The dilution effect: Conversational basis and witness reliability

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Abstract

The dilution effect occurs when the introduction of non-diagnostic information lessens the impact on reasoning of diagnostic information despite having no relevance to the hypothesis in question. While the effect has been reproduced in several studies, the psychological basis of the effect remains unclear. Some believe it to be conversational while others believe it to be cognitive and social.

The paper tests the conversational basis of the effect by minimising pragmatic, conversational influence. To this end, it makes use of a legal setting with witness testimonies. The studies replicate the dilution effect, which suggests that the basis of the results in the original studies is not conversational. However, the credibility of the source strongly influences whether or not the effect occurs. If reliable sources provide the non-diagnostic information, the effect lessens. Conversely, if unreliable sources provide the non-diagnostic information, we observe a stronger dilution effect.

Keywords: Dilution effect; legal reasoning; source credibility; witness testimonies

Introduction

Most information that humans gain throughout their lives comes from other sources. It may come from friends and colleagues, from professionals such as weather forecasters or news anchors, or it may come through de-personalised sources such as the Associated Press. However, information comes in various guises. Concerning the evidence itself, information may be highly diagnostic and related to a particular hypothesis at stake in the context or entirely unrelated and non-diagnostic. If, for example, an athlete is tested for doping before a race, the subsequent outcome of the test will be highly relevant in determining whether or not the athlete should be allowed to compete. The colour of the athlete's trousers worn during the drug test, however, should not. In addition, the information may be more or less noisy for a variety of reasons. This noise may be due to degradations in the access to information relating to the hypothesis (such as faulty equipment or poor visibility) or it may be due to the reliability of the person who delivers the information.

The aim of the current paper is threefold. First, as discussed in the following section, it has been suggested that the dilution effect (see next section) is a conversational rather than a social or a cognitive effect. In the original studies, it is the experimenter himself who presented the participants with diagnostic and non-diagnostic information. If participants believe that the experimenter has chosen the non-diagnostic information for a reason, it may prompt them to try and interpret the information as somehow diagnostic. By removing the experimenter as the source of the diagnostic and non-diagnostic information, we test this possibility. We offer a possible control of this by placing the information in a legal setting and by having witnesses provide the testimonies. Second, as the role of the source of the information has been suggested as an influential element in reasoning, we manipulate the reliability of the source such that the source is either highly reliable or entirely unreliable. Third, from the literature, it is unclear how participants conceptualise non-diagnostic information. In particular, it is unclear whether or not the participants expect the dilution effect to occur if they were put in an observer role. To test this, study 2 allows participants to provide qualitative replies. Here, they are asked to imagine how a jury would react to the information and whether they believe it would make a difference to include the non-diagnostic information with the diagnostic.

The dilution effect: A conversational explanation?

The dilution effect has been reported in several studies (e.g. Nisbett et al., 1981; Hilton & Fein, 1981; Krueger & Rothbart, 1988; Tetlock & Boettger, 1989, see also Troutman & Shanteau, 1977). However, aside from a few notable exceptions (e.g. Waller & Zimbelman, 2003), the effect has received relatively little attention in recent years compared with more prominent cognitive influences on reasoning such as the confirmation bias (e.g. Frost et al.,

2015). In particular, the basis of the effect has remained under-explored.

One question, though, has been raised about the dilution effect, namely whether the effect has a conversational, pragmatic basis rather than a social perceptual basis (see Igou & Bless, 2005; Kemmelmeier, 2007; Igou, 2007). It is well-known in the field of pragmatics that conversational expectations and extra-linguistic content can influence the interpretation of an utterance (see e.g. Sperber & Wilson, 1995; Carston, 2002; Katsos, 2008; 2009). If the non-diagnostic information was somehow perceived as relevant given the inclusion by the experimenter, it is plausible that the participants could generate interpretations that make the information more relevant than the experimenter intended.

It is possible that the methodology of the experiments prompts participants to treat all information given to them as relevant, as the experimenter provides it to them. If the participants approach non-diagnostic evidence as potentially diagnostic in some way that they did not understand given the fact that the information was chosen by the experimenter, this may introduce noise into belief revision, which should make judgments less extreme. That is, given an increase in the noise of the data, a participant would be expected to update in a more tempered manner. Kemmelmeier (2007) describes this position (which he criticises) thusly: "The mere fact that the information is provided in the experiment suggests to participants that the experimenter considers this information relevant and wants participants to use it in making their judgments." (p. 49)

The above studies aimed at testing the conversational basis of the dilution effect by trying to manipulate the relevance of the information provided, but kept using the main methodology where the information is provided by the experimenter, and the task had generally to do with social judgment. One way of manipulating the relevance was by explicitly warning participants that the information might not be relevant. For example, Igou and Bless (2005) state, "*prior* to the sales scenario, half of the participants were informed that some of the presented information might not be relevant to their task". This is a methodological attempt to prepare the participant for the fact that they may encounter irrelevant information.

