., S3 followed by S2 followed by S1 – clinicians should tend to agree to a lesser extent with the diagnosis stated in the preliminary information.

Then, we created clinical reports that could be either consistent or inconsistent with participants' causal theories of different disorders (see below). The target sentences provided information about the temporal sequence of the symptoms. We expected to observe longer reading times (RTs) in the inconsistent than in the consistent condition. At the same time, we expected both the information regarding the temporal sequence of symptoms and the information regarding causal connections between the symptoms to influence participants' judgments of agreement. Thus, the results of this experiment would provide evidence for intuitive causal reasoning and would allow us to assess the consistency between such intuitive reasoning and participants' diagnostic judgments. A similar approach to the study of reasoning processes in the diagnosis of mental disorders was already used by Flores, Cobos, López, & Godoy (2013). They also used the inconsistency paradigm to detect fast, automatic and on-line processes during reading of clinical reports for later diagnosis of mental disorders. However, their aim was to show that Type 1 processes were associated to the differential weighting of the DSM-IV diagnostic criteria rather than to assess the engagement of Type-1-based causal reasoning. Thus, instead of manipulating the temporal order of symptoms, they manipulated the presence or absence of specific symptoms to assess its impact on both RTs and diagnostic judgments. They found an inconsistency effect on RTs which were coherent with participants' diagnostic judgments. Their results might be taken as evidence of the intervention of reasoning processes that take place very early in time and in an on-line manner.

After the reading and the diagnostic judgment tasks, participants carried out a treatment efficacy judgment task. Judgments in this task were analyzed to check whether participant's causal beliefs were in accordance with the causal chain model (i.e., S1→S2→S3) on which we based our manipulation and predictions. Note that we are not concerned here with what the origin or what the specific content of this causal theory might be, but only with the fact that this theory should be compatible with the

S1→S2→S3 causal chain in which our experimental manipulation has been based. For every clinical report, the participants were required to judge the efficacy of three different treatments for removing each symptom. Treatments T1, T2, and T3 were thought to have a direct removal effect on Symptoms S1, S2, and S3, respectively. Interventions have an interesting consequence that only holds when the variables are linked within a causal structure and provided that people reason according to a rational approach to causal reasoning (Hagmayer, Sloman, Lagnado, & Waldmann, 2007; Meder, Hagmayer, & Waldmann, 2008; Pearl, 2000; Sloman & Lagnado, 2005). For example, a direct intervention on a specific symptom not only has its effects on this target symptom (i.e., a direct effect) but also on others symptoms that are causally connected with it (i.e., an indirect effect). In a S1→S2→S3 causal chain, for instance, a direct intervention on S2 would be equivalent to removing the S1→S2 causal link. This effect occurs because intervening on a variable renders it independent of its causes but not of its effects. Thus, a direct intervention removing S2 would have no consequences on the probability of S1 (a so-called backward effect) but would still vary the probability of S3 (a so-called forward effect). In other words, if participants assume the S1→S2→S3 causal chain, they would conclude that the removal of a symptom would also have consequences *down* the causal chain (i.e., removing the effects of the intervened symptom) but not *up* the chain (i.e., not altering the cause of the intervened symptom). This asymmetry should tend to disappear if no clear causal model links the different symptoms (Meder et al., 2008; Sloman & Lagnado, 2005).Thus, a distinctive pattern of treatment efficacy judgments should be found if participants' causal knowledge of the disorders was in agreement with the causal theory underlying our experimental manipulation of the Consistency factor.

Should participants understood the task correctly and had basic knowledge about the treatments, T1, T2, and T3 will receive the highest effectiveness ratings for the removal of symptoms S1, S2, and S3, respectively (i.e., direct effects). Of greater interest for our purposes, though, are indirect effects. Firstly, indirect effects should be modulated by the causal information provided by the clinical reports. Specifically, the difference between forward and backward effects should tend to disappear in the inconsistent condition. Note that, for example, if S1 is believed to be a causal antecedent of S3, then removing the former with Treatment T1 should contribute to the removal of the latter. In contrast, T3 would not be effective in removing S1 because, in general, removing an effect (S3) of a given symptom leaves its causes unaltered. This logic would no longer apply if no causal connection exists between S1 and S3 as in the inconsistent condition. In such a case, the effectiveness of T1 and T3 to remove S3 and S1, respectively, should tend to be similarly viewed. Secondly, the effect of causal information should only be evidenced in forward effects. Efficacy judgments for forward effects – i.e., T1 on S2 (T1-S2 hereafter), T2-S3, etc. should be higher in the causally consistent condition than in the causally inconsistent condition. This is because indirect forward effects are expected only to the extent that the symptoms are causally connected. On the other hand, no effects of causal information should be observed in backward indirect effects –i.e., T3-S2, T2-S1, etc. In this case, for the reasons just explained, low efficacy ratings were expected in both, the causally consistent condition and the causally inconsistent condition.

To sum up, the experiments reported aimed at showing whether performance on a diagnostic task is affected by intuitive causal reasoning processes operating in a fast, automatic and on-line manner. The second objective was to evaluate whether the causal bias in the diagnosis of mental disorders may also be evidenced by altering the temporal order in which the symptoms develop (i.e., a temporal order consistent with a causal connection between the different symptoms vs. a temporal order inconsistent with this causal connection). These objectives were addressed by using a sample of experienced clinicians and a sample of undergraduate Psychology students. One reason for including a sample of students was to assess whether they would engage in Type-1-based causal reasoning during the reading of clinical reports. As we said above, the implication of Type 1 processes would be especially favored in experienced clinicians as their causal knowledge is represented in a format that may be readily used by fast and automatic processes. Conversely, this implication of Type 1 processes will be less likely in the sample of students as their causal knowledge is less likely to be represented in a format amenable to such fast and automatic processes. However, a strong case for these predictions is difficult to make as the engagement of intuitive reasoning processes would finally depend on the specific materials used in the experiments and, consequently, the specific causal knowledge evoked by these materials.

Method

Participants and apparatus. A total of 101 participants took part in the experiment. Seventy-one Psychology undergraduate students from the University of Malaga volunteered to take part in the experiment in exchange for course credits. Out of a five-year degree, 67 were in their third year, 3 in their fourth, and one in his final year. Only the fourth and final year students had completed credits related to psychopathology and psychotherapy. All students were recruited in their classroom.

The sample of experienced clinicians included thirty clinical psychologists (22 women and 8 men) from private and public institutions who worked in Málaga and volunteered to participate in the experiment. The main theoretical orientation in their professional practice was: 16 cognitive-behavioral clinicians, three psychoanalysts, one humanist, one gestaltist, and nine who used multiple approaches. Their experience as clinicians ranged from three to 30 years and averaged 10 years. They were recruited by a telephone interview.

The experimental task was run on PCs in a laboratory that was equipped with ten semi-isolated cubicles. The sample of clinicians ran the experiment in their consulting rooms.

Materials and design. A total of 12 clinical reports were created to manipulate the causal consistency of the clinical reports. Accordingly, there were six causally consistent and six causally inconsistent clinical reports. We tested the effect of this manipulation on participants' RTs for the target sentences and on participants' judgments of agreement – i.e., judgments of the extent to which they agreed with the diagnosis that was stated in the preliminary information of the reports. Each clinical report included three different symptoms that are considered to be diagnostic criteria (according to the DSM-IV) for the disorder that was stated in this preliminary information.

