Reasoning under the Influence of Universal Distortion. Sex Offenders Case Study

Dov Gabbay
Ashkelon Academic College, Bar Ilan University, King's College London, University of Luxembourg, University of Manchester
dov.gabbay@kcl.ac.uk

Gadi Rozenberg
Ashkelon Academic College

Lydia Rivlin
King's College London (retired)

Abstract

We define and study the phenomenon of a universal distortion into a reasoning system or an argumentation network. Such distortions can happen for various reasons, for instance under the influence of alcohol or a fundamentalist religion, or as the result of a behavioural disorder such as paedophilia. We define the notion theoretically in the framework of abstract argumentation and present an actual case study of a sex offender. We then present a formal logical model.

1 Background and orientation

This paper is a conceptual follow up to our paper [1], in which we modelled Reasoning Schemes, Expert Opinion and Critical Questions on the risk involved in the release from custody of a sex offender. Dealing with sex offenders is a high profile area of activity in any society. Once a sex offender is convicted and given a prison sentence, to apply for remission for good behaviour, the sex offender is expected to express regret and remorse and is offered the opportunity to join a therapy group in prison. This will enable the sex offender to apply for good behaviour and reduce the prison sentence by a third (in Israel). Of course it is not surprising that many sex offenders join a therapy group. What is more surprising, is that the sex

offender therapists community uses logic and argumentation to treat these sex offenders. The community is not explicitly aware of this connection with the logic and argumentation community. They regard the sex offender as suffering from reasoning distortions (caused possibly by physical drives) and proceed to actually use argumentation to try to correct such distortions and reduce the temptation to re-offend. Once we, the authors, realised this, we were motivated to write the current paper and study reasoning distortions in general. Actually when you think about it, it is of great value to the logic community to have essentially a very high profile medical community using logic and argumentation. If the argumentation community could observe and model case studies from the therapy practice, this could immensely benefit both communities, as well as society in general. We envisage the argumentation community helping to improve the therapy methods of the sex offender community. Currently the therapy success rate is that out of the 100% set of sex offenders participating in therapy, 30% show significant improvement. Perhaps this success rate can be improved.

We would like to explain and make it clear to the perceptive reader of the argumentation community what to expect from this paper. The authors have three possible policy options

Policy Option E1 Observe the practical use of Logic and Argumentation in the sex offender therapist community, get new ideas for new theories of argumentation and write theoretical papers catering for advancing the research front of Argumentation and Computation. This is a safe bet and has serious value. To give an example from Applied Mathematics, we can observe how engineers push fluids through large pipes, miles long, and develop new theories of Turbulence. The advantage for us is that we do not have to model the application correctly or even mention it, it is enough to be inspired by observing the application, develop new theoretical logics and connect to other works of our theoretical colleagues. The disadvantage is that we give no help or better models to the sex offender therapist or the fluid engineer.

Policy Option E2 The other option is to try to model the case studies and practice using our knowledge and tool box of logic and argumentation, and be of more immediate use to the practitioners and to society. Unfortunately, in the case of the argumentation community and the sex offenders therapist community, we envisage two major problems.

a The theoretical COMMA (Conference on Computational Models of Argument) community does not have sufficient experience in this type of modelling.

b The sex offender community is medically minded. If you offer them a model, it is like offering them a new medicine. They would test it for years before finally accepting it.

So before we model practice, the two communities must understand each other much better and this will take time and effort.

Policy Option E3 The authors have decided on a middle option. Start with option 1 but at the same time try a first approximation model, to show the argumentation community that it is worth while to move later to option 2. The advantages of this approach are obvious, but there is also the risk of misunderstanding. Readers will criticise the partial model. We ask the reader to recognise an opportunity for further research and we will try to point out, as we develop this paper, any simplifications and shortcuts we employ.

So going back to the business of developing option 3 for this paper, we considered the influence of a rise of the sex drive on the offender's reasoning processes.

Our plan for this paper is as follows:

In Section 2, we bring formal background material from Argumentation. In Section 3 we say a bit more about universal distortion and then continue giving a general abstract view of distortion. This will prepare us for Section 4, where we discuss distortion in argumentation networks. We offer two main possibilities for distortion in the first two Subsections, these are

- Annihilator types of distortion. This means distorting by deleting (annihilating) some key argument that significantly changes the system, or in a system where arguments have strength, distorting by weakening this strength.

- Non-monotonic distortions. This means distorting by adding true or fake background additional information which gives a completely new perspective to the case.

We continue with Section 5 Subsection 5.1 by listing as examples various distortions by sex offenders. This prepares the connection with a sex offender's reasoning and in Subsection 5.2 we examine a real case study of a real offender.

The case study, presented in Section 5 is purely descriptive, relating reality as it is. It requires analysis and this we do in the next Section 6. The first Subsection, 6.1 presents the context (in the sex offender therapy community) of the case study and Subsection 6.2 analyses the arguments used in the case study. We are now in a position to understand, from the argumentation point of view, the nature and context of the sex offender reasoning distortions. We need however, before starting

with our formal modelling, to understand comparatively the workings of reasoning distortions in general (not just that of the case of sex offenders).This we discuss in Subsection 6.3 and in fact Subsection 6.4 reveals that the Literary pragmatics community also deals with reasoning distortions in literary narratives.

We are now ready to start modelling universal distortions. Section 7 presents a first attempt at modelling. We begin in Subsection 7.1 with an intuitive semi-formal discussion of possible ways to define models, leading to Subsection 7.2, where we focus on the use of valuations, (the distortion being lowering the value and relevance/importance of some arguments, thus distorting the network). Subsection 7.3 summarises our formal initial options and Subsection 7.4 gives an initial valuation model, where each argument x is given a number $V(x)$ saying how many successful attacks are required for x to be out. This model is studied in detail and is an example of "export" from the sex offender area into formal argumentation. The approach in Subsection 7.4 is set theoretical, there is also an algorithmic approach which is discussed in Subsection 7.5. Section 8 gives better models, comprising of an initial discussion of how to do better, leading to the better model of Abstract Valuation Frameworks (AVF). The AVF model is presented generically, in accordance with our following of Option E3 above. Section 9 compares with the literature and Section 10 concludes. We also offer further explanatory Appendices A and B about the sex offender therapy international community practices.

2 Background and concepts from abstract argumentation

2.1 Argumentation systems with attack only

This Section presents, for the convenience of the reader, some basic concepts of what we called traditional argumentation theory. Such systems contain attacks only. We refer to such system as Argumentation with Attack only. One can also add support to the system and in this case we get systems of Argumentation with Attack and Support. We shall then explain in what way the systems required for this paper depart from the traditional ones.

There are two ways to present the semantics for argumentation with attack, the traditional set theoretical approach and the Caminada labelling approach. For the mapping connections between the two approaches, see [22]. Let us briefly quote the traditional set theoretic approach:

Definition 2.1.

1. *We begin with a pair (S, R), where S is a nonempty set of points (arguments) and R is a binary relation on S (the "attack" relation).*

2. *Given (S, R), a subset E of S is said to be conflict free if for no x, y in E do we have xRy.*

3. *E protects an element $a \in S$, if for every x such that xRa, there exists a $y \in E$ such that yRx holds.*

4. *E is admissible if E is conflict free and protects all of its elements.*

5. *E is a complete extension if E is admissible and contains every element which it protects.*

6. *A subset E is a stable extension if E is a complete extension and for each $y \notin E$ there exists $x \in E$ such that xRy.*

7. *E is the grounded extension if it is the unique minimal extension (it exists, see Lemma 2.2).*

8. *E is a preferred extension, if E is a maximal (with respect to set inclusion) complete extension.*

9. *A Semantics is a (metalevel) property $\mathbb{S}$ of extensions, such as being stable, or being grounded or being preferred. Thus we can talk about $\mathbb{S}$-Semantics, (stable semantics, grounded semantics and preferred semantics) where we consider only $\mathbb{S}$- extensions.*

Lemma 2.2. *For any network (S, R) there exists a grounded extension (which may be empty).*

Proof. This can be proved, using set theoretical methods, see [22, 55]. A proof can be obtained from the proof of Lemma 7.8 in Section 7 for the case of V giving all arguments life 1. See also the general construction of Section 8.3. □

We can also present the complete extensions of $A = (S, R)$, using the Caminada labelling approach, see [22].

Definition 2.3. *A Caminada labelling of S is a function $\lambda : S \mapsto \{in, out, und\}$ such that the following holds.*

(C1) $\lambda(x) = in$, *if for all y attacking $x, \lambda(y) = out$.*

(C2) $\lambda(x) = out$, *if for some y attacking $x, \lambda(y) = in$.*

(C3) $\lambda(x) = und$, *if for all* y *attacking* $x, \lambda(y) \neq in$, *and for some* z *attacking* $x, \lambda(z) = und$.

Lemma 2.4.

1. *A consequence of (C1) is that if* x *is not attacked at all, then* $\lambda(x) = in$.
2. *Given an extension* E *let* λ_E *be defined by* $\lambda_E(x) = \{$ *in if* $x \in E$, *out if for some* $y \in E$ *we have* yRx, *and undecided otherwise*$\}$. *Conversely given a* λ, *define* E_λ *to be* $\{x|\lambda(x) = \ in\ \}$.
3. *Any Caminada labelling yields a complete extension and vice versa.*
4. *Any {in, out} Caminada labelling (i.e. with no "und" value) yields a stable extension and vice versa.*
5. *Set theoretic minimality or maximality conditions on extensions* E *correspond to the respective conditions on the "in" parts of the corresponding Caminada labellings.*

Proof. See [22]. □

Example 2.5. *It is useful to introduce a familiar story as an example, the story of the party.*

Story. The Party: *We are planning a party and we have a set* S *which is the maximal set of all relatives friends, colleagues, etc. who can be invited to the party. The problem is that some of them do not get along/hate some others. So we have a relation* R, *where* xRy *(which we might denote by* $x \twoheadrightarrow y$*) means that if* x *is invited,* y *must not be invited. We get here a traditional argumentation network with attack relation* R. *The complete extensions are possible groups of people we can invite, provided we invite all those to whom no other invitee objects.*

Remark 2.6 (Translation into classical logic)**.** *The network* (S, R) *can be viewed as a classical predicate model for a binary relation symbol* **R**. *The domain of the model is* S *and the extension of* **R** *is* R.

With this point of view , we can add additional predicates symbols to the language to be able to talk in classical logic syntax about extensions. Let us add the predicates **E**, *unary for subsets of* S, **In** *for points in* S *that are in,* **Out** *for points which are out and* **Und** *for points which are undecided.*

We can write axiomatically the conditions for **E** *being a complete extension and for the conditions of the vector (***In** *,***Out**, **Und***) to be a Caminada labelling.*

1. *Conditions on* $\mathbf{E}$ *(where "..." indicates a formula of predicate logic):*

   (a) "$\mathbf{E}$ *is conflict free":* $\forall x, y[\mathbf{E}(x) \wedge \mathbf{E}(y) \rightarrow \neg x\mathbf{R}y]$.

   (b) "$\mathbf{E}$ *protects the element* a*":* $\forall x[xRa, \rightarrow \exists y(\mathbf{E}(y) \wedge y\mathbf{R}x)]$.

   (c) "$\mathbf{E}$ *is admissible (i.e.* $\mathbf{E}$ *is conflict free and* $\mathbf{E}$ *protects all of its elements)":* "$\mathbf{E}$ *is conflict free*" $\wedge \forall a[\mathbf{E}(a) \rightarrow \forall x[xRa, \rightarrow \exists y(\mathbf{E}(y) \wedge y\mathbf{R}x)]]$

   (d) "$\mathbf{E}$ *is a complete extension (i.e* $\mathbf{E}$ *is admissible and contains every element which it protects)":* "$\mathbf{E}$ *is admissible*" $\wedge \forall a$ *[*"$\mathbf{E}$ *protects the element* a*"* $\rightarrow \mathbf{E}(a)$*]*

2. *Conditions for Caminada labelling:*

   (a) $\forall x[\mathbf{In}(x) \vee \mathbf{Out}(x) \vee \mathbf{Und}(x)])$

   (b) $\forall x[\neg(\mathbf{In}(x) \wedge \mathbf{Out}(x) \wedge \neg(\mathbf{Und}(x) \wedge \mathbf{In}(x)) \wedge \neg(\mathbf{Out}(x \wedge \mathbf{Und}(x))]$

   (c) $\forall x[\exists y(y\mathbf{R}x \rightarrow \mathbf{Out}(x)]$

   (d) $\forall x[[\forall y(y\mathbf{R}x \rightarrow \mathbf{Out}(y)] \rightarrow \mathbf{In}(x)]$

2.2 Adding valuations or preferences

Given an argumentation network (S, R), consider a node $s \in S$ and its set of attackers $A(s) = \{y \in S | yRs\}$. Following considerations in Subsection 2.1, the question of whether s is "in" or not is basically algorithmic based on the geometry of (S, R). The arguments $\{y | y \in A(s)\}$ themselves are atomic, and no considerations are available about their nature, such as "who put them forward", "why we think they are true", "how strong they are compared with other arguments", "are they independent of each other", etc., etc.

If we wish to protect node s from its attackers $A(s)$, we might wish to identify various properties $V_1(y), \ldots, V_k(y)$, of nodes $y \in A(s)$ and then argue, that given these properties, we want to reject some or all the attackers of $A(s)$. The predicates $V_i(y)$ are called valuations. They could be qualitative (true or false of y) or numerical ($V_i(y) \in [0, 1]$). These predicates are meta-level to the arguments in S, and they compensate for the abstract atomic nature of the elements of S.Their purpose is to mitigate the attacks of $A(s)$ on s. We can thus consider a formula $\mathbb{B}^s$ involving the predicates $\{V_i(y), V_i(s) | i = 1, \ldots, k, y \in A(s)\}$ which says something about $\{y | y \in A(s)\}$ and use it to modify clauses (C1)–(C3) involved in the Caminada labelling of Subsection 2.1. For example, we can say that if $\mathbb{B}^s$ does not hold then certainly s must be "in" because we should ignore all the attacks on s.

The idea of valuation is helpful in modelling reasoning distortions. We shall see our sex offender of our case study in Section 5, when defending the attack on the claim

$s =$ " I have not offended"

against the testimony of child y about the offence, the offender added

$V(y) =$ "y has not complained about the offence for a long time".

This is supposed to mitigate the seriousness of the offence. The predicate "V" is not part of the language of (S, R), it is a valuation added to it, and seems useful in modelling distortions introduced by sex offenders.

So if we have a system $(S, R, V_1, \ldots, V_k)$, a distortion can be affected either by modifying $\{V_i\}$ or by tinkering with $\{\mathbb{B}^s\}$.