Kemmelmeier, who argues against the conversational account of the dilution effect, claims that the alleged evidence in favour of the conversational basis is not proving anything. Kemmelmeier concludes:

> "Last, there is a very mundane reason to suspect that the dilution effect is not the product of conversational dynamics. The dilution effect occurs as much inside the psychological laboratory as outside of it (see Waller & Zimbelman, 2003, for a review). Often there are no specific individuals who can be identified as the source of non-diagnostic information, or one even has to assume that one's communication partner is potentially deceptive, as in the case of an accounting audit (Waller & Zimbelman, 2003). Because the dilution effect occurs regardless of whether non-diagnostic information can be assumed to be part of a meaningful communication, it seems highly questionable that the dilution effect has a conversational basis." (Kemmelmeier, 2007, p. 58)

In order to test the potential influence of the experimenter and to lessen the influence of social context, the current studies are set in a legal setting where the information is presented as a summarised court case concerning a murder in Paris. The existence of identified witnesses (with certain characteristics) attempts to alleviate the methodological problem of the experimenter providing 'irrelevant' information, as witnesses may provide more or less relevant statements during a trial. In order to manipulate the relevance of the statements, we manipulate the witness condition. As discussed in the following section, several studies have shown the influence of source credibility in reasoning tasks.

The dilution effect and source credibility

As the dilution effect has mainly been explored with the information being provided by the experimenter, little is known about the relationship between the effect and the credibility of the source.

Source credibility has been shown to influence several cognitive phenomena related to reasoning, argumentation, and decision-making. It influences the reception of persuasive messages (Petty & Cacioppo, 1984; Chaiken & Maheswaran, 1994; Tormala & Clarkson, 2007), is integral to the development of children's perception of the world (Harris & Corriveau, 2011), influences candidate choice (Hetherington, 1999; Citirin & Muste, 1999), increases adherence with persuasion strategies (Cialdini, 2007), and influences how people judge the quality of evidence from others in social situations (Fiske et al., 2007; Cuddy et al., 2011). The normative function of source credibility in reasoning and argumentation remains contentious. The dual-process-based Elaboration-Likelihood Model (Petty, 1981) describes reliance on the source of the message as a heuristic and shallow cue (Petty & Cacioppo, 1984; Briñol & Petty, 2009). Comparatively, Bayesian models integrate credibility in beliefs revision when a source provides information (Bovens & Hartmann, 2003; Hahn et al., 2012; Harris et al., 2015; Madsen, 2016).

According to the dilution effect, participants who are faced with non-diagnostic information in addition to the diagnostic information provided will become less extreme in their degree of belief in the overall proposition. Given the findings in the literature, we predict that testimonies from reliable witnesses will be seen as more persuasive than testimonies from unreliable witnesses.

The case study: Murder in Paris[1]

In order to make the experimental setting seem realistic, we made use of simplified version of a court case that happened recently in Paris. In the court case, the defendant, Siem, was accused of assaulting the victim, Tommy, which caused Tommy's fall to the ground. Further, they were told that

[1] For the sake of clarity, we provide the background story as an appendix after the bibliography.

the impact of the ground caused the brain injury, which led to Tommy's death.

The participants were told that they would read an excerpt from a court case in Paris, France. They were further told that the names of the people involved had been changed and that the story had been abbreviated significantly. The participants were then instructed to read the summary of the court case thoroughly as if they were a member of the jury in the trial. Specifically, they were asked to pay attention to what had happened and whether or not the defendant was likely to be guilty or innocent.

Study 1

Study 1 aims to replicate the dilution effect. To test the potential pragmatic basis of the dilution effect, the study was set in the legal context of a trial with all information provided by witnesses rather than by the experimenter. By using a realistic court case and witness testimonies rather than instructions from the experimenter, the design lessens the likelihood that the experimenter influenced the participants. The dilution effect predicts that participants should decrease their belief in the likelihood of the defendant being guilty when a non-diagnostic testimony was added to the diagnostic witness testimony.