Clinical reports were referred to clients who were diagnosed with one of six possible mental disorders: anorexia nervosa, major depression, specific phobia, obsessive-compulsive disorder, posttraumatic stress disorder, and generalized anxiety disorder. There were two clinical reports per disorder: one for the causally consistent condition, and one for the causally inconsistent condition. These specific disorders were selected as they had a relatively high prevalence in the general population according to DSM-IV (ranging from 0.5% of anorexia nervosa to 8% of posttraumatic stress disorder) and, additionally, because there are specific psychological theories that establish causal connections among the symptoms that are considered DSM-IV diagnostic criteria (Beck, 1967, 1985; Crisp, 1980; Ladouceur, Blais, Freeston, &

Dugas, 1998, Mowrer, 1947, Salkovskis, 1985). For example, according to Crisp's (1980) model of anorexia nervosa, an important cause of the development of the different symptoms is a feared situation, such as a strong fear of gaining weight (i.e., S1). This fear causes a refusal to maintain a minimal body weight (i.e., S2), an effect that is potentially evident in several overt behaviors, such as a strict diet, vomiting, and laxative abuse. These behaviors in turn cause weight loss and eventually a deterioration that may alter menstruation in women, producing amenorrhea (i.e., S3). In the example, symptoms S1, S2, and S3 are DSM-IV diagnostic criteria. Importantly, according to this theory, these diagnostic criteria should appear in a specific temporal order: first S1, then S2, and finally S3.

All clinical reports followed the same structure. After a first introductory sentence, participants could read the diagnosis made by a clinician. The next sentences introduced the symptoms from the client's verbalizations. Each verbalization suggested the development of one symptom and provided additional information regarding the moment in which the symptom appeared. For the causally consistent condition, the temporal order of the symptoms was consistent with the causal theory of the disorder (i.e., S1, S2, and S3). For the causally inconsistent condition, the temporal order of the symptoms was reversed (i.e., S3, S2, and S1). These were the target sentences for which RTs were registered. Following these target sentences, a final sentence was included that provided explicit information regarding the causal connections between the symptoms. In the causally consistent condition, the sentence stated that the three symptoms were causally related whereas in the causally inconsistent condition stated that no relationship had been established among them (see Appendices A and B).

We used clients' verbalizations to open up the possibility that the interpretation of these verbalizations as symptoms could be guided by causal theories. This way, if a verbalization suggesting a symptom appears in a causally inconsistent clinical report, participants may be more cautious against inferring this symptom. Consequently, the manipulation of causal information may have an effect on participants' tendency to infer the presence of symptoms, thereby increasing the effect of causal information on diagnostic performance.

In order to evaluate whether causal reasoning modulated participants' diagnostic performance, it is crucial to find independent evidence showing that our participants actually had causal beliefs about the disorders involved in the clinical reports, in agreement with the causal theories that served to define our experimental manipulation. This evidence may be taken as a manipulation check. For this, we set up a task in which participants had to judge the efficacy of three different treatments, T1, T2, and T3 for the removal of each of three different symptoms, S1, S2, and S3, that is, a total of nine efficacy judgments (see Appendix C).

Procedure. The experiment took place in two sessions, separated by at least a week. Each session took between 15 and 25 minutes. All participants read the instructions on the computer screen. The instructions included an example of the different tasks participants had to carry out. First, they made a careful and fluent reading of a clinical report referred to a hypothetical client. After that, participants were required to make a diagnostic judgment task and finally, they also had to rate the efficacy of three different treatments. Additionally, we also registered how long participants took to make each of these different judgments. Overall, we expected that judgments in the causally inconsistent condition would take longer than those in the causally consistent condition.

The reading task was self-paced. Initially, every letter of the text was substituted by a mask i.e., a forward slash. Participants proceeded from one sentence to the next by pressing the space bar. Each bar press made readable all letters from a sentence. A second bar press made unreadable the previously read sentence by masking all their letters by forward slashes. RTs for each sentence were defined, then, as the time elapsing between two consecutive bar presses. Readers were not allowed to go back to previously read sentences.

Once the whole text had been read, the diagnostic judgment task started. The clinical report was again displayed at the top of the screen, so that participants could re-read it at any time. At the center of the screen, a message prompted our participants to judge the extent to which they agreed with the diagnosis stated in the report. Below this message, participants could see a horizontal scrollbar that could be manipulated to make their estimations from 0 (i.e., "*Completely sure that the correct diagnosis is different*") to 100 (i.e., "*Completely sure that the clinician indicated the correct diagnosis*"). A small text box just below the scrollbar allowed participants to observe a numerical translation of the different positions of the scrollbar.

Once the diagnostic judgment had been made, the treatment efficacy judgment task started. Again, the clinical report was displayed at the top of the screen. Participants had to rate the efficacy of three different treatments for each of the three symptoms referred to in the report. For example: "*To what extent do you believe that a progesterone-based hormonal treatment will solve, in the short-, medium-, or long-term, the following problems?*" Note that in the example, the treatment mentioned is thought to be aimed at the amenorrhea symptom. The specific assignment of actual treatments to T1, T2, and T3 treatments was counterbalanced across participants. Then, a list including the three statements that were made by the client, each suggesting the presence of one symptom, appeared below this message in a random order. To the right of each statement, a scrollbar with a small text box below were shown. Participants could use the scrollbars to estimate how efficient the treatment was, whereas the text box was used to give participants a numeric translation (from 0 to 100) of their estimation. Once the judgment was made, participants proceeded to evaluate the efficacy of the other two treatments. Participants could revise their ratings before ending the task.

Once participants made their judgments, they could read the next clinical report and then carry out the corresponding diagnostic and treatment efficacy judgment tasks. For each of the two experimental sessions programmed, two sets of six clinical reports were defined, based on one of the six possible mental disorders that were described above. Half of the clinical reports in each set were assigned to the causally consistent and half to the causally inconsistent condition. Each set of clinical reports was used in a different session, the order of the sets being counterbalanced across participants. This way, two clinical reports based on the same disorder were never read during the same session. The order of clinical reports within each session was randomized across different participants.

We also measured how long participants took to make each of the judgments requested (i.e., the diagnostic and the treatment efficacy judgments). We expected that judgment in the causally inconsistent condition would take longer than in the causally consistent condition. In the former case, participants would be expected to spend more time and resources attempting to make sense of a clinical report that was inconsistent with the entertained causal theories. This effect should only occur as far as the participants were engaged in causal reasoning processes in making their judgments and decisions.

Results

Sample of Psychology students

Reading times. The RTs were filtered by removing outliers that were 3 standard deviations from the mean. There were only two outlier RTs, each from a different participant. Given that the target sentences were of different lengths, the RTs were normalized to the number of sentence characters (see Table 1). A repeated measures ANOVA 2 (Degree of Consistency: causally consistent vs. causally inconsistent) x 3 [Causal Status: S1 (high), S2 (medium), S3 (low)] was performed on the normalized RT, yielding a significant effect of Causal Status [F (2, 140) = 12.81, MSE = 40.33; $p <$ .001; η^2=.16] and a significant Degree of Consistency x Causal Status interaction [F (2, 140) = 6.32, MSE= 50.93; p = .002; η^2= .08]. The main effect of Degree of Consistency was only marginally significant [F (1, 70) = 3.35, p = .072; η^2= .05].