Definition 2.7 (Networks with Bench-Capon type valuations)**.**

1. *We say that networks of the form $(S, R, V_1, ..., V_n)$ are of Bench -Capon type if all V_i are subsets of S.*
2. *We define Caminada labelling for such networks in terms of the translation into classical logic of item 2 of Remark 2.6.*
3. *Let $\mathbb{B}(y, s)$ be defined as the formula $\mathbb{B}(y, s) = \bigwedge_{i=1\to n}[V_i(s) \to V_i(y)]$*
4. *Conditions for Caminada labelling:*
   - *(a)* $\forall x[\mathbf{In}(x) \vee \mathbf{Out}(x) \vee \mathbf{Und}(x)])$
   - *(b)* $\forall x[\neg(\mathbf{In}(x) \wedge \mathbf{Out}(x) \wedge \neg(\mathbf{Und}(x) \wedge \mathbf{In}(x)) \wedge \neg(\mathbf{Out}(x \wedge \mathbf{Und}(x))]$
   - *(c)* $\forall x[\exists y(y\mathbf{R}x \wedge \mathbb{B}(y, s) \to \mathbf{Out}(x)]$
   - *(d)* $\forall x[[\forall y(y\mathbf{R}x \to \mathbf{Out}(y) \vee \neg\mathbb{B}(y, s)] \to \mathbf{In}(x)$

2.3 Abstract dialectical frameworks (ADF)

ADF was introduced to the argumentation community in 2010 in [27]. It was originally introduced as (in our humble opinion) a mathematical extension of argumentation, giving it the strength of the classical propositional calculus in an explicit form. Such moves are common and useful in mathematics, and indeed ADF has evolved, overcame various difficulties and gained respectable grounds in the argumentation community since its introduction and is now a powerful tool, see [35]–[39], [54], [56]. To be able to discuss ADF, let us just give a definition of some simplified version of ADF.

Definition 2.8 (Boolean ADF networks)**.** *We formally define the notion of a Boolean ADF network. This is a notion just for this paper so the reader can have a formal definition of the type of ADF we are talking about.*

Let (S, R) be an argumentation network and for each s in S let $\mathbb{C}(s)$ be a Boolean combination of variables in the set of elements of $\{y|yRs\}$. Consider the set of equations of the form

$$s \leftrightarrow \mathbb{C}(s), s \in S.$$

Any solution of these equations in Kleene 3 valued logic is considered an Extension for the system $(S, R, \mathbb{C}(s), s \in S)$.

For Kleene 3 valued logic, see Figure 22 (1=in, 0=out, 1/2 = undecided).

Remark 2.9 (Some ADF variations)**.** *We can add some predicates to (S, R), say a family of n_i-place predicate P_i, and allow them to be used in the formulas $\mathbb{C}(s)$ above. We need to regard each $P(y_j)$, as propositional atomic, (a trick well known from classical logic model theory)*

Models of the sets of equations (equivalences) above in this language in Kleene 3 valued logic will give us the complete extensions, if they exist.

For the practical sex offender therapist, however, the mathematics is less important than the intuition behind it, and in this case, the ADF is intuitively capable, mathematically powerful, especially when generalised to a matrix form or a more general form as will be indicated in Subsections 8.2 and 8.3. We do require, however, some generalisations and some restrictions on ADF, if we want to use it for the sex offender case. First we need to use predicate logic formulas, not propositional logic formulas. Second, the argumentation/logical attacks on sex offenders are monotonic. The more attackers you have the stronger is the case. So if the set of arguments E can kill x, and E is a subset of E', then also E' can kill x. This property does not hold for a general ADF. We now explain.

Note that the traditional Dung notion of attack is lost in the framework of ADF. We start with (S, R), but regard, for each $s \in S$ the set $A(s) = \{y|yRs\}$ not as a set of attackers, but as a linked set of related nodes. We say that s is 'in" iff some Boolean combination $\mathbb{C}_s(\{y|y \in A(s)\}$ holds. So s is out when $\mathbb{C}_s$ does not hold, and then the set $A(s)$ can mount a successful attack on s.Thus we need to have a $\mathbb{C}_s$ associated with each s. This is not a monotonic attack condition. $\neg\mathbb{C}_s$ might say, for example, that the set $A(s)$ contains an even number of "in" elements. So if another attacker becomes "in", the attack fails. There is no monotonicity here. We may consider only monotonic ADF predicates. But even for this case ADF have their own way of calculating extensions, which is still incompatible with the sex offender case (we omit details here). Suppose still that we adopt this approach (of

taking monotonic $\mathbb{C}_s$) but calculate the extensions using Boolean equations, namely, we take as our (AVF) complete extensions of the network as all Kleene three-valued models of the theory $\{s \leftrightarrow \mathbb{C}_s | s \in S\}$.

We still cannot use this mathematical version for two reasons.

1. Even if we restrict the formulas $\mathbb{C}_s$ to be monotonic, (and this is not easy because the formula does not have a fixed number of variables), we still need the explicit intuition of "attack" which is implicit in ADF. The sex offender creates distortion as a response to direct explicit threats, not to implicit ones. Furthermore the sex offender does not protect himself by talking about combinations of in out of his attackers; he gives other types of valuations, like "racist attack", "unimportant", etc. This requires the formulas $\mathbb{C}_s$ to be predicate logic formulas containing the predicates $V(y)$, for yRs, which can be genuinely set theoretical or also be numerical values.

2. The valuation approach can technically represent the Boolean fragment of ADF. If we add naming valuations of the form $V_s, s \in S$ such that $V_s^y = \top$ iff $y = s$, then we can express Boolean ADF.[1] More importantly, we can be very specific and project a distortion on each and every individual argument $x \in S$ via the use of the naming predicate $V_x(y)$.

This observation is in fact important for Section 9, the comparison with the literature. There will also be a discussion at the end of Option 3 in Section 7.3.

2.4 The equational approach

This approach views (S, R) as a carrier for equations in $[0, 1]$ for the variables $\{s | s \in S\}$. We are given for each s a continuous function $\mathbf{f}_s(A(s))$ in the variable $A(s) = \{y | yRs\}$. We look at the equations $\{s = \mathbf{f}_s(A(s))\}$. These have solutions in $[0, 1]$. Any such solution generates a complete extension for (S, R) in the sense of Subsection 2.1, provided $\mathbf{f}_s$ satisfied the suitable properties, and provided that we let value 1 for s to mean "in", value 0 for s to mean "out" and otherwise undecided.

Two such functions are notable

$$\mathbf{f}_{\max}(s) = 1 - \max\{y | yRs\}$$

and

$$\mathbf{f}_{\text{inv}}(s) = \prod_{yRs}(1 - y).$$

[1] This is not a criticism of ADF. In logic there are many systems expressing one another, it is the presentation that makes the difference. Note that our machinery is not the same as ADF machinery, so although we can express Boolean formulas we do not do to it what ADF does.

The extensions we get from $\mathbf{f}_{\max}$ can be proved to yield exactly the extensions in Subsection 2.1. See [7].

The equational approach $\mathbf{f}_{\max}$ is suitable for modelling argumentation networks with numerical valuations. If the meta-predicates $V_i(s)$ give numerical values (see Subsection 2.2), these need to be integrated with the traditional "in", "out", "undecided" values for $s \in S$ (see Subsection 2.1). The best way of doing this is to adopt the equational approach to (S, R) and integrate the numerical functions V_i into the equations.

3 Abstract view of distortion

Reasoning distortions are common to every human being, but sex offenders have unusual and exceptional cognitive distortion. This motivated us to look at what happens when there is a major distortion of a reasoning network. The purpose of the current paper is to model the possible effects of such disturbances.

Let us list some familiar examples of universal disturbances.

1. A group of scouts equipped with compasses and maps, dropped on a hill in a national park is instructed to find their way to a meeting point. Nobody realises that there is a high concentration of iron ore in the area which distorts the compass readings and the group ends up moving in circles.

2. A man drinks a bit too much at a party and does not realise that the influence of alcohol is altering his perception of the reality.

3. A boy on a date is carried away by his hormones and does not respond to his girlfriend's objections to his sexual attentions.

4. A con man suddenly gets religion and changes his lifestyle.

5. A society is struck by an overwhelming natural disaster, such as an earthquake or hurricane and becomes subject to emergency laws.

6. A computer overheats and starts acting erratically.

7. A vital component fails in a complex system, affecting performance.

8. A cyber hacker maliciously penetrates a system and changes it.

9. Any small child has a major reasoning distortion in that the child does not have clear boundaries between what is real and what is imaginary. This creates problems for example when the child is a witness (being a sex victim). See Appendix A.

10. Advertising distortions. These are hard advertising campaigns intended to create reasoning distortions favouring sales. One such method is to associate a product (e.g. fast cars) with basic instincts such as Macho attitudes in men.

    > Psychologists Megan Vokey, Bruce Tefft and Chris Tysiaczny at the University of Manitoba (See [45]) analyzed advertisements in men's magazines to see what messages they were sending about what it means to be a man. They found that a significant number of the advertisements portrayed or promoted one or more of the following beliefs:
    >
    > - Danger is exciting.
    > - Toughness is a form of emotional self-control.
    > - Violence is manly.
    > - ItÕs fine to be callous about women and sex.

Remark 3.1. *We note that some of the distortions are mistakes which happen as a result of reasonable reactions based on incorrect assumptions. No-one would call into question — at least to start with — the sanity of the lost scouts in trusting their compasses.*

Another example would be the drunk man crossing the road using the following assumptions:

Assumption 1. *the car is moving slower than it is*

Assumption 2. *he can move quicker than he can.*

In the second example he may incorrectly assume that he is much fitter than he is, or he may simply be calculating his agility based on what he knows about his speed of movement when sober.

To take this to the example of the sex offender, men (even very reasonable ones) often make a lot of incorrect assumptions about women. Can it be that the sex offender is simply someone who has low or non-existent empathetic ability and who assumes everyone in the world thinks like him or is simply an instrument of his own urges? This basic assumption would result in inconsiderate behaviour at the very least and of violence if this view of the world is contradicted in some way. (This is in fact a major distortion and it will be addressed in our second model in Section 4.)

The example of sex offenders making the wrong assumptions and resorting to violence when contradicted can take an extreme form. There are many examples of sex offenders killing themselves when caught, see [62]. This would be a reasonable

and logical thing to do if the offender is a person who believes the rest of humanity is his toy, and then he discovers that the "toy" has turned back on him.[2]

We now consider our options for modelling universal distortions. Let us forget for a moment about practice and sex offenders etc. Let us just take the idea of a theoretical approach to universal distortion in a reasoning system. We have two problems here:

1. Formally define what is a universal distortion in formal logical system such as classical logic or abstract argumentation.

2. When we model a practical area where there is a possibility of a practical universal distortion, we try to model the area using a formal system with compatible formal distortions.

There are however problems. The first problem is that to model a distortion in a system we first have to model the system itself and then consider how the system may be distorted, which is not as simple as one might think.

Remark 3.2. *We are aware that there are related papers on Argumentation Dynamics and revision which need to compared. The difference is in scale and intention. If we delete or add an argument or cancel an arrow of attack or arrow of support, then this is more of a local interference than a large scale distortion. With a universal distortion we make a big global change/interference. Of course if we take out an argument which attacks many other arguments, or take out a large set of arguments,*

[2]There has been very little work on the reasons behind the suicide figures, beyond the four categories set out by Emile Durkheim in the nineteenth century (see Wikipedia [63]) but at the time Durkheim was writing there was very little study, or even recognition of, sex crimes as a separate category especially those relating to children.

There is no doubt that convicted sex offenders have a higher suicide rate than in the general population (see [53]) but we are somewhat thrown into speculation about why pedophiliac sex offenders have a higher risk of suicide and why this risk is especially high for those who have used violence. One theory we have discussed is based on the general recognition that almost all sex crimes of any sort are to do more with the exercise of power than with sexual desire and following from this proposition, that the sexual exploitation of children is the ultimate exercise of power for an inadequate individual. So, when such an individual is caught and all power is taken away from him, he can see no more meaning in life. Also, if an individual has a pattern of violence it would make sense that he would find a solution to his problems in violence — i.e. self harm — rather than in introspection. Whether the individual resorts to suicide because he is unable to cope with the feeling of powerlessness inherent in judicial confinement, or whether he is simply rejecting life itself as a disappointment too heavy to bear is a matter which might be worthy of some consideration. Unfortunately, finding out the deeper reasons will always be problematic, given that by the time the pattern has played out, the determined Suicide is beyond human analysis.

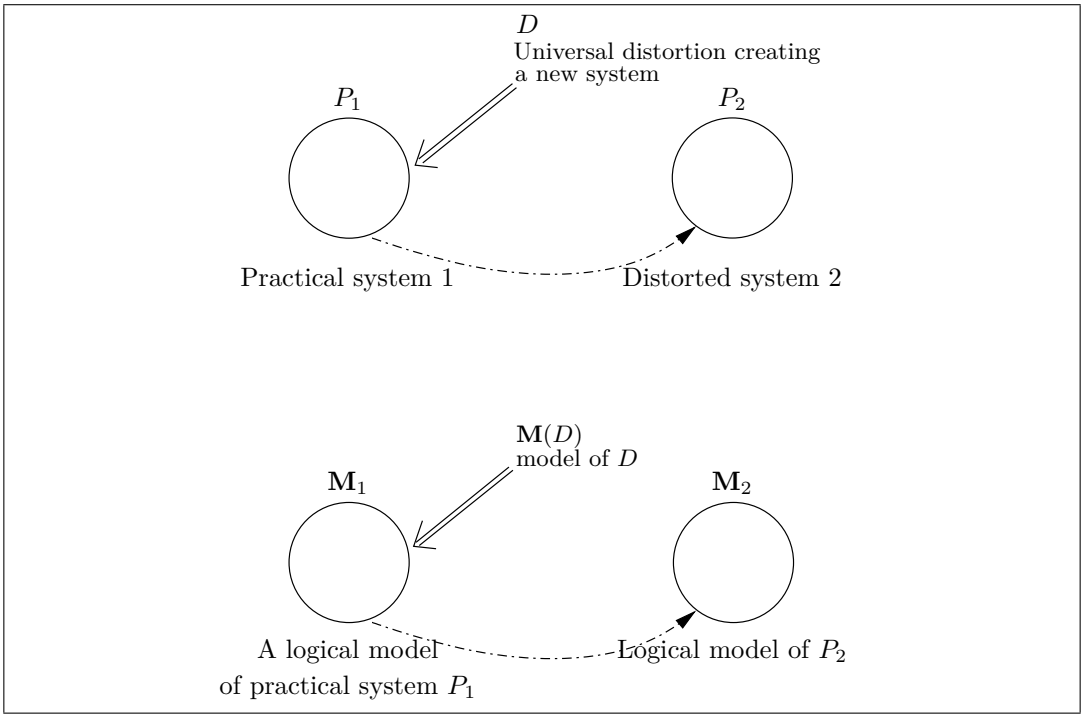


Figure 1

then the effect could be global, but the intention may be local but with global consequences. The global consequence are done, however, as a side effect, without any general principle involved. In the case of argumentation dynamics, on the whole we deal with is local interferences while the case of distortion on the whole is global via some general principles making a global change.

Consider the schema in Figure 1. In this figure, practical system P_1 is distorted by disturbance D to become the system P_2. The system P_1 is modelled by formal logical model $\mathbf{M}_1$. $\mathbf{M}_1$ is a natural best model for P_1. We would like to model the distortion by $\mathbf{M}(D)$ and formally apply it to $\mathbf{M}_1$ and get $\mathbf{M}_2$, modelling P_2.

It is important to note that the distortions, as modelled in this paper, do not change the underline logics, but distort the logical modellings of P_1/P_2. See, however, Remark 3.4.

This schema looks reasonable but is problematic in its execution. Here is a list of some major problems. The emphasis is on "best natural modelling".

Problem 1. We assume system P_1, which is a practical system, is naturally modelled by the logical system $\mathbf{M}_1$. We know that P_1 is distorted into P_2, which we may naturally be able to model by $\mathbf{M}_2$. But we also need a reasonable transformation from $\mathbf{M}_1$ into $\mathbf{M}_2$, by the logical tool $\mathbf{M}(D)$. This may not be possible because it may be the case that $\mathbf{M}_1$ is not capable of distortion.