The study was a 2x2 between-subjects design. To explore the influence of source credibility on belief revision and on the dilution effect, participants in the 'no witness' condition were told that the statements were 'information added to the initial enquiry'. As such, the information was provided with no specific source. In the 'witness' condition, a reliable witness presented the diagnostic testimony while an unreliable witness provided the non-diagnostic testimony[2].

To test if the dilution effect was replicable, half of participants saw only the diagnostic information while the other half saw the diagnostic *and* the non-diagnostic information. Diagnostic statements read: "There was a dispute about drugs between Siem and Tommy, and Siem had threatened Tommy several times. Siem was heard several times saying 'he will be dealt with soon, this fucking Caribbean!" Non-diagnostic statements read: "When walking, Siem always took great and long strides. Siem used to wear funny clothes. In particular, he liked to wear bright colours".

Participants: 200 participants were recruited from MTurk (see Paolacci et al., 2010 for validation of MTurk as a tool for data collection in social sciences). All participants had to be native English speakers and aged 18 or above.

Procedure: Having read the background story (see appendix), participants provided their degree of belief in the likelihood that Siem had assaulted Tommy on a gradient scale from 0-1, with 0 representing complete certainty that Siem did *not* assault Tommy and 1 representing complete certainty that Siem *did* assault Tommy. This elicited their belief in the likelihood of guilt prior to hearing witness testimonies.

After providing their prior belief in the likelihood of guilt, participants read the testimonies. Having read the testimonies (witness statements **or** additional information // diagnostic **or** diagnostic as well as non-diagnostic information), participants were asked to indicate their posterior degree of belief in the likelihood of guilt on an identical sliding scale from 0-1. Diagnostic evidence was presented before non-diagnostic evidence. In order to test the dilution effect, we compare the changes in beliefs from prior to posterior belief between conditions.

Results: As the study was carried out online via MTurk, we eliminated any participants who carried out the study in less than 120 seconds, as the study could not be completed in seriousness in such short time. In total, this eliminated 15 participants, leaving 185 participants.

To test the dilution effect, paired-sample t-tests show a significant difference between prior and posterior degrees of beliefs in both diagnostic groups (No witness condition: $t = 3.105$, $p = 0.003$ (df, 42); Witness condition: $t = 2.890$, $p = .006$, df (45)) while we observe no difference in degree of belief when non-diagnostic information is provided alongside the diagnostic (No witness condition: $t = 1.839$, $p = 0.072$ (df, 48); Witness condition: $t = .459$, $p = .648$, df (46)), see Fig. 1 for means and standard deviations.

Condition	Prior belief	Posterior belief
Diagnostic, no witness	60.67 (21.49)	69.93 (18.43)
Non-diagnostic, no witness	64.36 (17.88)	69.18 (17.94)
Diagnostic, witness	58.97 (18.87)	66.32 (19.38)
Non-diagnostic, witness	62.68 (22.24)	61.29 (22.27)

Table 1: Prior and posterior beliefs

Tentatively, it looks as if the witness condition yields different patterns in the non-diagnostic condition (as the no witness condition is borderline significant). To test the influence of witnesses, we calculate a change score by subtracting the prior belief from the posterior. Having done this, we run a 2x2 ANOVA to test the influence of the inclusion of a witness. We find an effect of diagnosticity ($p = .019$, $F = 5.556$), but no effect of the witness condition ($p = .149$, $F = 2.105$).

Testing for influence of gender and age yielded no significant results, as p's were between .103 (influence of age on posterior degree of belief in the likelihood of guilt) and .881 (influence of gender on prior beliefs).

Study 2

Study 1 suggests that the dilution effect was replicated in an experimental design aimed to lessen the experimenter's role and thereby reduced the potential for conversational effects. However, while the results of study 1 replicated the dilution effect, tentative evidence suggested that the reliability of the witness might have an impact on the relative strength of the effect. For one, the reliable witness always presented

[2] Alongside the background story, full witness descriptions can be found in the appendix.

condition the diagnostic information and the unreliable witness always presented the non-diagnostic information.

To test the potential influence of source reliability on the perception of evidence, half of the participants read the diagnostic testimony from the reliable witness and the non-diagnostic testimony from the unreliable witness whilst the other half were presented with the opposite source-message matrix.

While study 1 tested a specific question concerning the conversational basis for the dilution effect, study 2 is more exploratory, as the relationship between source credibility and the dilution effect has, to our knowledge, not been explored in detail (although, see Harkins & Petty, 1987). As a consequence of the exploratory nature, participants were given the opportunity to provide qualitative feedback.