Due to the significant interaction, simple effects were analyzed. The consistency effect was only significant within S3, F (1, 70) = 10.78, MSE= 67.92; p = .002; η^2= .13 (remaining F values < 1.65). Thus, the RTs for the target sentence that suggested the presence of S3 (the symptom with the lowest causal status) were significantly longer in the causally inconsistent than in the causally consistent condition. Though this effect may be viewed as consistent with the participation of intuitive causal reasoning, the absence of a significant effect within S1 or S2 (symptoms with higher causal status) speaks otherwise. Participants may have been simply unknowledgeable that S3 was a diagnostic criterion for the disorder mentioned in the report. Thus, when they noticed S3 in the causally inconsistent condition, they found it more unexpected than when they read about S3 in the causally consistent condition, after reading about S1 and S2. Therefore, the difference in RTs detected. Given that no consistency effect was found within S1 or S2, the analyses of the RT did not provide any convincing evidence of the participation of intuitive causal reasoning during reading in the sample of students.

Insert Table 1 about here

Diagnostic judgments. If students rely on causal theories to make diagnostic judgments, we would expect to observe higher ratings of agreement in the causally consistent than in the causally inconsistent condition. That is, students should agree to a greater extent with the diagnosis provided in the report if the temporal order of symptoms and the information regarding causal connectivity are consistent rather than inconsistent with the supposedly entertained causal theory.

Students' judgments were collapsed across clinical reports into a single judgment per condition per person (see Table 1 for mean judgments in each condition). The results revealed that students' ratings in the causally consistent condition were higher than in the causally inconsistent condition. This impression was confirmed using a paired t-test, which yielded a robust significant effect: t (70) = 8.96, p < .001, η^2= .53. Thus, students agreed to a greater extent with diagnosis provided when the causal information was consistent rather than inconsistent with the causal theory.

We also analyzed the time spent in making the diagnostic judgments (see Table 1). Two outlier cases (more than 3 *Sds* away from the mean), each from a different participant, were excluded from the analysis. Consistently with the results obtained in the diagnostic judgments, participants took more time in the causally inconsistent than in the causally consistent condition. This impression was confirmed using a paired t-test: t (70) = -4.76, p< .001, η^2 = .24.

Treatment efficacy judgment task: Evaluating the S1→S2→S3 causal chain. The results from the treatment efficacy task served us to have independent evidence regarding the causal theory that participants held concerning the disorders involved in the clinical reports. Specifically, we were interested in assessing whether the participants' causal theories were consistent with the S1→S2→S3 causal chain model on which we based our manipulation of causal information. For this, participants' efficacy judgments were considered in two different conditions, forward and backward indirect effects. Forward indirect effects included the efficacy of, for example, T1 to remove S2 or T1 to remove S3. Backward indirect effects included the efficacy of, for example, T3 to remove S2 or T3 to remove S1. Prior to the analyses, the judgments were averaged within these two different conditions and then averaged across the six clinical reports. For example, in the forward effect condition, an average rating was calculated from ratings for T1-S2 (i.e., the efficacy of T1 in removing S2), T1-S3, and T2-S3. This mean was calculated for each clinical report, and the means from the six clinical reports were collapsed into a single average. Additionally, the treatment task served us to test whether participants attributed to Treatments T1, T2, and T3 specific effects to remove Symptoms S1, S2, and S3 (i.e., direct effects). Figure 1A shows participants' mean ratings in each condition. The time spent in making these treatment efficacy judgments was also analyzed. Below, we report the results of the analyses that were conducted to test the different hypotheses.

According to our first prediction, if the participants' causal theories conformed to the S1→S2→S3 causal chain model, indirect forward effects should receive higher ratings than indirect backward effects, and this should be specially the case in the causally consistent condition. As can be seen in Figure 1A, ratings in the forward condition were higher than in the backward condition. A repeated measures ANOVA 2 (Degree of Consistency: causally consistent vs. causally inconsistent) x 2 (Treatment Effect: forward vs. backward) was conducted on the participants' mean ratings, which yielded the significant effect of Degree of Consistency, F (1, 70) = 9.69, MSE = 41.92; p = .003; η^2= .12, Treatment Effect, F (1, 70) = 53.78, MSE = 58.42; p< .001; η^2= .43, and Degree of Consistency x Treatment Effect, F (1, 70) = 5.67, MSE = 34.91; p = .020; η^2= .08. The main effect of Treatment Effect confirms the impressions suggested by Figure 1A and provide evidence supporting the prediction that indirect forward effects should receive higher ratings than indirect backward effects. Furthermore, the difference between the forward and the backward effect conditions should be greater in the causally consistent than in the causally inconsistent condition. In fact, this is just the impression suggested by Figure 1A. This impression, in turn, is supported by the significant Degree of Consistency x Treatment Effect interaction reported above. However, to strengthen the case for this prediction, we directly compared the mean difference between the forward and the backward effects in the causally consistent condition against the corresponding mean difference in the causally inconsistent condition. As expected, the difference in the former case was significantly greater than in the latter case, t (70) = 3.62, p = .001, η^2= .16. It is worth mentioning, however, that ratings for the forward indirect effects were significantly higher than ratings for the backward indirect effects even in the causally inconsistent condition, t (70) = 4.40, $p <$ .001, η^2= .21. This result suggests that the participants tended to adhere to an S1→S2→S3 causal model despite having received disconfirming information. This tendency may have been induced by two factors. First, the causally inconsistent clinical reports did not provide information that allowed the participants to build an alternative causal model with which to make sense of the clinical case. Second, the clinical reports were very brief and could make the participants believe that they lacked a good amount of information. These factors together may have led participants to discredit the clinical report to some extent. As a result, in many cases, the participants may have preferred to rely on their causal theory for the disorder to solve the efficacy judgment task.

According to our second prediction, the consistency effect should only be evidenced in forward effects. Specifically, ratings in the causally consistent condition should be higher than in the causally inconsistent condition when considering the forward effect condition. No difference was expected in the backward effect condition. The impression suggested by Figure 1A is consistent with this prediction. The ratings for the causally consistent condition were significantly higher than ratings for the causally inconsistent condition in forward effects, t (70) = 3.97, $p < .001$, $\eta^2 = .18$, but not in backward effects (t =.682, p =.497).

We also analyzed the time participants spent in the treatment efficacy judgment task. In this case, if participants had been engaged in causal reasoning, they would have taken longer to give their efficacy judgments in the causally inconsistent than in the causally consistent condition. In the former case, the absence of information regarding causal links between the symptoms may have made participants uncertain regarding the indirect effects of treatments, and thus, participants should have taken longer to make their judgments. Table 1 gives the mean time spent in each Degree of Consistency condition. As can be seen, there was a small tendency to the opposite direction, although a paired t-test yielded no significant effect [t (70) = 1.152, p = .253]. Thus, the time that the participants took to make their treatment efficacy judgments did not appear to reflect the use of causal reasoning.