Let us be more specific. Many members of the argumentation and related communities use classical logic as a major modelling tool. Classical logic is not easy to distort. To see this, let us take the most basic deduction in classical logic.

1	A	assumption
2	$A \to B$	assumption
3	B	conclusion by modus ponens from (1) and (2)

This deduction is presented by a child to his mother. "Mummy, you said that if I was a good boy you would give me chocolate. I was a good boy yesterday, can I have my chocolate now?"

Unfortunately mother is harassed and distracted. So we expect a distortion. How can we interfere with the modus ponens deduction?

Classical logic can only add or delete assumptions and rules from a deduction. In our case, deletion of (1) or (2) or both can be the interference. Therefore the the only possible distortion in this case can be that the mother would say to her child "I don't remember". This is fine for this case.

Let us agree: interference/distortion in classical logic is mainly deletion/loss of data. So to clarify, if we give a proof in classical logic based on assumptions, then the proof can be distorted if some assumptions are deleted or lost. Adding assumptions will not invalidate the proof. On the other hand if a top executive is seen pinching his secretary's bottom, common sense will immediately see the executive as a sex offender. However, adding the information that his secretary is his wife might add a new perspective on the case and might mitigate the offence.

Problem 2. Let us now look at a different scenario. The drunk man at the party mentioned above wants to cross the road. A car is coming. He estimates the car is far away. He crosses the road and is hit by the car. The problem is that no matter how you model this in classical logic, the only formal distortion available is deletion, but in this case the real distortion is is not a matter of deletion. The man does not believe that there is no car coming. We can of course try to be smart and take a more complex model with data about car speed etc and delete the car speed as a distortion. But this model is too complex and violates the principle of simplicity. Another option to model this scenario could be for the drunk man to think: "A car is coming. But I have time to cross the road". In this case, the distortion could be

represented by a deletion of the belief "I have time to cross the road". Again, we violate here the principle of simplicity. The fact is that a sober man sees the car far away and crosses the road and all is well. When drunk you do the same, except your reaction time is slow. The sober man does not calculate time, if this were the case, the drunk man would also calculate time and by the time he had finished his calculation, the car would have passed.

Let us now draw conclusions from the above discussion. To model distortion we need the following tools:

1. Understand formally how distortion can work in known logics, especially those logics which are used extensively in modelling reasoning. Let us call this "formal theory of distortion".

2. Identify those logics which are amenable to modelling distortions (of themselves) and try to use them to model those practical systems which are in practice prone to distortions. Such systems may unfortunately happen to be modelled by logics which are not capable of much formal distortion.

3. Study distortions in practical systems and try to understand how they work.

4. Use (1) and (2) to model (3).

We now give examples.

Example 3.3. *We discussed modus ponens in classical logic. Let us write a slightly different deduction:* $A, A \to (A \to B) \vdash B$. *There is not much that a distracted or drunk person can distort here except deletion.*

Suppose we work in a resource logics, say in linear logic. In linear logic the deduction above is not valid. You need two copies of A *to get* B, *i.e.* $A, A, A \to (A \to B) \vdash B$.

A drunk person has more scope for distortion in this logic, he/she may see double. So "A*" becomes "*A, A*" and the deduction goes through.*

Going back to the child, he may have needed to be a good boy for two days in a row, but he asked of his chocolate after the first day. The harassed mother did not notice.

On the other hand, crossing the road after the party, the man might think that there are two cars coming and might not attempt to cross the road at all.

Remark 3.4. *This is an opportunity to make a remark for readers familiar with the instantiated approaches to argumentation known as ASPIC or ABA, [7, 8]. These systems use arguments instantiated through proofs in classical logic, each in his own*

respective way. So it is quite possible to have several different arguments/proofs attacking another argument/proof, all using the same basic fact as part of their respective proofs. A universal distortion can be affected by rejecting classical logic in favour of linear logic, which allows the use of facts only once. Thus many attacks will be disqualified. In fact, the use of linear logic makes intuitive sense. Our perception of it in day to day reasoning is manifested in statements like "everything seems to depend on a certain key fact x".

The idea of linear logic is that we can use an assumption only once, after that the assumption cannot be used again. A favourite example is if you have a dollar you can spend it only once and after that you do not have it any more. Many arguments might use the same assumption/fact in several contexts and so saying let us use linear logic would invalidate such arguments. No sex offender would create a distortion by saying "I use linear logic" but the sex offender might say "you rely in all your accusations on this one witness, this is wrong".

Consider the following argument
Assumptions:

1. *If a dollar can buy you a cup of coffee then get a dollar*

2. *a dollar can buy you a cup of coffee*

Conclusion

3. *I have a cup of coffee*

Assumption 2 need to be used twice in Modus Ponens.

4 Distortions in formal argumentation (towards modelling sex offenders)

This Section models the distortion schema of Figure 1 for the case of argumentation. We get our inspiration from practice in dealing with sex offenders. We present two models. One we call the annihilator model and one we call the non-monotonic model. Let us give a brief intuitive explanation first and then we define and discuss the models in Subsections 4.1 and 4.2 respectively. Let us offer the reader two images which illustrate the two possible models. Let us start with a normal normative person with a reasonable normative reasoning system. Let us forcefully inject this person with hormones that permanently enhance his sex drive. From then on his reasoning and behaviour become distorted. This is the first model. A change due to one single disturbance. We can obtain the second model if we assume the person

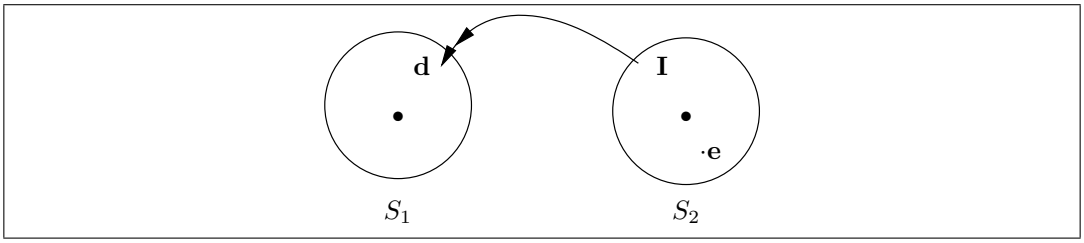


Figure 2: Schema for annihilator distortion

say survives miraculously some accident and becomes a born again believer. This is the second model. A sudden injection of a set of truths which changes his reasoning and behavioural patterns.

We note that the two models can be combined into a single model containing all features from both models. However, for exposition purposes and also for export to cases other than sex offenders, it is good to identify two separate models.

Let (S, R) be an argumentation network (for background definitions see Subsection 2.1). Let $\mathbf{I}$ be a new node. Let $\mathbf{d} \in S$. Form the new network $(S \cup \{\mathbf{I}\}, R \cup \{(\mathbf{I}, \mathbf{d})\})$. What we have done is added an external node $\mathbf{I} \notin S$ and let it attack $\mathbf{d} \in S$. This causes $\mathbf{d}$ to be out.

This is why we call $\mathbf{I}$ an annihilator. We now look at $\mathbf{d}$. We say that $\mathbf{d}$ causes a distortion, if from the point of view of (S, R), a change of (the {in, out}) value of $\mathbf{d}$ can cause large scale changes in the extensions of the network. For example, if $\mathbf{d}$ attacks a large number of other elements of S, then a change in the value of $\mathbf{d}$ can cause a distortion.

We now explain the nature of non-monotonic attacks. In our 2009 paper [5], we introduced the notion of non-monotonic attack. The nodes of the network (S, R) are non-monotonic theories. An attack from a theory Δ_1 to a theory Δ_2 is executed by forming $\Delta_1 \cup \Delta_2$. In such a context, a major distortion can arise if the underlying non-monotonic system is changed. For example we may inject into each theory of S the additional information, the theory Θ. Such a change may cause a large scale change in the nature of all attacks in the system.

4.1 Models for annihilator type of distortion

Figure 2 explains the model schematically. Our network (S, R) can be decomposed into the union of two networks (S_1, R_1) and (S_2, R_2).

S_1 is the undistorted system of argumentation. It allows for certain possible complete extensions which are considered acceptable and normative. The element $\mathbf{d} \in S_1$ is an argument which is out because of a related system S_2 in which a key

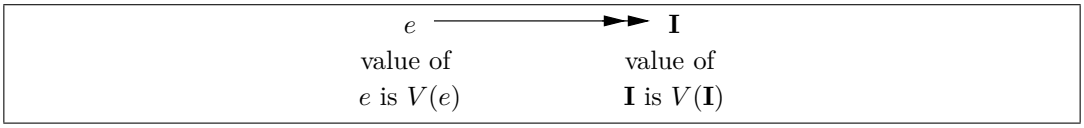


Figure 3: Attack with values

factor **I** is in. **I** is an annihilator node. This **I** attacks **d** and so **d** is out. If **d** were in it would cause distortion. We see **I** as an annihilator for **d**. The intuitive meaning of the concept of distortion is a large scale change in the extensions of S_1. Intuitively not every change of an element $x \in S_1$ from out to in will cause a large scale change. For example, if **d** attacks many elements of S_1 then if **d** changes from out to in, it may induce a large scale change in S_1. To explain our notation, we use **d** (for distortion) and we use **I** for the inhibitor. Changes occur in S_2 which force **I** to be out and so **d** becomes in and so **d** = in causes distortion. So what kind of changes can occur in S_2? For S_2 we use a seriously generalised and modified model, based on the technical instrument of a valuation function V employed in value based argumentation, see [3, 4] and for background material, see Subsection 2.2. The idea can be illustrated in Figure 3.

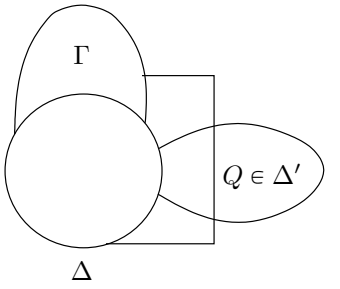
Our network has the form (S_2, R_2, V). Each node x in the S_2 has a value $V(x)$ attached to it, say a number $[0, 1]$. Assume $(x, y) \in R_2$, then if the value $V(x)$ is less than $V(y)$, then x cannot attack y. So if our S_2 is exactly the network described in Figure 3 and we have $V(e) < V(\mathbf{I})$, then we disregard the attack arrow $e \twoheadrightarrow \mathbf{I}$ and the complete extension of this network is e = in, **I** = in. Similarly if $V(e) \geqslant V(\mathbf{I})$ then we do not disregard the attack arrow $e \twoheadrightarrow \mathbf{I}$. Now assume that it is the case that $V(e) < V(\mathbf{I})$. A distortion occurs when a change in V occurs to V' and $V'(e) \geqslant V'(\mathbf{I})$. In this case the distortion is generated because the extension now is e = in, **I** = out.[3]

In Figure 2, the critical argument e changes value and as a result, **I** becomes out,

[3]We shall discuss in Subsection 7.1 the modification we need to the numerical comparison we have presented here. In Figure 3 we generalise as follows:

1. We allow the element e also to attack the value $V(\mathbf{I})$ and/or allow $V(e)$ to modify $V(\mathbf{I})$.
2. We allow for values to be transmitted (appropriately according to some algorithm) along attack (i.e. R) lines
3. These modifications will require us to work within the Equational Framework of [5].

We remark that one can also possibly use preference argumentation as our starting point, see Modgil [23]. This may be technically possible but we think the Bench-Capon valuation approach is more compatible with the sex offenders way of thinking. The therapists use numerical strengths in their tools. So distortions will change the numerical evaluations. In networks with preferences, a universal distortion can change the preferences.



[h!]

Common sense adds more to Δ. It adds Δ′. We write $\Delta|\sim Q$.
If we add more facts to Δ (say Γ) we might get less when using common sense, so now we might have that $\Delta + \Gamma \not|\sim Q$.

Figure 4

and no longer inhibits **d**. The choice of single factors **d**, **I** and e are examples only and in practice there may be several of them. The choice of the Bench-Capon model (see Definition 2.7) is based on sex offenders practice and therapy. The therapy used in the sex offenders area changes the relative value of various factors in S_2 to eliminate the distortion.

4.2 Non-monotonic distortions

We begin with an explanation of how the non-monotonic mechanism works. Consider Figure 4.

We start with given recorded data Δ. The non-monotonic commonsense mechanism adds more data to Δ. Call it Δ′. Δ′ is not recorded, it may be wrong, but commonsense dictates it. For example if the data is that John is on a strict diet and he is offered a huge ice cream cone, we can add using commonsense that he did not eat it all. Maybe he had a taste. But who knows, maybe it was so tempting that he rejected his diet program then and there!

Now suppose we add the additional data Γ that this ice cream was offered on John's 60th birthday and that he had been exercising extra hard in anticipation of this event. Now it is not clear whether or not John rejected the ice cream.

The perceptive reader might ask: what is the connection with sex offenders? We answer by an example showing how a normative teenager can end up accused of rape. Let us examine normal commonsense behaviour of a teenager asking a girl on a date. We can safely assume that if the girl says "no", then the boy should not force himself upon her. But in current conditions, with boys accessing pornography on the internet, this boy might have drawn the conclusion that girls never say "no"

and mean it.[4] He might interpret the "no" as "yes — but try a bit harder to get me".

This is a distortion. Instead of

$\Delta|\sim$ "no" means no, respect it!

we get

$\Delta+$ porn movies $|\sim$ "no" means "yes, but let us play the game of refusal and conquest".

So a universal distortion **D** in this context is a hidden set of assumptions such that every commonsense query $\Delta|\sim?Q$ becomes distorted into $\Delta + \mathbf{D}|\sim?Q$.

Remark 4.1 (Summary of Sections 4.1 and 4.2)**.** *Before we move to the next Section, let us summarise what we have so far from the current Section. We have two possible models for universal disturbance.*

We start with a traditional network (S, R)[5] *with* R *the attack relation on* S *and the universal disturbance is modelled as a change of* R *into* R'*. The situation of Figure 2 can be accommodated buy letting* $S = S_1 \cup S_2$*. Note that just changes* R *to* R' *connects us with many papers on argumentation dynamics existing in the literature. Are such existing Argumentation Dynamics models suitable for our purpose of addressing sex offender therapy? We think they are not. We say, however, after looking at the list of arguments presented in this Section, that we need to be more specific and look at value based networks of the form* (S, R, V)*, and generate the (argumentation dynamics) change of the attack relation by changing* V *to* V'*.*

As for the second non monotonic model, this is different. It has a different form. The nodes are logical theories and the attack relation is information input.

Fortunately, we have a new paper, entitled "the attack as information input" which can unify both approaches. The paper shows that the second model can simulate the first model. In short, more information can kill an argument. See [11].

So at this stage our models have the form (S, R, V)*, where* S *is a set of pieces of information,* R *is information input,* V *is a value function on* S *and the attack machinery, extensions, etc., etc., is a modification of some options from [11].*

To be able to proceed we need to learn more from the sex offender therapists about how they use logic and argumentation.

So we look in the next Section at some real sex offender arguments and proceed to further look in the next Section at an actual case study of a real offender.

[4] No porno film will end in the first 2 minutes because the girl said no. Similarly no action films ends in the first 10 minutes because the hero gets killed, etc., etc.

[5] We have included Section 2 giving some background material for the reader not from the argumentation community (hopefully from the sex offender therapist community).

5 Distortions in the Sex Offender Case

This Section presents the data about distortion in the thinking of sex offenders. This is the area we want to model.