Importantly, study 2 used a different dependent variable: In study 1, as participants in the previous study were asked to provide *their own* degree of belief in the likelihood of guilt; in the present study, the participants were asked to provide their personal estimation of how convinced a member of a jury would be if confronted by the diagnostic information in isolation or by the inclusion of the non-diagnostic statement. As such, they were asked to provide an estimation of the strategic potential of including or omitting the non-diagnostic statement. Consequently, all participants read the diagnostic and the non-diagnostic statements. Thus, only two participant groups emerged in the present study: diagnostic (reliable witness) and non-diagnostic (unreliable witness) **or** diagnostic (unreliable witness) and non-diagnostic (reliable witness).

Participants: 100 participants were recruited from MTurk. All participants had to be native English speakers and be aged 18 or above.

Procedure: Prior belief elicitations were identical to study 1, as participants read the court case and provided their initial estimation of the likelihood of guilt. After the initial case presentation, participants read both the diagnostic and the non-diagnostic statements and were asked to evaluate the degree to which they believed a jury would believe the defendant to be guilty if the diagnostic information was presented in isolation or in conjunction with the non-diagnostic statement. As such, each participant provided one prior degree of belief and two posterior degrees of belief: diagnostic and non-diagnostic.

Results: Initial paired-sample t-tests were conducted between prior and posterior degrees of belief to test the influence of the source on the likelihood that a jury would find the defendant guilty. In accordance with expectations from studies on source credibility in argumentation (e.g. Harris et al., 2015), participants who were presented with diagnostic incriminating evidence from the unreliable source either significantly or borderline significantly ***decreased*** their posterior degree of belief in the likelihood of guilt (diagnostic: $t = 2.812$, df (50), $p = .034$; non-diagnostic: $t = 1.799$, df (50), $p = .078$). Comparing the diagnostic and non-diagnostic posteriors, we observe no significant difference ($t = .893$, df (50), $p = .376$). This suggests that testimonies from an unreliable source might ***decrease*** adherence with the proposition despite being diagnostic. It further suggests that no dilution effect was observed when the witness was reliable. See table 2 for means and standard deviations for both conditions.

In the condition where the reliable witness provides the diagnostic evidence, we observe a significant or borderline significant ***increase*** in the degree of belief in the likelihood of guilt (diagnostic: $t = 4.848$, df (49), $p < .001$; non-diagnostic: $t = 1861$, df (49), $p = .069$). While we did not find support for the dilution effect when the reliable witness presented the non-diagnostic information, we observe a significant difference in the condition where unreliable witness presents the non-diagnostic information ($t = 2.983$, df (49), $p = .004$). That is, compared with the condition in which the reliable witness presented diagnostic evidence, the condition where the reliable diagnostic testimony was followed by an unreliable non-diagnostic testimony decreased the overall estimation of guilt.

Comparing the two conditions, this suggests the reliability of the source that provides the non-diagnostic information influences whether the dilution effect occurs or not. As we did not have a clear hypothesis as to the direction of the influence, qualitative replies were also collected. In the following, we examine these replies.

Condition	Prior belief	Posterior belief (diagnostic)	Posterior belief (non-diagnostic)
Unreliable-reliable	64.19 (17.18)	56.09 (22.31)	58.57 (23.66)
Reliable-unreliable	57.4 (22.25)	71.60 (18.33)	63.82 (23.82)

Table 2: Prior and posterior beliefs

Qualitative replies By analysing the qualitative responses, we can get a tentative impression of the differences between reliability conditions and between participants themselves. In the unreliable-reliable condition, 25 participants provided qualitative feedback. In the reliable-unreliable condition, 30 participants provided feedback.

Participants in the condition where the unreliable witness presented the diagnostic information did not make specific comments about the persuasive advantage or disadvantage of presenting the non-diagnostic information (despite the fact that it was presented by the reliable witness). Rather, in line with expectations, they provided character-related comments for the unreliable witness and content-related comments for the reliable witness (e.g. “I'm not sure what Mrs. Lanavan's statement had to do with the case. And the fact that Ms. Harry is unstable would reduce her credibility” and “I think the first is incredible due to her personal history and the second's testimony really is irrelevant to the incident”).