Insert Figure 1 about here

Sample of experienced clinicians

Reading times. As with students, RTs were filtered and normalized to the number of sentence characters. Only two RTs from one participant were withdrawn from the analysis. Table 1 gives the mean normalized RTs per condition. As expected, the mean RTs were consistently longer in the causally inconsistent than in the causally consistent condition. This result was confirmed by a repeated measures ANOVA 2 (Degree of Consistency: causally consistent vs. causally inconsistent) x 3 [Causal Status: S1 (high), S2 (medium), S3 (low)] performed on the normalized RTs, which revealed a significant effect of Degree of Consistency, F (1, 29) = 10.60, MSE =226.71, p = .003, η^2=.27. Neither the effect of Causal Status nor the Degree of Consistency x Causal Status interaction were significant (all F values < .546). Consequently, the clinicians' RTs were altered by on-line intuitive reasoning processes as a consequence of the manipulation of the temporal sequence of symptoms. This result suggests that clinicians engaged in intuitive causal reasoning processes during reading of clinical reports. Such causal reasoning seemed to rely on assumptions of causal connections between symptoms consistent with the S1→S2→S3 causal model.

Diagnostic judgments. As with the students, clinicians' judgments were collapsed across clinical reports into a single judgment. An inspection of the mean judgments of agreement shown in Table 1 reveals that, as expected, the clinicians' ratings in the causally consistent condition were higher than in the causally inconsistent condition. This impression was confirmed by a paired t-test: t (29) = 4.27, p < .001, η^2= .39. Consistent with this result, the clinicians took longer to make their diagnostic judgments in the causally inconsistent than in the causally consistent condition (See Table 1): t (29) = -3.83, p = .001, η^2=.33.

This result is in line with Kim and Ahn's (2002) results in that all of them strongly suggest that clinicians' diagnostic judgments appear to be biased by causal theories despite having been trained to use the DSM-IV without relying upon any theory. The novelty of the present study is that it indicates that the use of causal reasoning is not limited to calculating the likelihood of a disorder on the basis of the symptoms that are present or absent. Clinicians also appear to use causal reasoning to process information that is more directly related to the causal structure that explains the symptoms, such as the temporal sequence of symptoms and the explicit information regarding the causal links between the symptoms.

Treatment efficacy judgment task: Evaluating the S1→S2→S3 causal chain. Ratings in this task were analyzed to assess whether the clinicians relied on causal theories consistent with the S1→S2→S3 causal chain model. As in the case of the students' ratings, a single mean rating was calculated for each Treatment Effect condition within each level of Causal Information. Figure 1B shows the mean ratings in each condition.

According to our first prediction, we assessed whether ratings in the forward conditions were higher than in the backward conditions, especially in the causally consistent condition. As can be seen in Figure 1B, ratings in the forward conditions were higher than in the backward conditions. We conducted a repeated measures ANOVA 2 (Degree of Consistency: causally consistent vs. causally inconsistent) x 2 (Treatment Effect: forward vs. backward) on participants' mean ratings, which yielded the significant effect of Degree of Consistency, F (1, 29) = 6.58, MSE = 32.42, p = .016, η^2= .19, Treatment Effect, F (1, 29) = 65.28, MSE = 47.67, p< .001, η^2= .69, and a Degree of Consistency x Treatment Effect interaction, F (1, 29) = 12.52, MSE = 12.84, p = .001, η^2= .30. The significant main effect of Treatment Effect provides evidence supporting the prediction that indirect forward effects should receive higher ratings than indirect backward effects. An inspection to Figure 1B also reveals that the difference between the forward and the backward effect conditions was greater in the causally consistent than in the causally inconsistent condition. This impression was supported by the significant Degree of Consistency x Treatment Effect interaction reported above. However, as we did for the sample of students, we directly compared the mean difference between the forward and the backward effects in the causally consistent condition against the corresponding mean difference in the causally inconsistent condition. The resulting difference was greater in the causally consistent than in the causally inconsistent condition, t (29) = 3.55, p = .001, η^2= .30. As with students, the asymmetry observed between the forward and backward inferences indicates that clinicians were reasoning according to an S1→S2→S3 causal model and that their reliance on such causal model was less pronounced in the causally inconsistent than in the causally consistent condition. However, the ratings for the forward indirect effects were significantly higher than the ratings for the backward indirect effects even in the causally inconsistent condition, t (29) = 7.22, p < .001, η^2= .64. As with students, this result suggests that the clinicians tended to adhere to an S1→S2→S3 causal model despite having received disconfirming information.

According to our second prediction, we assessed whether the effect of Degree of Consistency was significant in the forward indirect effect conditions only. An inspection of Figure 1B confirms this prediction. The difference between the causally consistent and the causally inconsistent conditions was significant in the forward indirect effects, t (29) = 4.29, p < .001, η^2= .21, and not in the backward effects (t =.273, p =.787).

Finally, the analysis of the time spent in the efficacy judgment task revealed that clinicians were significantly slower in the causally inconsistent than in the causally consistent condition (see Table 1), t (29) = -2.394, p = .023, η^2= .16. This result suggests that in the absence of causally consistent information, clinicians appeared to spend time attempting to determine the causal mechanism that explained the symptoms to judge the efficacy of treatments on symptoms.

Overall, the results provide consistent support for the influence of causal beliefs through rapid, on-line intuitive reasoning processes during reading of clinical reports referred to DSM-IV disorders, and when making diagnostic and treatment judgments. Furthermore, the results obtained in the treatment efficacy judgment task showed that clinicians' causal theories of the disorders were consistent with the causal chain model on which our manipulation was based. This result supports the hypothesis that the clinicians' use of causal theories is not limited to the processing of information regarding what symptoms are present or absent. These theories also appear to be used to process other relevant information regarding the causal structure underlying the different symptoms.

General discussion

One of the goals of the present study was to show that the diagnosis of mental disorders can be biased by relevant causal information that goes beyond the presence or absence of symptoms that form part of the diagnostic criteria considered in the DSM-IV. Specifically, we focused on information concerning the temporal sequence of symptoms and the causal connections between them. The other objective of our experiment was to show that some of the reasoning processes responsible for the bias referred can take the form of very fast and automatic intuitive reasoning processes that take place on-line – i.e., at the very moment in which reasoners receive relevant information through clinical reports. These on-line and fast causal reasoning processes were inferred from RTs in a self-pace reading task designed according to the inconsistency paradigm used in reading comprehension studies. The experiment was carried out both with students and experienced clinicians. The results found with students showed that their diagnostic judgments were biased by information about the temporal sequence of symptoms together with information about causal connections.

Specifically, students agreed on the diagnosis received by the hypothetical clients to a greater extent when the temporal sequence of symptoms and the causal connections between them were consistent with causal theories of the diagnosed disorders than when the information provided was inconsistent with such theories. Also, students spent more time in the diagnostic judgment in the causally inconsistent than in the causally consistent condition. However, we did not find convincing evidence of fast and on-line intuitive causal reasoning, as the time spent reading the target sentences conveying information about the temporal sequence of symptoms seemed to be unaffected by whether the temporal order was consistent or inconsistent with the causal theory of the disorder mentioned in the preliminary information of the clinical report.

The results found with experienced clinicians also showed a greater agreement on the diagnosis received by the hypothetical client in the causally consistent condition than in the causally inconsistent condition. Clinicians also took longer in the diagnostic judgment task in the latter than in the former condition, suggesting that they were trying to solve the causal inconsistencies found in the clinical report before making the judgment. Additionally, we found evidence of fast and on-line intuitive causal reasoning, as evidenced by the clinicians' RTs for the target sentences. Specifically, RTs were significantly longer when the information was inconsistent than when it was consistent with causal theories of the disorder with which the hypothetical client had been diagnosed.