5.1 List of sex offender's arguments

We now show that our model is reasonably motivated by sex offenders' arguments. One of the main differences between sex offenders and offenders in general is the distortions in the sex offenders' reasoning process. These distortions can be characterised by the following features (as accepted in the professional community). Before we list the features, we repeat our words of caution to our perceptive readers:

1. The list below is has been recognised and compiled by the community of sex offenders therapists.

2. We the authors looked at this list and as a result decided to start our theoretical modelling with the Bench-Capon valuation approach.[6]

3. We are not claiming that we are going to model or can model the features in the list below. Our first look at the list below gave us the impression that if we can model the features suggested by the list below, then we should start from the Bench-Capon valuation approach.

4. Our view shall be further refined as we go along and we shall offer more refined models until we discuss a much better model in Section 8.

So let us start the list:

1. Exaggeration. A simple insult can become a major attack which requires a serious counter-measure.

2. Generalisation. One girl rejected me and so I have no chance with girls and my only option is to take one by force.

[6] The Bench Capon approach has two aspects:

(a) The Technical aspect, given an argumentation network (S, R), we can associate with each argument x a value $V(x)$.

(b) The qualitative aspect, the meaning we give to these values and what we do with them.

We use the technical aspect of Bench Capon, but give the meaning used in the sex offender case, which is some semi numerical strength/relevance/importance value to the arguments.

3. Misinterpretation of facts. My wife smiles at someone and I am sure she is having an affair.

4. Unfounded deduction. A woman accepts my invitation for coffee, which means she agrees to have sex with me.

5. Extreme opinions.

    - My wife says she wants a divorce, but if I force sex on her she will stay mine.
    - Children love sex with grownups.
    - I must have sex with this woman, otherwise my life is not worth living

The sex offender distorts the system in order to feel more comfortable with what he is doing. In the annihilator model he would change V in a way which puts anything having to do with himself in the highest V value.

The following list gives samples of sex offenders' rationalisations:

1. Kindheartedness.

    - I was not attacking, I was only trying to help.
    - I did not do anything.
    - I exhibited myself in order to teach the children about sex, or the child was sad and I only amused him.

2. Helplessness.

    - I cannot stop myself. My drive controls me.

3. Projection-blaming.

    - She made me do it.
    - I was drunk.
    - My friends started it, I was just swept along by them.

4. I have the right to ...

    - I spent money on her, she owes me.
    - She is my wife, I have the right.
    - She is my daughter, I created her.
    - My wife denies me sex, so her daughter takes her place.

- It is ridiculous. A man cannot be accused of raping his wife any more than he can be accused of stealing his own radio.

5. Minimalization.

   - It did not bother her.
   - Other people do worse.

6. Justification.

   - She annoyed me. She deserves it.
   - Youngsters nowadays know more about sex than grown ups. They want sex. So what if she is only 12 years old?
   - I had a hard day and was a long time without sex.
   - She sleeps with everybody, why pick on me?

7. Self importance.

   - I am beyond the law.
   - All women adore me. I thought she was just playing hard to get.
   - I know what women think. I know she wanted me.
   - She contacted the police only because I stopped having sex with her and she just can't give up on me.

To put all the above arguments in some perspective, consider a recent incident reported in the BBC news, of a "proxy" sex offender (ex-girlfriend's dog beater), see [61]:
Speke man jailed for pouring boiling water on girlfriend's dog, by Andy Gill BBC North West Tonight.

Here we have an interesting case of a man who beat up his girlfriend's dog.

He was obviously taking out his frustrations on the animal, but the interesting thing is that when speaking about it in court, although acknowledging that he did it, he denies that he is capable of such a thing.

That is, he is holding two mutually exclusive views of reality.

1. He did it.

2. He is not a bad person and so could not have done it.

5.2 Case Study supervised by Dr Gadi Rozenberg

We describe here an example of distortion in an actual sex offender. The therapy has emotional, cognitive and behavioural aspects, [47] but this paper focusses on only the cognitive point of view. It includes therapy for changing the distortion [48] and also recommendations for therapy that are not modelled in our paper, as we are dealing only with the distortions themselves. The sex offender builds a view (a non-monotonic distortion) which makes him more comfortable with his actions. The therapy is to challenge the offender's view using logic. The sex offender's reasoning is distorted only in connection with his offences. His reasoning is sound in other contexts. The therapist shows analogy between the distorted context and a sound context and points out that the sex offender's reasoning is not consistent. Furthermore the therapy is conducted in groups. It it surprising but it seems that although one sex offender's reasoning may be distorted for his own case, when faced with the identical distorted reasoning from another offender, the original offender can spot it as a distortion. So the sex offenders can see what is wrong in other offenders but not in themselves. This makes logic group therapy quite effective.[7]

Once the therapy is successfully completed,[8] statistics show that 30% of the successful candidates do not re-offend in comparison with offenders who did not participate in the therapy, see [49].

The following is a description of this particular case [34]. Note the arguments and counter arguments between the offender and Dr Rozenberg. The time scale is 1 year and 8 months.

The case is of a native Jewish Israeli ultra-Orthodox man of about 39, with four children aged 7, 10, 11 and 13.

He would normally spend half of every working day in a religious study group

[7]Yes, it is significant that this international community of experts dealing with sex offenders actually use argumentation extensively! It offers more opportunities for further research for both communities. We stress again that our purpose in this Section is to present the case study as it is, with a view to determining further what kind of theoretical tools we need if we want to model it. So we are sort of "casing the joint", to further refine our understanding of what kinds of tools we need. We are not yet ready for an initial model. We shall use footnotes to remark on items that require special modelling attention. The next Section will analyse the case study further, but still not yet model it. We shall summarise and offer an initial model in Section 8. We need to properly lead up to this model.

[8]"Successful candidate" means the candidate realised his reasoning was wrong and expresses regret about his actions. Successful candidates can get a third of their prison sentence reduced. Of course with such an incentive some (but not all) sex offenders join therapy and express regret but for some of them it becomes genuine. The group therapy (10-14 sex offenders) takes 20 months. In short: Success means the candidate managed to finish the therapy and the therapists believe that his risk to sex offences recidivism is reduced.

and the other half working part-time as an estate agent, but he is serving a second prison sentence for committing two child sex offences. His first offence was for sexual contact with a child aged about 9, and when he met Dr Rozenberg he was serving a second sentence for sexual activity with two of his neighbours' children, boys aged 9 and 11.

Before the therapy, he denied the offences, stating that the children had falsely accused him but without being able to suggest a reason for their allegations. Following talks with a clinical criminologist, he gradually began to open up about the details of his behaviour. It was decided to accept him for group treatment in the prison Forensic Psychiatric Division for sexual predators. Treatment is about psychological introspection coupled with experience to lead to a change of pattern of thought and behaviour. During treatment all patients experienced a variety of interventions in their distortions. Group therapy lasted one year and eight months, during which the patient expressed a variety of distortions.

Presented below are some of the distortions of thinking and a summary of comments that arose during treatment. The goal was to try to enter his conceptual world and change the mindset and habits of the patient.

When the subject was asked whether he was willing to participate in treatment, he said he would concentrate on the study of Torah to take his mind off thinking "prohibited" thoughts which would prevent him from re-offending. He was told that Torah study for a religious person is very important and can help, but he was asked how he coped with his aberrant drives after his first offence. The subject admitted that he decided to get married as soon as he could in the expectation that his sexual needs would be met by his wife.

It was explained to him that the two solutions he described are external solutions which, although important, are probably not sufficient. Marrying does not shut down a strong attraction to children, which is the central problem. Many victims of this drive honestly repent and believe that the repenting will "save them", but they repent every day, and fail and re-offend every day. Obviously repenting is not enough to break the cycle. In the same way, punishment is generally ineffective in preventing repetition. Instead there is a need for internal adjustment, usually guided by therapy.

At the beginning of the treatment the subject frequently referred to offences in the third person in an attempt to distance himself and so avoid responsibility. For example, he described the offences with the word "occurrence" and described each "occurrence" as a "mistake". It was then pointed out to the patient that he had committed actions of his own volition and, as he had elected to participate in treatment, so he had to regard the offences not just as accidents but as the result of his own thought and planning. To do this he had to start by describing his actions

accurately and admitting their significance so that he could take responsibility for them. Review of his actions would extend to his description of even small things. For example, it would not be acceptable to say "the cup fell," it would be necessary to say "I dropped the cup".[9]

After we dedicate time and effort in reviewing relatively minor details, it is thenÊ easier to set things right in more significant areas. For the purpose of illustration, we asked a group of patients the following question:

Raise your hand if you have ever said to yourself "I'm going to rape now!" or "I'm going to commit a sexual offence".

To date, none of Dr. Rozenberg's patients has raised his hand. All have justified their actions with a variety of explanations and rationales. Such explanations have been along the lines of "I am going to have fun", "it is not offensive", "it is just a game", "the child will love it" and so on. It is therefore critical in our therapy to make clear the importance of correct and precise definitions. We also correct common statements like: "I must say something" and explain that the word "must" implies that there is no choice, and we always have a choice. Even if someone puts a gun to our head and demands we do something, we can still choose not to do so. In pointing this out we make our patients more aware that there is always a choice and therefore it is more accurate to say "I want to say."

The patient made an attempt to transfer responsibility by blaming his inclinations on the sexual attentions of a teacher to which he was subject at about 11 years old. He related that he still had harrowing nightmares and maintained that these memories filled him with "prohibited" sexual impulses. He had not told anyone about it until treatment but he believed that because he was a victim of sexual assault he had become an offender.

After expressing sympathy for the patient, the therapist asked if the patient believed that every victim of sexual abuse became a sex offender. Various studies were presented to him and he had to admit, most importantly to himself, that despite the trauma he nevertheless still had a choice. Dr Rozenberg tried to show him that even though he had suffered harm, he had managed his studies, started a

[9]The formal logician might ask, how are we going to model the subtle difference between "the cup fell," and "I dropped the cup"? After all, modelling the passive in classical logic (and bringing the difference of the passive as compared with the active) is not easy. We say there is no need to micro-model here. We simply annotate one with responsibility and the other without it. So we read the meaning of "I dropped the cup" as saying "I dropped the cup and I am responsible for this" and we read "the cup fell" as "the cup fell and I am not responsible for it". The problem with the sex offender reasoning is that the sex offender does not want to take responsibility for his/her actions. For this reason saying the "the cup fell" in the passive attaches less responsibility than saying "I dropped the cup". Similarly lowering the valuation V on the descriptions of the offences is designed to distance the responsibility for the offences from the offender.

family and functioned as a father.

Another attempt to reduce personal responsibility was the patient's emphasis on feelings of helplessness. He spoke of a strong sexual attraction to children and a lack of ability to resist his impulses, while telling himself that this was his inescapable destiny.

In this case we used examples from religious texts which emphasise the personal responsibility given to each human being by divine power, with righteous behaviour bringing appropriate rewards and wicked behaviour bringing just punishment.

With regard to the patient's inability to overcome his sexual urges we presented him with a strategy we call "The Policeman Test".

In The Policeman Test, the patient is asked if he believes he would commit the offence if there was a policeman standing nearby. Of course if the individual is not suffering from a mental illness the answer is "no" which again proves the existence of choice.

We pointed out to the patient that he had controlled his impulses in the case of his own children, because of the paternal love he felt towards them — a connection which he did not feel towards the other victims.

The patient initially tried to minimise the severity of his crime by emphasising that he had not raped but had "only" committed indecent acts. We explained to him that illicit sexual activity is not a competition and that he cannot compare one offence with another but has to recognize that any harm to a victim is a severe blow. We pointed out that if a man is severely beaten, he will suffer physical pain and psychological damage and that it is not reasonable then to tell him that he should not worry about it because some people have been stabbed to death. Also, we emphasised that an injury can disrupt the entire world of the victim, who will internalise it and carry a lifelong trauma that will affect all future actions and relationships. In this way an indecent act is never trivial but is in fact a severe injury. We also used his own argument that he himself was abused, an experience which has left him with painful and ineradicable memories which have distorted his social interactions and which set him on the path to becoming a sex offender himself. This was given as an example of why he should consider the outcome of his actions and the injury to his own victims.

In the same context the patient argued that his offences could not have been too serious as the children did not object immediately but waited some time before complaining about what had happened to them. We countered that he himself remained silent about the abuse that he had suffered, even though he was well aware of how badly damaged he was by the behaviour of his teacher.

One more argument that the subject used was that the children agreed to his actions and did not protest. We then asked the subject whether he would be willing

to commit seppuku. When he found himself unable to answer that question, on the grounds that he did not understand the word, we explained to him that "seppuku" is a Japanese word referring to ritual suicide, which was an act expected of an honourable Samurai in certain circumstances. Just as the subject did not know how to react to the word that he did not understand, so a child who does not understand sexual activity would not know how to consent to, or reject such activity.

6 Analysis of the case study

6.1 Initial analysis

Taking a first look at the case study of the previous Section, we find ourselves puzzling over the process. The first question we might ask is why it takes 20 months to put forward certain arguments to the sex offender. Granted there must be time taken for administration and it is group therapy but still 20 months is a long time. Is there some need for additional, time consuming steps forced by the logical nature of the therapy and the logical attack on the universal distortion of the sex offender? Let us start by giving more details of the therapy process:

> The goal of the therapy is prevention of further offences.

Treatment makes the following assumptions:

A There is no complete cure, but the offender can learn how to avoid abusive behaviour.

B Even if the offender continues to have deviant thoughts he can choose not to act upon them.

C SUD mode (Seemingly Unimportant Decision), see [50]. For example, a sex offender with a paedophilic disorder is asked to deliver packages on a regular basis to an office which happens to be next door to a kindergarten. TheÊ seemingly unimportant decision to accept the job may lead to abusive behaviour.

D The offence is planned rather than impulsive.

As is customary in the international sex therapist community, we are using the Relapse Prevention Model to reduce risk in sex offenders. We believe that correction of cognitive distortion is an important part of the therapy.

At the best of times, even a treated offender may continue to experience the urge for deviant sex. This treatment model seeks to help the offender in managing such urges but it is not necessarily a cure nor does it guarantee removal of the urge

to re-offend. We focus our treatment on the identification of the offender's sexual offence chain and cycle, and the development of plans to prevent the offender from experiencing a total relapse. We develop the relapse prevention plan after extensive education on the sexual offence chain and cycle. This incorporates an examination of the progression from the initial urge through the stages that culminate in the sexual offence. We then help the offender to understand his own offensive chain and cycle, and to identify his specific pre-offence thoughts, feelings and behaviours. We identify the progressive and self-re-inforcing nature of the pre-offence components to help the offender to recognise that his offence is not a spontaneous event, but the product of a generally predictable series of thoughts, feelings and behaviours.

The relapse prevention plan then takes each step of an offender's chain and/or cycle and generates options [51], diversions and/or alternate behaviours that interrupt his sexual offence path.[10] All activities carried out in therapy relate directly or indirectly to interrupting his offence chain and cycle, and strengthening the relapse prevention plan. The offender is required to acknowledge all his sexual offences during therapy, whether they are known or unknown to other people. The goals of therapy include identification of the patient's chain and cycle of offending, a reduction of denial, working toward taking full responsibility, recognising the impact on victims and developing victim empathy, recognising the impact of victimisation on family members and friends, planning for regaining the trust of family members, self-management of deviant sexual arousal, and working toward implementing an effective relapse prevention plan.