In the condition where the reliable witness presented the diagnostic information, comments were more mixed. 11 participants directly stated that including the non-diagnostic witness would **not** make a difference (e.g. “I don't see how

Ms. Harry changes anything. Her testimony doesn't really say anything useful" and "I think the jury would react the same way"). Comparatively, 13 participants stated that it **would** make a difference to include the unreliable witness (e.g. "The statement by Ms. Harry doesn't prove or disprove anything, but it takes away from the validity of the first witness, IMO", "Tough call- the statement of Ms. Harry would irritate the jury and would lean the jury to the more credible witness", and "I think maybe the prosecution loses some credibility if they put someone on the stand who gives testimony that doesn't seem substantive"). One participant argued that the inclusion would **boost** the probability of getting Siem convicted ("more witnesses the more weight the testimony will get I imagine, also the woman is more convincing").

Given the limited population size, the above comment should be taken with extreme caution. However, it suggests that participants may entertain two very different ideas of the reasoning of jurors. While the sample is too small for statistical analysis, the participants appear to entertain realistic approximations of their estimations of the reactions of jury members concerning the inclusion of the non-diagnostic information. The 11 participants who stated it would make no difference report no difference between the prior and the posterior.

Concluding remarks

The paper set out to explore three different aspects of the dilution effect. First, given the debate concerning the basis for the dilution effect (whether it is conversational, cognitive, or social), study 1 used a legal setting to lessen or alleviate the potential influence of the experimenter and present the information as a court case with witness testimonies. Study 1 replicated the dilution effect.

Study 1 suggested that the credibility of the source might influence the strength of the dilution effect. Consequently, , study 2 manipulated the reliability of the witnesses who provided the diagnostic and the non-diagnostic information. Argumentation studies in source credibility suggest that the degree of belief in a proposition can be negatively influenced despite a diagnostic statement in cases where the source is unreliable or distrusted (see Madsen, 2016). In line with these findings, study 2 found that diagnostic statements from an unreliable source **decreased** participants' degree of belief in the likelihood of guilt while the same statement from a reliable source **increased** participants' degree of belief. Further, study 2 suggests that the dilution effect does not occur in situations where the non-diagnostic information is provided by a reliable source while we observe a strong dilution effect when an unreliable source presents non-diagnostic information. Future studies should look at the function of and relationship between source credibility and diagnosticity in more detail.

Study 2 gave participants the opportunity to provide qualitative feedback. Of particular interest, we noted a tendency for two strategy approximations to occur when the reliable source presented the diagnostic evidence and the unreliable source presented the non-diagnostic statement. 11 (of 50) participants believed it would make no difference to the minds of a jury while 13 (of 50) believed it would have a negative effect. Their posterior belief revisions were in line with these estimations. This suggests that participants might entertain different perceptions of persuasion strategies and of the effect of evidence. However, as the current study is exploratory, we cannot draw any strong conclusions from these reports. We hope that future studies will explore the role of persuasion strategies and the dilution effect in more detail.

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Appendix: Background story and witness descriptions

Background story

On the 31st of December 2010, around 7:30pm, the body of a man was found on the Place de Stalingrad, in Paris. The man was later identified as M. Tommy Tessel, a homeless drug-addict from Martinique. He died a few hours later, in the hospital.

A local police inquiry was conducted. All the people questioned in the neighbourhood initially denied having seen anything directly.

Some of them reported having heard that the victim had fallen after having been punched by a third party. The case was initially treated as an accident. No crime scene inspection was performed; no trace of blood was found.

On the 5th of January 2011 (5 days after the event), a person, who wanted to remain anonymous, reported to the police that a drug-addict often hanging around near the Rotonde (the rotunda of the Place de Stalingrad), of Senegalese descent, in his fifties, had punched the victim in the face and the victim had fallen heavily on the ground.

On the 8th of January, a crime investigation was opened. The criminal investigation department asked the local police for the victim's clothes so as to perform a DNA test. But it appeared that they were thrown away on the 5th of January for hygienic reasons.

An autopsy was performed on the deceased. The victim death's was directly caused by the brain injury resulting from the shock of his skull on the ground, probably due to a fall.

Reliable witness: Mrs. Rose Lanavan (55, social worker)

Mrs. Lanavan was employed as a cleaner in a pharmacy for around 20 years, after which she decided to enroll in a training programme for adults to become a social worker. She now works with drug-addicts and homeless people, helping them with any administrative procedures in relation to health, lodging, and judicial issues.

She is unanimously reported as a trustworthy and caring person. She works and lives in the area of Stalingrad, and knows well the people living there.

Unreliable witness: Ms. Edith Harry (26, no occupation)

Ms. Edith Harry is a drug-addict, often lurking in the area. She has tried a rehab several times, but always went back to smoking crack. She is reported to be psychologically unstable (she is reported to suffer from a serious personality disorder — labeled 'paranoid-delusional').