A key issue of our study is to show that the effects found are due to the consistency or inconsistency of the clinical reports with participants' causal theories. In other words, to show that participants' causal theories or believes conformed to the causal chain model (S1→S2→S3) that served to base our consistency manipulation. The treatment efficacy judgment task developed served this purpose. In this task, participants had to judge the efficacy of three different treatments to remove each of the three symptoms suffered by the client. Each treatment (T1, T2, and T3) was thought to have a specific direct effect on one of the symptoms (S1, S2, and S3, respectively). The results found in this treatment efficacy judgment task provided compelling evidence that both students' and clinicians' causal theories were consistent with the causal chain model we assumed for the consistency manipulation. First, we found that judgments for forward indirect effects (indirect effects down the causal chain; e.g., the effect of Treatment 2 on Symptom 3) were higher than judgments for backward indirect effects (indirect effects up the causal chain; e.g., the effect of Treatment 2 on Symptom 1). This difference persisted even in the causally inconsistent condition despite the fact that the information provided through the clinical reports was inconsistent with the causal chain model. As expected, however, this difference was larger in the causally consistent than in the causally inconsistent condition. Second, the manipulation of the degree of consistency affected participants' judgments of treatment efficacy only within the forward indirect conditions. Judgments in the direct and backward effect conditions did not differ as a function of the consistency condition. This pattern of results is what from a rational approach to causal reasoning should be expected if participants assumed a causal chain model of the form S1→S2→S3. Consequently, the results suggest that both students' and clinicians' causal theories of the disorders used in our clinical reports were consistent with this specific causal model, even when the information provided through the clinical reports was inconsistent with such model and discouraged participants to engage in causal reasoning.

The results concerning the clinicians' RTs showed converging evidence with previous reading comprehension studies (see, for example, the work by León & Pérez, 2001 in which experts made faster diagnostic inferences than novices though not focusing on causal reasoning processes). There are studies, however, showing that causal relationships play an important role in the search for links between different parts of a text in order to preserve global and local coherence (Black & Bower, 1980; Kendeou et al., 2013; Schank, 1975; Trabasso & Sperry, 1985; Trabasso & van den Broek, 1985). This process of building links between different parts of a text requires access to previous causal knowledge and believes as well as integration processes based on inferences. If the inferential process leads to the detection of an inconsistency between two ideas from the text, the integration cannot be performed in a fast way, which leads readers to spend more time and resources to solve the inconsistency. It is important to note that, when a specific domain is concerned, the detection of causal inconsistencies through fluent reading not only requires the possession of causal theories relevant within such domain but, also, that such causal theories are represented so as to allow for a fast and efficient access and use. The acquisition of these special representations, in turn, is not likely to occur if domain-specific causal theories are not predominantly used to understand and make sense of events within the domain. Therefore, the results corresponding to the sample of clinicians suggest that the use of causal theories in the diagnosis of mental disorders is not something rare that only occurs in artificial environments as a result of experimental manipulations. Rather, such use of causal theories seems to be part of reasoning processes that take place in natural environments.

Although our study was not mainly concerned with the comparison between clinicians and Psychology students, the different results found in RTs deserve some attention. Specifically, there are two differences that seem relevant. One of them is the different impact of the consistency manipulation in each sample. Whereas clinicians were clearly affected by the temporal order of symptoms, no main effect of this factor was found in the case of students. The other difference concerns the different reading speed of each group: In general, students were considerably faster than clinicians. These differences were partially confirmed by a three-way omnibus ANOVA which included the variable Group (clinicians vs students) as a new factor. This analysis yielded the significant effect of Degree of Consistency, F (1, 99) = 11.88, MSE = 137.82, p = .001, η^2 =.11, the significant effect of Group, F (1, 99) = 23.91, MSE = 1249.97, p < .001, η^2 =.20, and the marginally significant effect of the interaction between both factors, F (1, 99) = 3.25, p = .075, η^2 =.03. The fact that only the clinicians' RTs were affected by the manipulation of the temporal sequence of symptoms might suggest that the students group did not possess any causal theory of the disorders consistent with the causal chain model. However, this conclusion is contradicted by the results found in the diagnostic judgment task and the treatment efficacy judgment task, which showed that participants in both samples seemed to rely on equivalent causal theories of the disorders. Therefore, the whole pattern of results seem to suggest that clinicians and students possessed equivalent causal theories of the disorders, but only the former could retrieve and use such theories in a fast and efficient way, affecting the normal reading process in an on-line manner. As for the difference in reading speed, our results seem rather counterintuitive and conflicts with previous results showing shorter RTs in readers with previous domain specific knowledge compared with readers lacking such knowledge (see, for example, León & Pérez, 2001). The former have also been shown to be faster at retrieving and using domain specific contents than the latter (for a review, see Ericcson & Kintsch, 1995; and Ericcson, Patel, & Kintsch, 2000). We have no clear explanation for this difference in reading speed and, as far as our study is not directly concerned with it, we prefer to avoid any speculation. Having said that, one may argue that the fact that the clinicians were slower than the students undermines our conclusion that the consistency effect in clinicians is the result of Type 1, intuitive reasoning. As the clinicians were slower than the students, the former might have been more engaged in slow and effortful deliberate thinking, leading to the consistency effect on RTs. Although this claim cannot be completely rejected on the grounds of the present study, other results found in our laboratory strongly suggest another explanation for the different impact of causal consistency on RTs. In two further experiments conducted by Flores, Cobos, and Hagmayer (submitted), students' RTs were shown to be affected by causal consistency, which was manipulated by varying other features of causal relationships rather than the temporal order of events. Crucially, the RTs found were similar to those found in the students' sample of the present study, but the materials used were different. Therefore, the different impact of causal consistency on clinicians' compared with students' RTs is likely to be related to a difference in their familiarity with the materials used. Furthermore, as said in the introduction, there is ample neuroscientific evidence showing that both local- and discourse-level inconsistencies are detected in a few more than 250 ms (Hagoort & Berkum, 2007), which strongly suggests that the detection of inconsistencies do not require the operation of slow, deliberate thinking.

A possible criticism regarding our interpretation of the effect of inconsistency on clinicians' RTs is that, although causal relationships between the symptoms necessarily involve a specific temporal order, the latter does not necessarily imply that the symptoms are causally connected. Longer RTs in the causally inconsistent condition could be due to the low frequency of clinical cases in which the different disorders develop according to the inconsistent temporal sequence. Thus, in their experience, clinicians may have encountered more cases in which the disorders develop according to the consistent temporal order than cases in which the development conforms to the inconsistent temporal order. According to this account, although clinicians encounter many cases in which symptoms develop in the consistent order, they would nonetheless remain uncommitted to any interpretation regarding how symptoms are causally related. Therefore, the inconsistency effect would be due to clinicians' previous knowledge of temporal precedence completely free of any causal interpretation. Although this alternative explanation cannot be completely ruled out, it is not very convincing. As said above, the results that were observed in the causally inconsistent condition in the treatment efficacy judgment task strongly suggest that the clinicians hold causal theories for the different disorders according to which S1 would be a causal antecedent of S2, and S2 would be a causal antecedent of S3. Moreover, it appears that the clinicians were somewhat reluctant to avoid using such theories despite having received a) information regarding the temporal order of symptoms that contradicted their theories and b) explicit information regarding causal connections discouraging the participants from engaging in causal reasoning. Given this strong tendency to assume the existence of causal links between symptoms, it is more likely and parsimonious to think that such causal theories played an important role in explaining the impact of the temporal order of symptoms on RTs.