Other issues, such as healthy attitudes toward sexuality, substance abuse and anger management are also addressed. The offender is expected to increase coping skills for all activities, especially when stress or gratification needs are present. Usually, the offender is expected to be in treatment for 12 to 18 months successfully to develop an effective, individualised relapse prevention plan

Treatment focuses on the emotional, cognitive and behavioural aspects and the steps upon which the Group focusses are:

1. familiarity, working on a establishing contact with the candidates.

2. "I and the other" — patients are asked to draw a picture/image of themselves and draw significant figures in their lives and the work on such drawings allows

[10]The perceptive reader should observe that logically this is a sort of time action cyber protection model.

Let us rephrase this:

The Cyber Protection plan then takes each possible step of a Hackers chain and break in cycle and generates options, diversions and/or alternate behaviours that interrupt the possible Hackers break in plan.

focussing on the life history of the individual. Other methods at this stage are guided visualisation, therapy cards, and "Anibi"[11]

3. Empathy or identification of emotions — work on the different feelings and emotions of the patient and the others. This can be done using pictures with facial expressions, writing a letter to a victim and a letter from a victim, reading the testimonies of the victims and so on.

4. Sexual functioning — It is imperative that we convey to the patient not only what is prohibited, but also what are the alternatives.

5. Offence Cycle — can be identified as a summary of most of the therapy progression.

   (a) trigger: accelerator of the cycle, which may be an event which is not necessarily sexual in nature

   (b) feelings, thoughts (cognitive distortions),

   (c) dis-inhibitors (like alcohol, drugs and pornography),

   (d) planning,

   (e) focus on the offence,

   (f) reconstruction.

Finally, we work on risk situations and ways to deal with them.

6.2 Further analysis

Continuing our discussion about how to model the sex offender's reasoning distortions and their therapy, we get our clue from the following part of our case study. We said in our description above of the therapy process that:

> "In the same context the patient argued that his offences could not have been too serious as the children did not complain immediately but waited some time before complaining about what had happened to them. We countered that he himself remained silent about the abuse that he had suffered, even though he was well aware of how badly damaged he was by the behaviour of his teacher."

[11] anibi — name of special Therapointing cards with pictures that the patient should choose and tell about himself in an indirect and non-threatening way.

It is clear from the above description that there was an internal inconsistency in the patient's statements. The therapist detected it and pointed it out to the patient and made him aware of the distortion in his reasoning.

We understand this as typical of many cases of universal distortion. The distortion affects only part of the system leaving some of the system unaffected, thus exposing a detectable internal inconsistency.

Furthermore, in group therapy with other patients, although each patient is unable to detect inconsistencies in his own narrative, each patient does detect such (even identical) inconsistencies in the other patients narrative. So the therapist can point out to each patient the similarities of his own narrative to other narratives and thus making him able to detect his own inconsistencies.

Therefore the therapy proceeds along the following lines:

1. (a) Take steps to gain the trust of the patient and let him disclose more and more of his reasoning network so that internal inconsistencies can be better detected

   (b) Put several patients in group therapy, let them give their own narrative to their fellow patients. The other patients will detect inconsistencies in others but not in themselves and then therapy can proceed to make them see the inconsistencies in themselves.

   This process, as described above, takes time.

2. Find ways to encourage in the patient a desire to be helped.

3. Use logic and arguments to have the patient see his internal inconsistencies and minimise the distortion.

6.3 Comparison with other kinds of distortions

There are cases —such as the universal distortion which results in victims joining fundamentalist (and sometimes murderous) religious movements such as ISIS — which might not be amenable to this type of treatment. Since part of the distortion involved in such cases is that no-one has the correct view of the world except the victim him/herself and other people subject to the same distortion, the victims are not looking for a way to change their attitudes and therefore will not be receptive to understanding their own illogic. Even if we gain the trust of the patient and point out some inconsistencies, the patient might even resort to re-enforcing his beliefs by increasing the distortion instead of decreasing it.[12]

[12]The discussion about ISIS and religious fundamentalists is speculation/conjecture by the authors. We plan to ask for funding and get permission to form therapy groups and see what happens.

One of our authors remembers what is now an amusing anecdote from her childhood in Yorkshire in the 1950s — a place hardly notable for its cosmopolitanism. As the only Jewish child in her school she was often challenged by her classmates on biblical matters to which they had been exposed during their Sunday school lessons. On one occasion she was cornered by a group who said "You killed Our Lord". Startled by the inconsistency of this argument, the girl responded along the following lines: "Didn't Jesus die to save you from your sins?" This fact was acknowledged. The girl continued: "If He did not die, you would not have been saved." This was also acknowledged. "So what are you complaining about? If the Jews did kill your Lord, we did you a favour." At this point, the whole logic of the argument descended into violent rejection. Whether that was because the attackers were unwilling to accept the truth of the argument, or whether they were simply annoyed with their victim for being a smart-aleck is now something we will never know but the main problem with the counter-argument was that it did not go back far enough to the basic assumption. The problem was not that the Jews had "killed our Lord" but that the Jews were not Christian. Finding and altering such a basic assumption would be extremely difficult and some might say completely impossible.

The story of ISIS is not so amusing, but it follows similar lines. An orthodoxy is disseminated, based on certain 'truths' which the adherents take for granted and assign to these truths as much reality as we would assign to the existence of France. Once these rock-solid truths are established everything else flows from them with perfect logic. No amount of arguing can shift that unless the original assumption is destroyed. This does occasionally happen, particularly when the victim finds himself on the receiving end of the sort of cruelty which he may have inflicted upon others, having been convinced that what he has been told to do is necessary for the building of whichever ideological paradise is his particular poison.

With regard to point 2 above — that a solution to the problem can be found only if the patient wants to be cured — in the clinical field we have not once met a sex offender who rejects any change at all and argument therapy is more successful than most in preventing recidivism. For example if the recidivist rate is 10 percent, offenders who take argument therapy will have a 7 percent recidivist rate.

Some of the patients have serious organic mental disturbance that would manifest itself whatever treatment was given but some of the patients are not curable because although they are aware that their actions are illegal, they do not want to be cured. That is, they have a low empathetic index and regard their own wishes and feelings as superceding those of any others. In their case any logical argument would hit the brick wall of the patient's own desires.

With reference not to the distortions of sex offenders, but to the distortions formed by religious fanaticism, we might take the example of those who have been

ensnared by an organisation such as ISIS. Many column inches in British newspapers have been devoted to the question of why star students have forsaken a comfortable suburban life in the UK to become cold blooded murderers in Syria. There is also speculation about whether or not such people might be amenable to therapy to rid them of their lethal ambitions but it is likely that intervention will work only if the subjects themselves want to change. Since there have been some defections, we can see that a change of mind is possible but a Moslem who has espoused the most literal interpretation of his religion is absolutely convinced of the existence of Paradise and Hell and would not regard any killing for the sake of Islam as murder–even the killing of innocent co-religionists.

In 2014 a Taliban group stormed a school in Peshawar and murdered 141 people, all of them Moslem. See `http://www.bbc.com/news/world-asia-30491435` (accessed May 16, 2017, 1230p hours UK time). The justification for this was that the guilty adults were being punished while the innocent children were being fast-tracked to Paradise before they had been corrupted by their wrong-dealing parents and teachers. According to one survivor, "the terrorists shouted at the boys to say a 'kalma' (an especially holy prayer) before they shot them". It is obvious that the assassins regarded their actions as a kindness, saving the children from an eternity in Hell.

Such people go to their own executions with the certainty that martyrdom will not only ensure their immediate acceptance into Paradise but also the acceptance of their close family members.

It may be observed that although the effects are more extreme and result in more casualties, the rationalisations for the activities of fundamentalists of this type follow the same structure as the arguments used by sex offenders, such as "I have no choice" or "I was converted/corrupted/brainwashed in childhood by a teacher/parent/neighbour" or "I was trying to educate the unbeliever", "this is what I am, I cannot change", etc.

We now conclude our discussion. We note that the above observations allow us to formally model distorted systems via detecting its internal inconsistencies. This is done by internal analogies and isomorphisms. So we need to define such concepts in a plausible way. Our latest model from previous Sections had the form (S, R, V), Where S is a set of atomic arguments, R is a binary relation on S and V is a (qualitative and technical variation of) Bench-Capon valuation. The distortion is modelled as a change in V. We also mentioned that we can generalise and take an information input model as in [11]. Let us for the moment remain within the framework of general abstract set S. We need to introduce analogy and isomorphism. If S has no internal structure, then the isomorphism will be just an abstract automorphism of (S, R). This is useless for practical modelling. We must give S internal structure.

The second idea we got from this Section is the need to model the religious fundamentalist who perpetuates and expands his distortion. We leave the details of this modelling case for a subsequent paper. Religious fundamentalists cling to their distortions, even at the cost of denying obvious facts. Dealing with such an attitude is an entirely different ball game. The sex offender knows deep down that there is something wrong and so there is some hope for therapy with him.

Dr Gadi Rozenberg points out that therapy is more difficult with sex offenders who are lawyers or academics. They seem to be more resistant to his therapy logic arguments. We might be tempted to consider a different point of view regarding the role of therapy.

A lawyer believes he is cleverer than the therapist, and demonstrates his intelligence by using ever more devious arguments. One theory that may be advanced is that what is happening is a duel or a game of chess. Sex offenders know they are doing wrong — there are very few who are convinced they are right and they are the ones with psychoses or mental disabilities who cannot in any case keep up an argument — so it could be that when the therapist argues with an offender of normal mental capacity is that he or she is convincing the patient of the therapist's superior intelligence whose logical arguments should be taken on board as having validity.

In that particular model the it is lawyer who resists who is fighting to keep up this structure of his own power. Only when the therapist proves to be cleverer (by putting forward arguments he cannot counter) will he begin to cave in and perhaps finally see things as the therapist sees them.

Dr. Rozenberg refutes this theory. While agreeing that beginning therapy can be described as a fight, in his experience, "winning" increases resistance and cure starts only when the patient realises the therapist cares about him and that they both have a common goal.

We do think however that the "power" model might work with religious fanatics. They believe they have power (God, Allah) on their side and so they feel powerful. However much you argue with them, they have to keep up this illusion of their own power. Even being in prison will not shake them, because they can believe they still have all the power of Truth on their side. It is only if you have better arguments that you will overcome this resistance.

The argumentation would have to be of an extremely high (and possibly superhuman) quality but it might mean that what is needed in such cases is not psychologists but lawyer — and lawyers of a particularly high calibre.

6.4 Connection with the Pragmatics Community

There is a connection with the Pragmatics community which study text and testimonies to check for internal consistencies and distortions. The need for this arises especially in allegations of sex victims' testimony, such as children. Paper [25] is a sample. The pragmatics community studies text for consistency and coherence. We study arguments of sex offender for the same. To what extent the methods are similar and the mistakes and distortions are similar remains to be studied. The pragmatics community is vibrant and connects with other further away communities such as literary analysis and language and psychology. It is exciting for us to look forward to working with this community.

See also Appendix A for the Israeli guidelines and Appendix C for the UK approach. We quote its summary

> SUMMARY (quoted from [25])
>
> "In evaluating the truthfulness of children's allegations of (sexual) abuse, German forensic experts have focused on qualitative aspects of the content of a witness's statement. Within the overall credibility assessment of a witness's statement, known as statement validity analysis (SVA), they have developed a technique referred to as criterion-based content analysis (CBCA), which utilizes content criteria that supposedly are indicative of the truthfulness of a statement. While first validation studies of CBCA criteria have been undertaken, a theoretical basis of why and under what circumstances deceptive and truthful accounts should differ with respect to these criteria has been wanting. The reality monitoring (RM) approach is proposed as a theoretical basis for discriminating between fabricated and self-experienced events. The present experiment links forensic CBCA credibility criteria to the reality monitoring approach and tests the relative validity of CBCA and RM criteria in discriminating between fabricated and self-experienced video recorded accounts of adult participants. Transcripts rated for the presence of CBCA and RM criteria by trained experts could be classified in an above- chance fashion. On the basis of a factor analysis of CBCA and RM criteria, commonalities and differences between the two approaches are noted."

Another sample paper is [24]. Again we quote from it

> Abstract
> "This study describes the linguistic differences between the discourse of truth and discourse whose objective is to mislead. The intention to

mislead arouses cognitive and emotional functions in the speaker that affect his speech. An examination of the linguistic characteristics that distinguish between the discourse of truth and that of invention among 48 native Hebrew speakers who were asked to tell both true and invented stories found 13 criteria that differentiate between the two types of discourse. The criteria were classified according to the cognitive and emotional functions affecting the speaker, also addressing his level of awareness of these functions. The objective of this paper is to demonstrate the effectiveness of the linguistic examination in differentiating between truth and deception. This effectiveness is due to the uncontrollable psychological processes that cause differences between the discourse of truth and invention. The results may enable us to construct an instrument for linguistic examination to differentiate between the two types of discourse."

Paper [26] studies the way an offender views his actions in a way that makes the offender more comfortable with himself. This is directly related to the way we analyse our case study. Again we quote from [26]:

Abstract
"This article deals with the strategies the storyteller uses to influence the listener's perception and thinking. It is based on qualitative research, which examined the narratives of 12 men who killed their female partners. After entering prison, the murderer attempts to salvage some part of his social image. He does this using an assortment of means in two areas: the content of the narrative and its linguistic style. In terms of content, all the storytellers present themselves as extremely positive and their wives as very negative. With respect to language, the killers use verbs that distance them from responsibility, they hedge, repeat words and phrases to persuade, and use figures of speech they expect will impress their listeners. This artificial discourse is cunningly interwoven in terms of content and story art to recreate an alternative reality of a man who is normative and whom society can accept."

7 Formal models of distortion, a first attempt towards sex offender case

In Sections 3 and 4 we discussed modelling distortion in logic and argumentation. In Sections 5 and 6 we discussed distortion in the minds of sex offenders . We

are now ready to connect the two discussions and attempt to model the distortions we see in the thinking of sex offenders using the theory of distortion in logic and argumentation. First we identify the principal distortion features we have observed in sex offender thinking (sections 5 and 6). This will help us decide what formal logic features we need to model them.

Sex offenders like to feel comfortable with themselves. They are doing no wrong. They are doing good. They educate small children. Women find them irresistible and in fact to the extent that they can be blamed, it is not their fault. They are the victims.

So when presented with arguments and facts to the contrary they distort the evidence and the reasoning using more or less the following:

1. any argument against them is valued as insignificant (lowering its V value) and adding various other qualitative V values that make it less important.

2. add more arguments to show that they are victims.

So from the above it is clear that we need to use formal argumentation systems of the $(S, R, V_1, V_2, ...)$ and the distortion is achieved by lowering /changing the V values.

Furthermore, the distortion the sex offender offers is only partial, affected only in those parts of the system containing arguments attacking his integrity. Other similar parts of the system, not directly related to him, remain intact. This creates structural inconsistency in the sex offender narrative. The therapy, as we have seen in the case study, makes use of this inconsistency. So we need to be able to show formally that parts of S look like/are structurally isomorphic to other parts of S, and further show that the structure of one part is valued differently from the structure of the other part (thus showing the inconsistency). This necessitates that we give internal structure to the elements of S so that we can use the internal structure to define the similarity.

We now have an initial idea of what we need, so let us proceed with our modelling, first with informal discussion and then with a more formal one.

The reader is warned that formal machinery can acquire a life of its own. We have identified that we need to develop formal models of the form $(S, R, V_1, V_2, ...)$, where the Vs are valuation and the elements of S have additional internal structure. Once we look at such structures formally, we have to deal with them in the context of formal argumentation which could mean that we deal with features beyond what is needed directly to model the distortions of sex offenders. Look at it as export of new ideas from the sex offender field into argumentation, pushing argumentation in

new directions, not necessarily fully correlated with sex offenders reasoning. This is what is happening in Sections 7.2 to 7.4 and later in Section 8.

This is not surprising, it happens all the time in Science. For example the bouncing of a ball striking a wall necessitated the Dirac δ function, which in turn motivated the development of the the mathematical theory of distributions. For the formal argumentation reader, we recommend to view Sections 7 and 8 as new theories of argumentation arising from the application area of sex offender reasoning.

Let us now discuss the correlation between features of the sex offender case study and corresponding formal properties required to model these features.

Feature 1. Many lives annotation to arguments

In recent years (especially in the last 2 years), there have been many cases in the press of senior politicians and celebrities both in Israel and the UK who have been accused by victims of sex offending. The patterns are all very similar. A victim from years past accuses the person x of sex offence. x denies it all and gives some explanation pointing out that if it were that serious, why wait so many years to complain? A short while after the first complaint more victims come forward and complain. The number rises to k victim complaints. At which point either x resigns and/or the police investigates and/or x is condemned in the social media, etc., etc. We call k the numbers of lives of x, notation $k = V(x)$.

For example an Israeli minister x resigned after four complaints. An Israeli general y was prosecuted after two complaints, etc.

So the obvious formal addition to the formal Dung theory of abstract argumentation is to add the many lives annotation function V. Networks have the form (S, R, V), where S is the set of arguments, $R \subseteq S \times S$ is the attack relation and $V : S \mapsto \{1, 2, 3, \ldots\}$ is the many lives function. The meaning and role of V is very clear.

- $x \in S$ is considered "out" if the number n of "live/in" attackers of x is $\geqslant V(x)$.

Although the idea behind the addition of the many lives function V is very intuitive, its formal mathematics is not as simple, see [44] and Subsection 7.5. It requires a special additional research paper. There are conceptual problems to be resolved and the new concepts must agree with the old concepts as special cases. This is in addition to showing how to model the sex offender case study. Here is a partial list of questions.

First we note that the obvious distortion in (S, R, V) is to change V. The sex offender will increase V to suit himself.

Q$_1$: Suppose we have two nodes x and y, each having three lives with x attacking y and y attacking x. Clearly none can 'kill" the other (assuming the attack takes only one life). So $E1 = \{x, y\}$ is "conflict free" and is indeed a "complete extension".

How many lives does x, y each have left? The obvious answer is 2 lives each. But note what we have here! The set $E1$ is a complete extension to the original network but it also a new network with two lives for each member. So extensions are not just sets of points but are networks with different, derived/calculated new V.

Repeat the process on this new network $E1$ and get a further new network $E2$, this time with one life for each member. $E3$ is a traditional Dung network. So how do we continue? If we continue our calculations as Dung would do then we should have 3 traditional extensions, but if we uniformly repeat our own process we get only $\varnothing$.

So we lose uniformity or we lose compatibility. We need an algorithm which will do a compatible job uniformly and unambiguously. We now describe this algorithm through our example. More details in Subsection 7.5.

We start with a and b having 3 lives each. Choose either a or b from the network. Say choose a. The case of the choice of b is symmetrical.

* Attack along the arrow, i.e. a attacks b. b now has 2 lives.

* b is still alive so b attacks a, now a has 2 lives.

First cycle complete
Start second cycle

** a continues and attacks b. Now b has one life.

** b attacks a, now a has one life.

Second cycle complete.
Start third cycle

*** a attacks b, now b has 0 life.

*** carry on, b attacks a but b is dead and so now a still has 1 life.

Third cycle complete
Start fourth cycle

**** a attacks b, b has 0 life.

**** continue to a, a has 1 life.

Fourth cycle complete and is equal to third cycle

Stop because nothing is new, (fourth cycle equals third cycle).

If we start with b we end up with b having one life and a having 0 life
If we start with a and b together we end up with both $a = b = 0$ life.
This is a uniform process yielding all options.

The mathematical implementation of it in the general case is complex, as we shall see in Subsection 7.5. See also [44]. See also the next question.

Q$_2$: How do we find all "extensions" in the general case using say the cycling algorithm?
The reader should note that we still need to develop and investigate our cycle algorithm. Our Policy Option 3, which we follow in this paper, is just to explain the formal properties and what they entail in principle but not necessarily develop them in detail in this paper. So we tell you that the cycling algorithm as described in the previous question, needs to be modified a bit. Take for example a traditional 3 cycle network (traditional means one life only). That is, $S = \{a, b, c\}$ and with aRb, bRc and cRa. This has as extension all undecided. If we cycle through starting with a, we get

- $a = 1$, attacks b, making $b = 0$.
- $b = 0$ attacks c, leaving $c = 1$.
- $c = 1$ attacks a making $a = 0$.

We now have stability and so the extension $\{c = 1, b = a = 0\}$.

We do not have the rule that if all attackers y of a node x which is dead ($x = 0$) are all dead (all $y = 0$) then the said node x comes back to life (x becomes $x = 1$)!

Q$_3$: Can we offer an equational approach to (S, R, V)? What do the solutions mean?

Q$_4$: Can we view V as a special case of weighted/numerical annotation and compare with existing numerical/fuzzy argumentation papers? See Example 7.23.

The reader can see that these questions are questions of the integration of the new ideas within the old framework ideas. Actually [44] sees the formal model as a survival game. The complete extensions being survival groups unable to completely kill one another and containing all others which they can protect.

Feature 2. The attack as information input

Many of the claims of the sex-offender add more information. For example, if y complains about x that he raped her, then a very common answer is that there was consent. This adds more information and changes the nature of the attack/offence. There are two ways to see this:

1. x sends information I to y and so $y + I$ (the information y with I added to it) no longer attacks x.

2. x adds an evaluation $V_I(y) =$ "there was consent".

This new V_I lowers the value of y as an attacker.

The (1) interpretation is wide ranging and requires a new research papers. See papers [11] and [1]. This is the non-monotonic approach.

For our purposes, we use the (2) interpretation. It is simpler and more uniform with the numerical many lives V. This forces us, however, to consider the network of the form $(S, R, V_1, V_2, \ldots)$, where $V_i(x)$ are general formulas of predicate logic which can also be numerical. These mixed possibilities, however, push us to adopt an algebra of the labels $\mathcal{A}$ and the modelling of Section 8.3. Section 8.3 can be very general, see [55].

Feature 3. Internal isomorphism

We note the sex offender case study, where the subject claimed that the child y was not seriously abused and as evidence the offender put forward $V(y)$, that the child has not complained for 20 years. Furthermore, the offender claimed that he x himself is actually a victim. He put forward $V(x)$, that he himself was abused by his teacher 20 years ago and that he, x, was made to be like he is by his teacher abuser. The therapist pointed out that x is inconsistent. He cannot use $V(z)$ to suit himself.

The case of x is similar to the case of y. We cannot express this if x and y are atomic. We need to put content into x and y. We do not need to add much, just

$$\begin{aligned} y &= \text{ offender } \bigcirc \text{ child} \\ x &= \text{ teacher } \bigcirc \text{ offender.} \\ V(x) &= \text{ 20 years passed} \\ V(y) &= \text{ 20 years passed.} \end{aligned}$$

So now we can show the similarity between the two cases, but this means that our model puts structure into the argument. This is discussed in Section 7.1.

Feature 4. Bipolar networks

Sex offenders bring character support. This requires using bipolar systems with attack and support. Support increases $V(x)$ = number of lives and decreases any numerical values $V_{\text{risk}}(x)$, saying how strong is a risk to let x loose in society. We have not addressed bipolarity in this paper. We treat this aspect in [44], see also [1].

7.1 Informal discussion

The previous Section showed us that there are two ways to detect distortion in a patient.

The first is to detect internal inconsistencies in his own reasoning system, and the second is to compare his reasoning system with other similar systems. Both ways can be used simultaneously. This is what group therapy does. Put together several sex offenders, let them describe their systems to each other and point out and detect inconsistencies in each other. This means that in order to model distortions we need to use a family of argumentation networks with values, of the form (S, R, V), where the audience for each network in the family are all the other networks. To do this successfully we need a similarity mapping and a good definition of the values function V. We first discuss the similarity mapping and then we discuss the values V. To model a similarity mapping we need to instantiate the atomic arguments in each network S. This instantiation gives the arguments internal structure which can be used to define a similarity mapping. Without the internal structure, if we just leave the arguments as atomic, any similarity mapping would have to be an arbitrary function from S into S and this is too abstract. All we need is some reasonable minimal instantiation. We need not go as far as ASPIC or ABA [7, 8] but it is sufficient to regard diagrams of finite predicate models.

The diagram idea is very simple. Consider the statement a offended b. This statement is atomic. In classical propositional calculus we can only denote it by an atomic letter say q = "a offended b". The internal structure is lost. So if we also have q' = "a' offended b'", we cannot point out the similarity between q and q'. However if we allow the letter "O" for "offend" in the language then we can say that "aOb" is similar to "$a'Ob'$".

Imagine for example a set of elements, say $\{t, a, b\}$ and predicates $\{O$ (binary) and C unary$)\}$. We can form the following atomic statements U (the universe from which we form our arguments) using the diagram of this language:

$$U = \begin{array}{l}\{C(a), C(b), C(t), tOb, tOa, tOt, bOb, bOa, bOt, aOa, aOb, aOt, \neg C(a),\\ \neg C(b), \neg C(t), \neg tOb, \neg tOa, \neg tOt, \neg bOb, \neg bOa, \neg bOt, \neg aOa, \neg aOb, \neg aOt\}.\end{array}$$

The unary and binary predicates and the list of elements allow us to define the similarity mappings.

The valuation V is defined on elements of U. Let us at this stage take a simple two valued $V(X) \in \{0, 1\}$, as we first want to illustrate the instantiation.

Let us form an example of an (S, R, V):

$$S = \{aOb, tOa, \neg C(b), C(b), \neg C(a), C(a)\}$$

Where the meaning is:
t = teacher; a = patient; b = child
$aOb = a$ sex-offends b
$C(b) = b$ complains
$V(X) =$ "X" is a serious matter
$V(aOb) =$ "a sex-offending b" is serious.

The reasoning goes as follows:

$$\frac{\begin{array}{c}\text{Assumption 1.} \quad aOb \\ \text{Assumption 2.} \quad \neg C(b)\end{array}}{3. \quad \text{Conclusion } \neg V(aOb).}$$

a offends b, b has not complained, so the offence is not serious.[13]

The analogous argument is:

4. tOa teacher offended patient
5. $\neg C(a)$ patient did not complain
6. $V(tOa)$ but nevertheless the patient thinks it is serious.

We can therefore point out the analogy function α and detect a distortion.

The function α is:

$$\alpha : a \mapsto t$$
$$\alpha : b \mapsto a$$
$$\alpha : O \mapsto O.$$

We point out to the patient that:

[13] We are modelling the following argument from the case study:

> "In the same context the patient argued that his offences could not have been too serious as the children did not complain immediately but waited some time before telling other adults what had happened to them."

Note that "$\neg C(b)$" attacks the valuation "$V(aOb)$" and not the argument "aOb". This is not allowed in the Bench-Capon model.

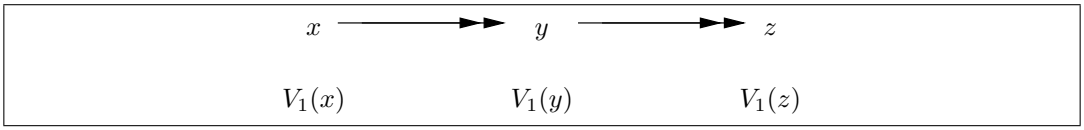


Figure 5

For aOb you said $\neg V(aOb)$
but for the analogous tOa you said $V(tOa)$.

In case we have other networks by other patients we can also have inconsistency detected by other patients. Our patient says:

$$\frac{\begin{array}{c} aOb \\ \neg C(b) \end{array}}{\text{Conclusion } \neg V(aOb).}$$

Other patients (for example the abusing teacher) will point out that the reasoning is wrong! It should be $V(aOb)$, even though other patients themselves will say in their own respective networks

$$\frac{\begin{array}{ll} 1. & tOa \\ 2. & \neg C(a) \end{array}}{3. \quad \text{Conclusion } \neg V(tOa)}$$

In fact, if the teacher who abused is also present at the therapy it is likely that he will recognise the inconsistency but will exempt himself.

7.2 Discussing valuations

Let us now turn to examine what kind of valuation function V we need to use. Consider the network (S, R, V_1) in Figure 5.

Assume that V gives values in [0,1].

Assume that $V_1(y) = V_1(z)$ and that $V_1(x) < V_1(y)$.[14]

Let us see what we need to do and what the Bench-Capon model does.

1. According to Bench-Capon, since $V_1(x) < V_1(y)$, x cannot attack y and so we have one extension E.

$$E_1 = \{x = \text{ in}, y = \text{ in}, z = \text{ out}\}$$

[14]We really want relative strength. Taking values in [0,1] gives us relative strength for any finite set of arguments. We take the smallest number as strength 1 and present all the others as multiples of it. We shall insist on the multiples to be natural numbers, which is a restriction on V.

To model the sex-offender's argument we must also allow x and $V_1(x)$ to attack $V_1(y)$ and so we need sound procedures and definitions of how to do that in a way that generalises the Bench-Capon model as a special case, as well as being able to model the sex-offender's application. So, for example, if we allow $V_1(x)$ to reduce $V_1(y)$ to a new $V_1'(y)$, say $V_1'(y) = V_1(y) - V_1(x)$, then we get the $V_1'(y) < V_1(z)$ and so y with its new value cannot attack z and the extension will be

$$E_2 = \{x = \text{ in}, y = \text{ in}, z = \text{ in}\}$$

2. We also need to be able to transmit the V value from x to z somehow. This will be addressed later in Section 8 Example 8.9, but we can already use Figure 5 to show the difference in approach.

   The Bench-Capon model says that we get the extension

   $$E_1 = \{x = \text{ in}, y = \text{ in}, z = \text{ out}\}$$

   We ask, what is the V of this extension? The obvious answer is that it is the same as before. In fact, Bench-Capon does not worry about this question. He just uses V to get the extensions. We can however generalise and say, for example, that we get a new $V = V_2$, with

   $$\begin{aligned} V_2(x) &= V_1(x) \\ V_2(y) &= V_1(y) - V_1(x) \\ V_2(z) &= V_1(z) + V_1(x). \end{aligned}$$

The above is an arbitrary illustration. It does not necessarily fit the sex-offender's application area, but it shows what kind of options we have. The network of Figure 6 is analysed in Section 8, Example 8.10, using the Equational Approach.

When we consider the above directions we would need to generalise, we find that we might consider using the equational framework of [7]. Put differently, since many lives is numerical, we need to augment the equational framework into an equational system (S, R, V) with valuations. We have to say how to generate equations for such a system. We should do this in a general way, as a theoretical endeavour and mention the connection to the case of sex-offender's modelling. At this point we are not committing to the equational approach. We might prefer to use the traditional Dung set theoretical fixed point approach, because the many lives although numerical, are natural numbers and solving equations can yield rational or real numbers. We shall address this in Section 8. See [10].

Let us now give a more specific comparison between our view of value based argumentation and the Bench-Capon view. Consider the network of Figure 6. We have arguments $\{x, y, z, u\}$ and value function V.