A slightly different explanation of the inconsistency effect on RTs would be that clinicians may prefer to read and write down symptoms of mental disorders in the consistent order (i.e., S1-S2-S3). Thus, the participants may have expected to receive information regarding the symptoms in the consistent rather than in the inconsistent order. According to this hypothesis, the inconsistency effect would be a consequence of the order in which the symptoms are listed in the text rather than the order in which the symptoms appeared in the client. The problem with this account is that we lack an explanation of why clinicians' preferences coincide with the causal model that they appear to assume. Given that we used six different disorders to design the clinical reports, it is not very likely that this coincidence is due to randomness. A reasonable explanation would be that clinicians' preference for one symptom order or another is determined by their causal theories. However, if clinicians' preferences for the consistent text order are determined by their causal theories, such causal theories would play an important role in explaining the inconsistency effect on RTs after all. In this line, Pennington and Hastie (1988) worked on juror decision making and showed that even if the events happened in a temporal order that makes sense, people's judgments are influenced by whether they find out about the events in a different order. It would be interesting to see in future experiments whether a similar effect can be found by using our materials and experimental paradigm.

Our results are in line with previous findings. Specifically, as explained in the Introduction section, Kim and Ahn (2002) also found evidence demonstrating a causal bias in the diagnosis of mental disorders of the DSM-IV. Regarding this previous finding, we have gone some steps further in several respects. First, we have shown the implication of automatic and on-line intuitive causal reasoning in clinicians' comprehension processes during reading of clinical reports. Additionally, the results found in RTs were quite consistent with the causal bias found in diagnostic judgments, which suggest that intuitive causal reasoning processes could play an important role in clinicians' bias. Second, our results show that causal reasoning can be tapped by information that goes beyond the presence or absence of diagnostic criteria. Finally, at variance with Kim and Ahn's study in which participants had to draw causal maps for every disorder before making diagnostic judgments, in ours, participants did not perform any extraneous task that may be interpreted as having prompted the use of causal knowledge. Therefore, the use of causal reasoning (especially, in clinicians) has been shown to occur with an experimental procedure that may be regarded as being relatively frequent in ordinary clinical practice.

Our results regarding the efficacy judgment task are also in line with several previous findings found in clinical (de Kwaadsteniet et al., 2010; Yopchick & Kim, 2009) and in non-clinical contexts (Meder et al., 2008; Sloman & Lagnado, 2005). For example, Yopchick and Kim showed that treatment efficacy judgments were determined by the causal status of the symptom more directly affected by the treatment. Thus, if the treatment was aimed at removing the first symptom in a causal chain, it was considered as more effective than if the same treatment was aimed at removing the second symptom in a causal chain. One of the main differences between Yopchick and Kim's study and ours is that the causal chain models in their study were created by the experimenters. Also, treatments in their study were not realistic treatments devised to remove specific symptoms. Another important difference is that the task used by Yopchick and Kim was not focused on mental disorders from the DSM-IV taxonomy. Finally, their study did not include a sample of clinicians. Regarding Meder et al. (2008) and Sloman & Lagnado (2005), participants in their experiments were provided with causal models to link different variables and were requested to make predictive and diagnostic inferences from direct interventions on certain specific variables. As a result, these authors observed the same sort of asymmetry as in our experiments. Specifically, intervening on a variable was judged to have a greater impact on its effects than on its causes. This asymmetry disappeared or tended to decrease when the variables were merely correlated or when the variables were observed rather than acted upon. The interesting aspect of these results is that they indicate the special consideration that interventions have in causal thinking. This consideration is a distinctive feature of causal reasoning that makes intervention tasks a highly relevant experimental tool from which to infer the presence of causal reasoning.

The persistent tendency to use causal reasoning conflicts with both DSM-IV recommendations and with how clinicians are trained to use this resource. It therefore appears that the DSM-IV prescriptions of not relying on causal theories are not sufficient to prevent clinicians from using causal reasoning when performing clinical tasks. In this sense, the recommendation made by DSM-5 of considering clinical diagnosis within the specific formulation of a case seems more compatible with the results reported here. Our results suggest that one explanation for the difficulty of using an atheoretical taxonomy may be that clinicians are not overtly aware of their intuitive causal reasoning processes. Intuitive reasoning processes are thought to be fast and automatic, which makes it more difficult to control. If such is the case, and following DSM-5 recommendations, clinicians' training should be supplemented by training in causal reasoning. This training could be conducted by receiving instructions about the different and (occasionally) subtle ways in which causal theories and beliefs can influence judgments and decisions through intuitive reasoning processes in the clinical context, including the diagnosis of mental disorders from the DSM-IV taxonomy. For this, clinicians may receive information to be aware of the different phenomena evidencing the influence of causal reasoning in different clinical tasks (Ahn et al., 2009; de Kwaadsteniet et al., 2010; de Kwaadsteniet et al., 2013; Kim & Ahn, 2002; Kim, Yopchick, & de Kwaadsteniet, 2008; Yopchick & Kim, 2009).

It is beyond the scope of the present study to assess whether causal reasoning (whether intuitive or reflective) helps clinicians or is a source of errors that should be avoided when dealing with mental disorders. In any case, training in causal reasoning and intuitive reasoning should help clinicians gain further control of their reasoning and decision making and to follow DSM-5 recommendations. Thus, given that intuitive causal reasoning may be exerting its influence in clinical practice, even in an inadvertent way, the idea of guiding clinical decisions by stringent, controlled, systematic causal tests before assuming causal relationships should be in order. In other words, given the pervasive influence of causal reasoning, it would be helpful for clinical practice to guide such influence with rigorous, systematic ways of evaluating causal relationships in clinical practice. Nevertheless, caution should preside over any assumption concerning the existence of causal mechanisms in the clinical work (Garb, 2005; Haynes, O'Brien, & Kaholokula, 2011; Haynes, Spain, & Oliveira, 1993).

Our results also appear to have interesting implications for evidence-based clinical practice, specifically for the application of empirically supported treatments (EST). According to the American Psychological Association, ESTs are currently considered to be the best methods for addressing the treatment of mental disorders and clients' behavioral problems. Although ESTs are quite standardized, there is evidence demonstrating that clinicians have difficulties in following the indications that are prescribed in textbooks (Waller, 2009) and tend to adapt the treatments to either the clients' individual characteristics (McHugh, Murray, & Barlow, 2009) or to the clinicians' case formulation, even when such formulations are not explicit or structured (Pain, Chadwick, & Abba, 2008; Persons, 2006). Our results suggest that causal theories, which appear to be readily available in the clinician's mind and used in a rapid and nearly inevitable way, may play an important role in clinical case formulations (Eells, 2007). Such clinical case formulations would in turn be responsible for the difficulties that are experienced by clinicians when attempting to strictly follow the treatment protocol, especially when the theory on which the EST is based differs from the clinician's causal theory (Anderson & Strupp, 1996; Beutler, 1999). Thus, clinicians' application of ESTs may benefit from a certain degree of training in causal and intuitive reasoning that is aimed to make clinicians aware of the different and subtle ways in which it can affect treatment decision making and treatment application.