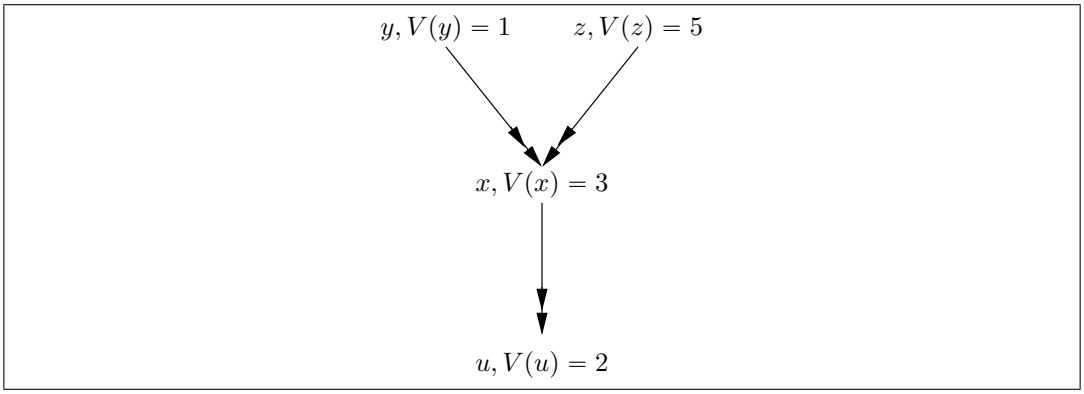


Figure 6

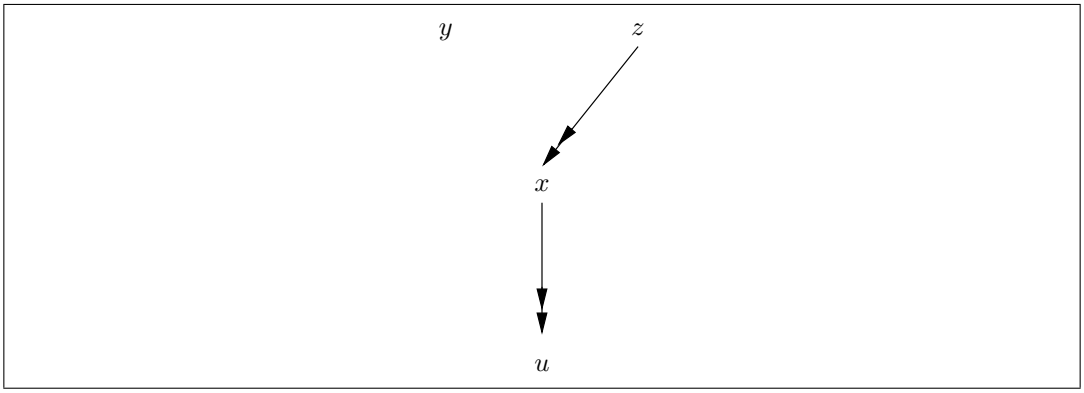


Figure 7

The values V are relative strength. It is a small generalisation over Bench-Capon (he would only write the order $V(y) < V(u) < V(x) < V(z)$) but we need to quantify V, in order to better represent our view. Bench-Capon (see Definition 2.7) will say y cannot attack x but z can. So according to him, Figure 6 is equivalent to Figure 7 (without values).

Our view is different. Let us call it the HML-view (How Many Lives-view). We know the saying that cats have nine lives, so to make sure a cat is dead, you have to kill it 9 times.

So we interpret $V(a)$ as saying how many lives a has. There are still several options for us in interpreting the number $V(a)$, and its relationship with the numbers V of the attackers of a.

Let us look at Figure 6 and see what are our options in reading it.

1. For any x, $V(x) = 0$ means x is out/dead and cannot attack.
2. $V(x) > 0$ means that x is alive/in and can attack. There is still the question of how does it attack? In what manner? The options for the manner of the attack are dealt in 3., 4. and 5. below.
3. We can understand the number $V(x)$ as indicating how many different in/live attackers are needed to have x = out/dead.

   This understanding requires that we count the number of y such that y attacks x and $V(y) > 0$. The attack of y on x is not influenced by the number $V(y)$. All we need is that $V(y) > 0$. So if for example $V(y) = 7$, y counts as attacking x only once.
4. Another option is to take into account the number $V(y)$ in the consideration of y attacking x. If we want to do that we need to give V a completely different interpretation. Think of $V(x)$ as saying how many missiles does x have to attack or protect itself. So in Figure 6, y has one missile, z has 5 missiles and since they have missiles to shoot, they are in. x has 3 missiles . So if y and z shoot their combined missiles at x, x can only counter with 3 missiles, so x will be dead/out.

   This is the cowardly approach, everyone shoots. We can adopt the brave approach, (5) below.
5. Only the attackers y with $V(y)$ greater or equal $V(x)$ can shoot/attack x.
6. We can use any other criterion to define which nodes y can attack x.

So Figure 6 becomes according to (4) above Figure 8

Perhaps a better way to think of the circles in Figure 8 as people with guns and the value V giving how many bullets they have. The people can be live/active/in or dead/not active/out or unknown/undecided.

We can follow for example a variation of (5) and require that from among the active people, we select one with maximal bullets and let him attack. So in Figure 8, it is the z which attacks the x. The result is that x is dead because z has more bullets than x has lives. If z were not alive, then the attacker chosen would have been y and y has only one bullet and so x would have survived with two lives left.

The reader should note that this simple idea of HML (How Many Lives) uses the traditional Dung point to point attack idea to define a new type of simultaneous attack on both the argument a and its value $V(a)$.

We need not work out the details in this Subsection, since we just want to explain the idea here.

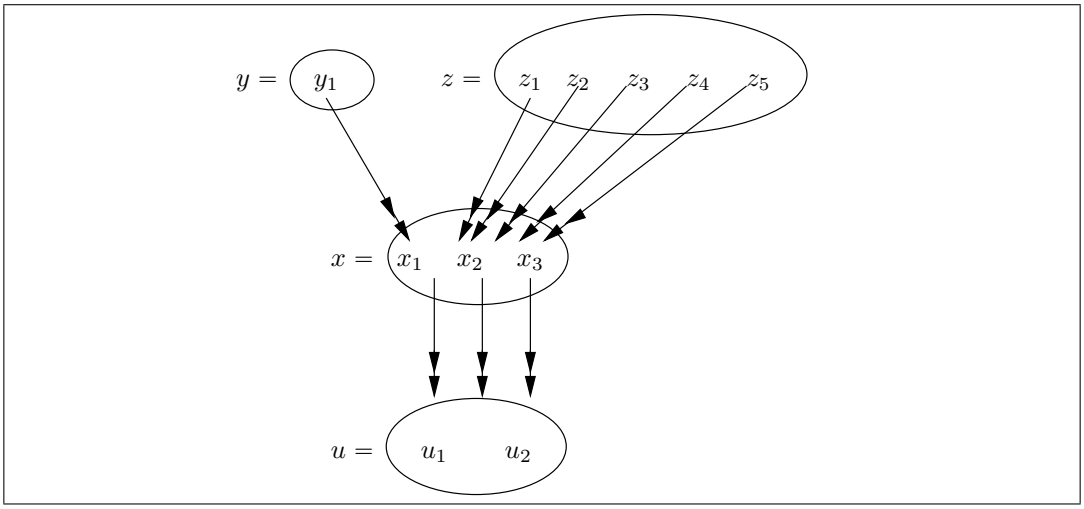


Figure 8

Let us further remark that in Figure 5, for the case of

$$V_1(x) < V_1(y) = V_1(z),$$

if we were to be more specific and have $V_1(x) = 1$ and $V_1(y) = V_1(z) = 2$, then according to our HML model the extension would have been $\{x =$ in, with $V(x) = 1, y =$ in with $V(y) = 1$ and $z =$ in with $V(z) = 1\}$.

7.3 Intermediate summary of options

We need to pause for a moment and summarise our options for the new concept of argumentation networks with values. We list points of difference with the Bench-Capon approach.

Option 1. Geometrical values. The Bench-Capon approach is essentially geometrical. Let (S, R) be an argumentation network. Bench-Capon essentially defines a function $\beta(x), x \in S$, telling us which points in S are not allowed to attack x. That is, $\beta(x) \subseteq S$. This is done externally at the meta-level. For example we can give colours to each node and list which colours are stronger than which colour and forbid a weaker colour from attacking a stronger colour. We call this approach geometrical because we can work with R_β instead of with R, where

$$xR_\beta y \text{ iff } (x \notin \beta(y)) \wedge xRy.$$

So for example Figure 6 describing (S, R) is transformed into Figure 7 describing (S, R_β), where $\beta(y) = \beta(z) = \beta(u) = \varnothing$ and $\beta(x) = \{y\}$.

Option 2. Geometrical partition values. The Bench-Capon approach essentially divides S for each $x \in S$ into two subsets, $\beta(x) =$ set of nodes which cannot attack x and $S - \beta(x) =$ the set of nodes which can attack x. The obvious way to generalise this partition is to look at several disjoint subsets of S, forming a partition of S,

$$S_1, S_2, \ldots, S_k, k \geqslant 1$$

and require that any attack on S to be represented by nodes from some combination of S_i. Thus for each $x, \beta(x) \subseteq \{1, \ldots, k\}$. We allow x to be attacked by $\{y|yRx\}$ only if for each $j \in \beta(x)$ we have

$$\{y|yRx\} \bigcap S_j \neq \varnothing.$$

A further generalisation is to say that $\beta(x)$ simply lists the subsets of S which can attack x. That is $\beta(x) \subseteq 2^S$, and we have that x can be attacked only if $\{y|yRx\} \in \beta(x)$.

The above generalisations are still geometrical. Their meaning is that we want attacks on x coming from different audiences and $\beta(x)$ gives the possible acceptable mixtures of audiences.

To connect with the numerical $V(x)$ discussed in Section 6.1, let for example $V(x) = 2$. We can take: $\beta(x) =$ all subsets of S containing at least two elements.

The above generalisation is still geometrical. We can still define

$$xR_\beta y = xRy \text{ and } \{z|zRy\} \in \beta(y).$$

Option 3. Non-geometrical partitions. Option 2 becomes non-geometrical when we connect the geometry with the notion of extension. In other words we require of any acceptable complete extension to satisfy the following:

- x is "out" iff $\{y|yRx$ and $y =$ "in"$\} \in \beta(x)$.

To see the difference, consider Figure 9

Assume that $\beta(z) = \{\{u\}\}$. We do not care about the other values of β. In the pure geometrical interpretation, (Option 2) since the attackers of z is the set $\{y, u\} \notin \beta(z)$, we delete the attacks $y \twoheadrightarrow z$ and $u \twoheadrightarrow z$ and end up with $R_\beta = \{x \twoheadrightarrow y\}$ and the only extension we get is $\{x, z, u\}$. However, if we use Option 3, since $x =$ in and $y =$ out, and $u =$ in, we have that the set of "in" attackers of z is $\{u\} \in \beta(z)$ and so the attack of u on z is accepted and the extension is $\{x, u\}$ only.

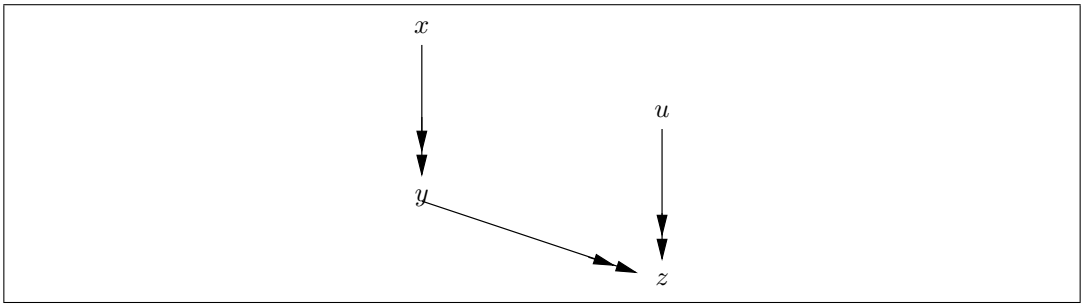


Figure 9

This can be expressed in Abstract Dialectical Framework (ADF) [27], see Subsection 2.2.[15] In this framework, a node x is "in" iff some Boolean formula B_x holds for $\{y|yRx\}$ under the truth values assignment to the ys generated by ($y =$ "in"). Consider for example Figure 9, in this figure z is attacked by y and u. We can consider the formula $B_z = (y \wedge \neg u) \vee (\neg y \wedge u)$. According to this formula, z is "in" if exactly one of its attackers is "in". Compare with Example 4 of Brewka and Woltran's paper [27]

Option 4. Dynamic non-geometrical. This option is where the function β of Option 3 changes dynamically with the construction of the extension. Such a possibility was hinted at in Section 6.1. We need the equational approach to implement it. We cannot say more in this summary Section.

7.4 The formal many lives valuation models

We now develop several formal models to reflect our discussion in the previous Subsection.

Our first model has the form (S, R, V) where S is the set of arguments, $R \subseteq S \times S$ is the attack relation and $V : S \mapsto \{0, 1, 2, \ldots\}$ gives for each argument $x \in S$ the value $V(x)$ in the set of natural numbers indicating how many 'lives' x has.

For example we have the idea that a cat has nine lives. So to get it 'dead' you need to 'kill' it nine times. In argumentation terms, for x to be 'out', it needs to be attacked by at least $V(x)$ number of attackers which are 'in'.

[15] ADF is a recent powerful framework which we considered modifying and using for our purposes. This option is still on the table. ADFs are defined for all of "Dung standard-semantics" as well as for some other semantics (like stage, semi-stable, ...). We shall propose in Section 8 our own Abstract Valuation Networks, AVFs, which we will discuss and compare with ADFs in the light of the complete semantics.

To give an example, suppose the wife is considering taking the family with the children to a three week holiday to India. The husband wants to argue against it. To really "kill" this option he needs several arguments

1. The holiday is too expensive, we cannot afford it
2. The 3 weeks package group holiday is too long, we will have to take the children out of school
3. India is not the best place to go, we will have to be careful what we eat and drink. Westerners are not immune to local infections.
4. The flight is too long, the younger children cannot take it.
5. The real reason might be that the husband simply does not like travelling but he cannot say this to his wife.

Note that each attacker y can kill only one life of the cat x. The attacker himself may have say $V(y) = 2$ lives, but for the purpose of attacking x it can take out only one life of x. If there are only $m < V(x)$ such attackers, we have two ways to view this:

1. The attack fails and the number $V(x)$ remains unchanged
2. The attack fails but the value for x is reduced to $V'(x) = V(x) - m$.

We are now ready with our formal description of the model.

For the purpose of exposition and clarity of conceptual progression, we start with networks (S, R), that are finite acyclic.

Definition 7.1. *A network (S, R), with S non-empty and R a binary relation on S is said to be acyclic if there does not exist a finite sequence of nodes of the form $(s_1, \ldots, s_n)$ such that $n > 0$, and $s_n R s_1$, and for each $0 < i < n$ we have $s_i R s_{i+1}$.*

The next Definition 7.2 is a technical definition needed for later proofs. It recursively defines the distance of a point from the top nodes of acyclic networks. For example in Figure 6, nodes y and z are of level 1, x is of level 2 and u is of level 3.

It is placed here in the paper but its use is later.