Our study leaves many interesting questions unresolved, for instance, the role of the clinicians' theoretical approach in causal reasoning. Given that the theories on which we based our manipulations come from the cognitive behavioral approach, one may expect to find that the effects of such manipulations are modulated by clinicians' theoretical approaches. Unfortunately, the number of clinicians with non-cognitive-behavioral approaches who participated in our experiments was very small, precluding our assessment of this modulating role. However, future experiments may be conducted to answer this question. A related question is the source of clinicians' causal theories. Given that our manipulation was based on theories within the cognitive-behavioral framework taught at academic institutions, it is tempting to conclude that clinicians' causal theories come from this academic instruction. However, the fact that the effects that were observed in the diagnostic and the treatment efficacy judgment tasks were also observed in the students group suggests that there may be alternative origins of causal theories. However, it should be acknowledged that the disorders that were used to design the clinical reports are highly prevalent in the population and well known through the media. Moreover, the causal chain model underlying the symptoms may have appeared to be self-evident given the symptoms and clinical reports used. Therefore, it is possible that the causal beliefs that have been tapped in our experiment do not require any expertise at all. In this sense, it remains to be determined whether the same results hold for less known and less frequent mental disorders. Lastly, when assessing the influence of causal theories on clinical reasoning in the context of DSM-IV disorders, attention has normally focused on theory-derived causal links between the symptoms. However, theories of mental disorders also have implications concerning the causal mechanisms and roots, which are not part of DSM-IV's diagnostic criteria. For example, the fear of becoming fat may cause an aversion to eat, which in turn may cause loss of weight. Alternatively, the fear of becoming fat may cause stomach problems, including bleeding, which in turn may cause a loss of weight. In both cases, the fear of becoming fat is a causal antecedent of the loss of weight. However, the first causal mechanism may be viewed as more consistent with causal theories of anorexia than the second. Consequently, clinicians and perhaps even lay people may be more likely to perceive the first case as suffering from anorexia than the second case. To the best of our knowledge, no experiment has been conducted to test this hypothesis.

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Footnote

1. The term *bias* refers to the fact that, according to DSM-IV, the diagnosis of mental disorder should not rely on how symptoms are causally connected. On the other hand, DSM-5 conceives the diagnosis of mental disorders as part of a case formulation that leads to a fully informed treatment plan for each individual (American Psychiatric Association, 2013). In this sense, DSM-5 considers that a proper diagnosis may involve considering more elements (e.g., predisposing, precipitating, perpetuating or protective factors) than just diagnostic criteria. Thus, considering how symptoms are causally connected may not necessarily be regarded as a bias (see also the Discussion section). In any case, the word bias may be taken as meaning, more modestly, going beyond the strict application of diagnostic criteria as part of the diagnostic process, whether this may be regarded a true bias or error would depend on the specific version of DSM considered.

2. Everything we discuss with respect to DSM-IV-TR (2000) is also generally applicable to DSM-5 (2013) as the American Psychiatric Association has not changed the atheoretical nature of its diagnostic criteria.

Table 1.

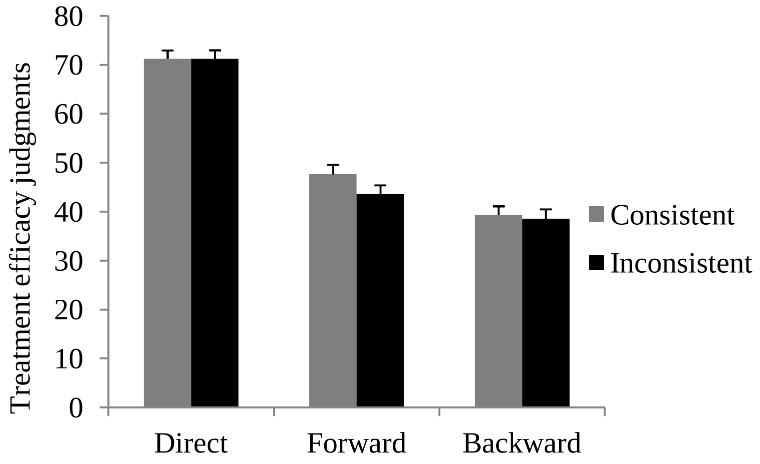
Means and standard deviations of reading times for the target sentences (in milliseconds, normalized per letter) across the different Causal Status conditions and of decision times (in milliseconds); and means of the diagnostic judgments made (in a 0 to 100 rating scale) in the sample of students and in the sample of clinicians.

	Students											
	Causally consistent condition						Causally inconsistent condition					
	S1 (High)		S2 (Medium)		S3 (Low)		S1 (High)		S2 (Medium)		S3 (Low)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
RT target sentences	42.54	11.94	44.71	13.83	42.95	14.61	41.05	13.88	47.45	16.73	46.83	13.86
	M			*SD*			*M*			*SD*		
Diagnostic judgments	75.00			11.56			58.97			14.96		
Decision time for diagnostic judgments	11801.62			5004.51			14266.16			5841.43		
Decision time for treatment efficacy judgments	112747.90			44533.17			102393.40			33604.03		
	Clinicians											
	Causally consistent condition						Causally inconsistent condition					
	S1 (High)		S2 (Medium)		S3 (Low)		S1 (High)		S2 (Medium)		S3 (Low)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
RT target sentences	54.69	20.77	56.92	19.33	53.57	16.97	62.89	25.63	62.92	22.86	61.28	17.82
	M			*SD*			*M*			*SD*		
Diagnostic judgments	70.61			14.35			60.47			11.01		
Decision time for diagnostic judgments	23690.92			10680.38			31423.11			15466.74		
Decision time for treatment efficacy judgments	137554.50			49794.77			173191.10			84050.94		

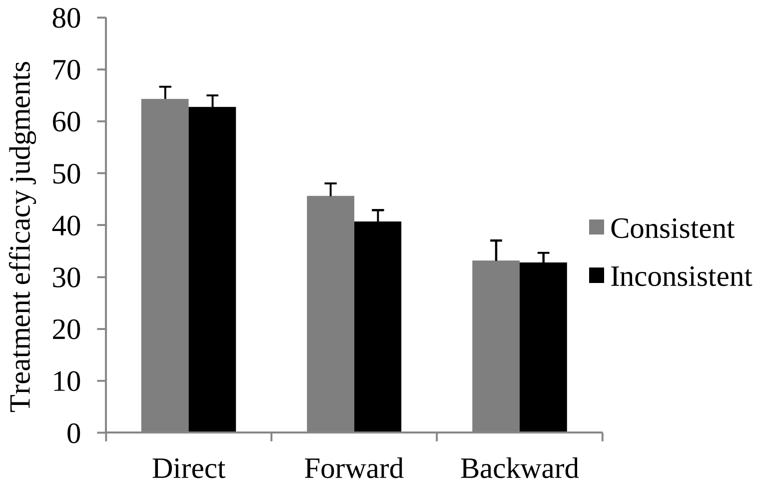
Figure 1.

Mean treatment efficacy judgments across different conditions (Direct effects, Forward effects and Backward effects) in the sample of students (Panel A) and in the sample of experienced clinicians (Panel B). Judgments were made on a 0 to 100 rating scale, where 0 meant “*Completely sure that the correct diagnosis is different*” and 100, “*Completely sure that the clinician indicated the correct diagnosis*”. The error bars represent the standard error of the means.

Panel A



Panel B



Appendix A

Target sentences of causally consistent report and causally inconsistent report

Diagnosis	Target sentences	
	Causally consistent report	Causally inconsistent report
Anorexia Nervosa	"At first I started to get distressed about the possibility of becoming fat " "Some time later, I started to refuse to eat " "Eventually, my period stopped"	"At first, my period stopped " "Some time later, I started to refuse to eat " "Eventually, I have started to get distressed about the possibility of becoming fat "
Major Depressive Disorder	"At first I started to feel very bad with myself for all the problems that happened to my family" "Some time later, I started to feel apathy for everything" "Eventually, I have started to have sleep problems"	"At first I started to have sleep problems" " Some time later, I started to feel apathy for everything " "Eventually, I have started to feel very bad with myself for all the problems that happened to my family "
Anxiety Generalized Disorder	"At first I started to experience continuous worries that I didn't know how to control" "Some time later, I started to suffer from breathlessness, unease and palpitations that could happen at any time" "Eventually, I have started to feel tiredness and lack of energy"	"At first I started to feel tiredness and lack of energy" "Some time later, I started to suffer from breathlessness, unease and palpitations that could happen at any time" "Eventually, I have started to experience continuous worries that I don't know how to control "
Obsessive Compulsive Disorder	"At first I started to feel continuously anxious when seeing anything dirty" "Some time later, I felt could not stop cleaning and checking everything is clean" "Eventually, I have started to feel unease because of the lack of time for family life and work"	"At first I started to feel unease because of the lack of time for family life and work" "Some time later, I felt could not stop cleaning and checking everything is clean" "Eventually, I have started to feel continuously anxious when seeing anything dirty"
Posttraumatic Stress Disorder	"At first I started to get very anxious when remembering the car accident I had" "Some time later, I started to try by every means not to think about the car accident that I had" "Eventually, I have started to get unease for feeling discouraged and unable to drive a car"	"At first I started to get unease for feeling discouraged and unable to drive a car" " Some time later, I started to try by every means not to think about the car accident that I had" "Eventually, I have started to get very anxious when remembering the car accident I had"
Specific Phobia	"At first I started to feel anxiety and unease when coming across dogs" "Some time later, I started to try to avoid walking in places like parks and residential areas" "Eventually, I have started to feel worry and unease about the idea of getting out of home"	"At first I started to feel worry and unease about the idea of getting out of home" "Some time later, I started to try to avoid walking in places like parks and residential area" "Eventually, I have started to feel anxiety and unease when coming across dogs"

Appendix B

Example of the two types of clinical reports used

Example of causally consistent clinical report in which the order of the symptoms is coherent with the order proposed by the theory of the Anorexia Nervosa Disorder and in which the causal connection between symptoms is explicitly made:

P. decided to see a clinical psychologist because she suffered from some problems. After the assessment process, she was diagnosed with Anorexia Nervosa. In what follows, it is provided some of P.'s verbal expressions that the clinician considered relevant. "At first I started to get distressed about the possibility of becoming fat"."Some time later, I started to refuse to eat"."Eventually, my period stopped". After the assessment process, a second clinician found that the events mentioned were strongly related, so that the distress about the possibility of becoming fat originated the refusal to eat which, in turn, made the period stopped in the long run.

Example of causally inconsistent clinical report in which the order of the symptoms is incoherent with the order proposed by the theory of the Anorexia Nervosa Disorder and in which the absence of causal connections between symptoms is explicitly made:

S. decided to see a clinical psychologist because she suffered from some problems. After the assessment process, she was diagnosed with Anorexia Nervosa. In what follows, it is provided some of S.'s verbal expressions that the clinician considered relevant. "At first, my period stopped"." Some time later, I started to refuse to eat"."Eventually, I have started to get distressed about the possibility of becoming fat". After the assessment process, a second clinician could not find any relationship between the events mentioned: the distress about the possibility of becoming fat, the refuse to eat, and the interruption of the period.

Appendix C

Wording of the questions used to request participants the treatment efficacy judgments

ANOREXIA NERVOSA:

"*To what extent do you think that a progesterone-based hormonal treatment will remove, in the short-, medium-, or long-term, the following problems?*"

"To what extent do you think that a treatment focused on a progressive approach to food together with a therapy on nutrition based on the acquisition of healthy habits will remove, in the short-, medium-, or long-term, the following problems?"

"*To what extent do you think that a treatment making the patient face up the possibility of gaining weight, and training her/him to confront the consequences, will remove, in the short-, medium-, or long-term, the following problems?*"

MAJOR DEPRESSIVE DISORDER:

"*To what extent do you think that a treatment based on stimulus control and on learning how to schedule timetables for sleeping and working out will remove, in the short-, medium-, or long-term, the following problems?*"

"*To what extent do you think that a treatment focused on the search for motivating hobbies and daily activities will remove,, in the short-, medium-, or long-term, the following problems?*"

"*To what extent do you think that a treatment aimed to change the attributive style of the patient and self-esteem will remove, in the short-, medium-, or long-term, the following problems?*"

GENERALIZED ANXIETY DISORDER:

"*To what extent do you think that a medical treatment based on energetic dietary supplement will remove, in the short-, medium-, or long-term, the following problems?*"

"*To what extent do you think that a treatment based on control of activation, such as relaxing and breathing activities, will remove, in the short-, medium-, or long-term, the following problems?*"

"*To what extent do you think that a treatment based on thought stopping and changing techniques will remove, in the short-, medium-, or long-term, the following problems?*"

OBSESSIVE COMPULSIVE DISORDER:

"*To what extent do you think that a treatment focused on the learning of strategies of time organization and management will remove, in the short-, medium-, or long-term, the following problems?*"

"*To what extent do you think that a treatment by exposure and response prevention will remove, in the short-, medium-, or long-term, the following problems?*"

"*To what extent do you think that a treatment focused on the control of intrusive-thoughts and on eradicating self-blaming about feared catastrophic consequences will remove, in the short-, medium-, or long-term, the following problems?*"

POSTTRAUMATIC-STRESS DISORDER:

"*To what extent do you think that a treatment to strengthen self-esteem by showing the patient her/his own capacities will remove, in the short-, medium-, or long-term, the following problems?*"

"*To what extent do you think that a treatment based on the exposure to specific thoughts and on thought control techniques will remove, in the short-, medium-, or long-term, the following problems?*"

"*To what extent do you think that a treatment based on the learning relaxation and breathing techniques will remove, in the short-, medium-, or long-term, the following problems?*"

SPECIFIC PHOBIA:

"*To what extent do you think that a treatment based on a progressive exposure to places outside-home (cinema, bars, shops) will remove, in the short-, medium-, or long-term, the following problems?*"

"*To what extent do you think that a based on a progressive exposure to places where dogs are likely to be found (parks, residential areas, veterinary) will remove, in the short-, medium-, or long-term, the following problems?*"

"*To what extent do you think that a treatment based on a progressive exposure (to) and interaction with dogs will remove, in the short-, medium-, or long-term, the following problems?*"