Definition 7.2. *Let (S, R) be a finite acyclic network. We define the notion of a node x in S is of level n, $n = 1, 2, 3, \ldots$ as follows.*

- *x is of level 1 if there is no y such that yRx.*

- *Assume a subset S_n has been defined of nodes of level less than $n+1$. Assume each point of S_n has a unique level $k < n+1$ and that if any such point y is of level $k > 1$, then for some point x in S_n of level $k-1$ we have xRy.*

Let z be any point of level n and assume u is a point such that zRu holds. We must have that u is different from x. If u is not in S_n declare u as a point of level $n+1$.

Let S_{n+1} be $S_n \cup \{u : u$ is declared of level $n+1\}$.

Since S is finite the process will terminate.

Proposition 7.3. *Let (S, R) be a finite acyclic network, then it has at least one point x such that there is no y such that yRx holds. In terms of Definition 7.2, the node x is of level 1.*

Proof. Assume otherwise, then for each x there is a y such that yRx. Choose any point x_0 in S. Then there is an x_1 such that x_1Rx_0. Continue and find x_2 such that x_2Rx_1. Continue by induction and get an infinite sequence $x_0, x_1, ...$ All points in the sequence must be different because we have no cycles.This contradicts the assumption that S is finite. □

Definition 7.4 (V-network)**.**

1. *A finite acyclic argumentation network has the form (S, R), where S is a finite non-empty set of arguments and $R \subseteq S \times S$ is the acyclic (see Definition 7.1) attack relation.*

2. *A function V from S into the set of natural numbers $\{0, 1, 2, \ldots\}$ is called a many-lives (ML) valuation on S.*

   We require that if x is not R attacked $((\neg\exists y)(yRx))$, then $V(x) > 0$.

Remark 7.5. *This remark motivates Definition 7.6 of the notion of V-semantics.*

Our starting point is a network $(S, R), S \neq \varnothing, R \subseteq S \times S$. Let us choose $x \in S$. An attacker of x is any y such that yRx. This attacker y can "kill" x if y is "alive" (i.e., y is in) in which case we must have that x is out. To defend x against y we need an element d such that dRy.

This is the traditional semantics, where each element $z \in S$ has one life ($V(z) = 1$).

When x has more than one life, say $V(x) = 2$, any geometrical attacker y on its own is not endangering x to be "dead", even if y is alive. We need two such live attackers at least. Therefore we have to think in terms of sets $Y \subseteq S$ of attackers of any node x. If the number of elements of Y is at least $V(x)$ and for all $y \in Y$ we

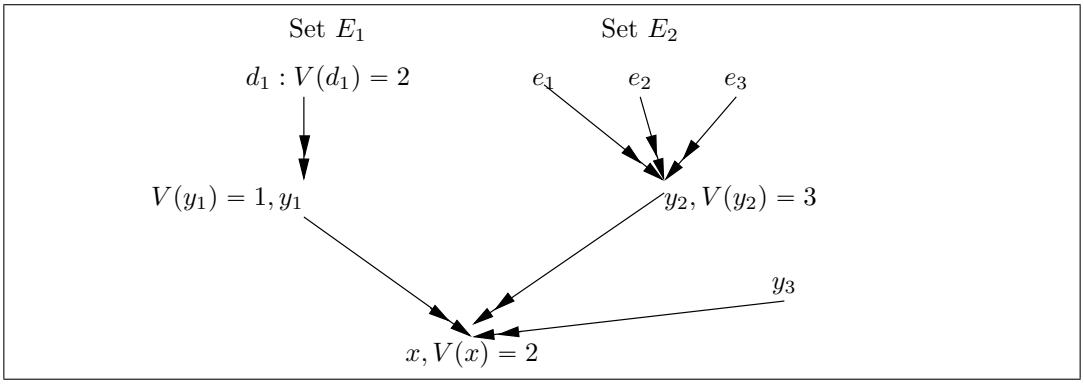


Figure 10

have yRx, then Y is a potential threat to x. If all its elements are alive then Y can kill x.

Now let us look at defence. How can x be defended against Y? We simply need to reduce the number of live members of Y to be less than $V(x)$. So (consider Figure 10 and) assume for example that $Y = \{y_1, y_2, y_3\}$ and $V(x) = 2$ and that y_1Rx, y_2Rx and y_3Rx.

So to defend x against Y we need to be a threat to at least two of the elements of Y. Say we have attackers of y_1 and y_2. We already agreed that such attackers must be subsets of S, E_1, E_2 with enough elements in them to be more than $V(y_1)$ and $V(y_2)$ respectively. Say if for example $V(y_1) = 1$ and $V(y_2) = 3$, then E_1 must contain at least one element d_1 and E_2 must contain at least 3 elements e_1, e_2, e_3 such that d_1Ry_1 and e_1Ry_2, e_2Ry_2 and e_3Ry_2 all hold.

Figure 10 describes this situation geometrically (i.e., in terms of R).

Let us state this formally. Let E be a set containing $E_1 \cup E_2$. We can say that E defends the node x against the attack of Y on x because there exist $E_1 \subseteq E$ and $E_2 \subseteq E$ such that the situation of Figure 10 holds.

Namely E_i attacks with sufficient force (i.e., number of nodes z in E_i is at least $V(y_i)$ respectively) to reduce the number of unattacked nodes of Y to be less than $V(x)$.

Let us now consider the set $E' = E_1 \cup E_2 \cup \{x\}$. Is this set conflict free? The answer is yes. Although x attacks d_1, we have $V(d_1) = 2$ and so x cannot kill d_1 even if x were alive.

Does this set E' protect its members? The answer is yes. The potential attackers of x are the sets $\{y_1, y_2\}, \{y_1, y_3\}, \{y_2, y_3\}$ and $\{y_1, y_2, y_3\}$. The set E' has subsets E_1 attacking y_1 and E_2 attacking y_2 so that all attack sets are left with not enough attackers on x.

So E' is a complete extension in this Figure 10. It is conflict free, it protects its members and it contains all those it protects.

Definition 7.6 (V-semantics)**.** *Let (S, R) be given and let V be an ML valuation on S. We define the V-semantics for (S, R).*

1. *A set $E \subseteq S$ is said to successfully V-attack another node $x \in S$, iff the following holds:*
   (a) *For all $y \in E, yRx$*
   (b) *$V(y) > 0$ for all $y \in E$*
   (c) *The number of elements of E is greater or equal than $V(x)$.*[16]

   Let $E \subseteq S$, we say that E is V-conflict free iff the following holds and such that $V(y_i) > 0$.
   (a) *For no $x \in E$ and $E' \subseteq E$ do we have that E' successfully V-attacks x*
   (b) *For all $e \in E, V(e) > 0$.*
2. *Let $E \subseteq S$ be a set of arguments and $x \in S$. We say that E V-protects x iff the following holds.*
   (a) *For no subset E' of E do we have that E' successfully V-attack x*

[16] To explain condition (c) assume for example that $\{y, z\}$ attack x (i.e. yRx and zRx holds) and that they are the only attackers of x. Assume further that $V(y) = 2, V(z) = 1$ and $V(x) = 3$. Condition (c) reflects the understanding that $V(y) = 2 > 0$ means that y is alive and can generate only a single attack on x. Since x has three lives and only two attackers it is not going to die and as a result of the attack will have only one life left.

We can change our assumptions and allow y to have two attacks on x, one attack for each of its lives. In this case x will die as it is attacked 3 times, twice by y and once by z. We can bring the difference mathematically and uniformly as follows:

Let us define functions $\delta_i(x)$ for $\in S$, as follows:

- $\delta_1(x) = 1$, if $V(x) > 0$ and $\delta_1(x) = 0$, if $V(x) = 0$.
- $\delta_2(x) = V(x)$.

Then condition c can be written as

$$\sum_{y \in E} \delta_1(y) \geqslant V(x).$$

If we use δ_2 in the above equation we get the alternative approach, as described above. There are other possibilities for the use of δ_1, for example we can sum only on y in E for which $V(y) > 1$ (instead of $V(y) > 0$). This means that we allow elements to attack only if they have at least 2 lives.

(b) *Let* $E' = \{y_1, \ldots, y_k\}$ *be all elements of* S *such that* $y_i Rx$ *holds and such that* $V(y_i) > 0$ *and* y_i *is* not *successfully* V*-attacked by any subset* E' *of* E*. Then* $k < V(x)$.[17]

We say E *is a* V*-admissible if* E *is* V*-conflict free and* V*-protects its elements.*

3. *We say that* E *is a* V*-complete extension if it is admissible and contains all the elements* x *such that* $V(x) > 0$ *and it* V*-protects* x*.*

4. *Let* E *be a* V*-complete extension. Define for each* x *in* E *the value* $V_E(x)$ *to be* $V(x)$ *— [the number of elements* y *in* E *such that* yRx *holds]. Then* $V_E(x) > 0$*, since* E *is conflict free*

Lemma 7.7. *Let* E *be* V*-admissible set an let* x *be an element which is* V*-protected by* E *and such that* $V(x) > 0$.

Then $E \cup \{x\}$ *is* V*-admissible.*

Proof. First note that $E \cup \{x\}$ certainly V-protects its elements. The question is whether it is conflict free. Let $E' \subseteq E \cup \{x\}$ and $z \in E \cup \{x\}$ be such that E' successfully V-attacks z.

We show that this is impossible.

Case 1. x does not appear in E' and z is not equal to x. Then this is impossible because E is V-conflict free.

Case 2. $z = x, x \notin E'$. Let $\{y_1, \ldots, y_k\} = E'$. So on the one hand we have the $y_i Rx, i = 1, \ldots, k$ and $k \geqslant V(x)$ and on the other hand E V-protects x so for some y_i we must have that E successfully V-attacks y_i. The two options are impossible together since E is V-admissible.

Case 3. $x \in E'$ *and* $z = x$. In this case we have on the one hand that $\{y_1, \ldots, y_{k-1}, y_k = x\}$ successfully V-attacks x and so again $k \geqslant V(x)$ but also we must have that E must successfully V-attack some y_i. Again this is not possible because E cannot successfully V-attack any y_i nor x.

[17] Using the δ function, we write

$$\sum_{y \in E'} \delta_1(y) < V(x).$$

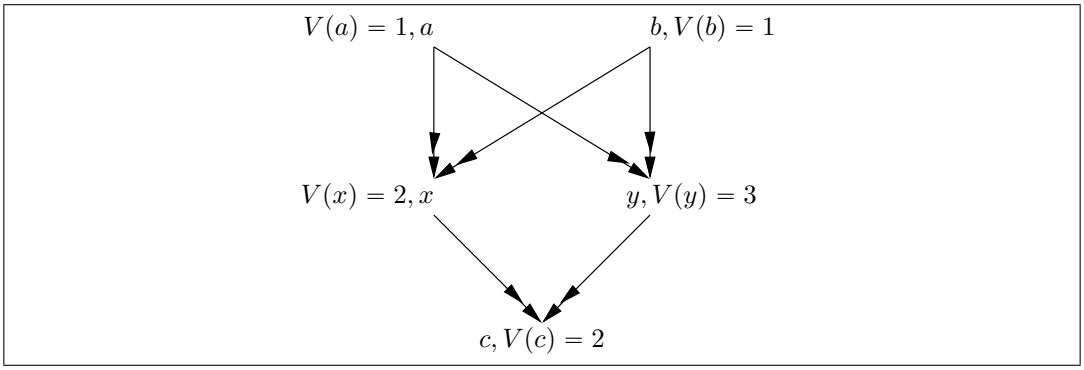


Figure 11

Case 4. $x \in E'$ *and* $z \neq x$. Similar to Case 3, since E V-protects z. □

Lemma 7.8. *Let (S, R, V) be given. Then there exists the smallest V-complete extension.*

Proof. Start with $\varnothing$. This is a V-admissible set. If there are *no* points $x \in S$ such that $V(x) > 0$ and there are no attackers yRx with $V(y) > 0$, then $\varnothing$ is a complete V-extension since it obtains all the elements it V-protects.

If there are $x \in S$ such that $V(x) > 0$ and for all y, yRx implies $V(y) = 0$, then $\varnothing$ V-protects such x and so these xs can be added to $\varnothing$. Continue this process and get a V-complete extension. □

Example 7.9. *We now illustrate the concepts of V-attack and V-admissibility in an example.*[18] *Consider Figure 11.*

Let us compute the complete extensions E in two ways:

1. *Propagation along the tree:*

   (a) *a, b are alive, since they are not attacked $V(a) = 1 = V(b)$.*

   (b) *x is dead, being attacked by $\{a, b\}$. So $V_E(x)$ becomes 0. y is alive but with reduced $V_E(y) = 1$.*

   (c) *Since now x is dead and $V(c) = 2$, c remains alive with reduced $V_E(c) = 1$.*

   Therefore the complete extension when computed in this way is $\{a, b, c, y\}$ with $V_E(a) = V_E(b) = V_E(c) = V_E(y) = 1$.

[18] I thank one of the referees for giving this example to show that the original definition of V-attack needed to be corrected.

2. *Let us look at the set* $E = \{a, b, c, y\}$ *and check whether it is conflict free, protects itself and contains all elements it protects, as defined in Definition 7.6. Clearly the attacks of* $\{a, b\}$ *on* y *fails because* $V(y) = 3$ *and* $|\{a, b\}| = 2$.

   Similarly the attack of $\{y\}$ *on* c *fails. So* E *is conflict free. Can* E *protect itself? the set* $\{x, y\}$ *attacks* c. *But a subset* $\{a, b\} \subseteq E$ *attacks* x *and kills it and* $\{y\}$ *on its own does not kill* c. *So* c *is protected. What would* V_E *be for the elements of* E? *According to item 4 of Definition 7.6, we get* $V_E(a) = V_e(b) = 1$, $V_E(y) = 1$ *and* $V_E(c) = 1$. *This is the same as calculated in (1) above.*

Theorem 7.10. *Let* (S, R, V) *be a finite acyclic network. Then there exists a unique* V*-complete extension* E *such that*

$$S = E \cup \{y | E \text{ successfully } V\text{-attacks } y\}.$$

Proof. We define the sets E_n^+, E_n^- by induction on $n = 1, 2, \ldots$. E_n^+ is the set of elements that are certain to be "in" at step n and E_n^- are the elements that are certain to be "out" at step n.

Step 1. We know by Proposition 7.3 that S has at least one point of level 1, i.e. a point x such that $\neg\exists y(yRx)$. Let E_1^+ = the set of all point in S of level 1. Let $E_1^- = \varnothing$.

Step 2. Let E_2^- be the set of all points y such that E_1^+ successfully V-attacks y Let $E_2^+ = E_1^+$.

Step 3. Let y be any new point not in $E_2^+ \cup E_2^-$. Let $\text{Att}(y) = \{z | zRy\}$. Consider the set $A(y) = \text{Att}(y) - E_2^-$. Let $E_3^+ = E_2^+ \cup \{y | \text{number of elements of } A(y) < V(y)\}$. (This means that there are not enough attackers or potential attackers to "kill" y. So y is for sure "in".)

Let $E_3^- = E_2^-$.

Step 4. Let E_4^- be the set $E_4^- = E_3^- \cup \{y | y \text{ is successfully } V\text{-attacked by } E_3^+\}$.

Let $E_4^+ = E_3^+$.

Steps $2k + 1, 2k + 2$**.** Continue by induction as done in steps 3 and 4 in terms of steps $2k - 1, 2k$.

Since the sets E_n^+, E_n^- can only increase and S is finite the process will become stable say at E_m^+, E_m^-.

We now show that

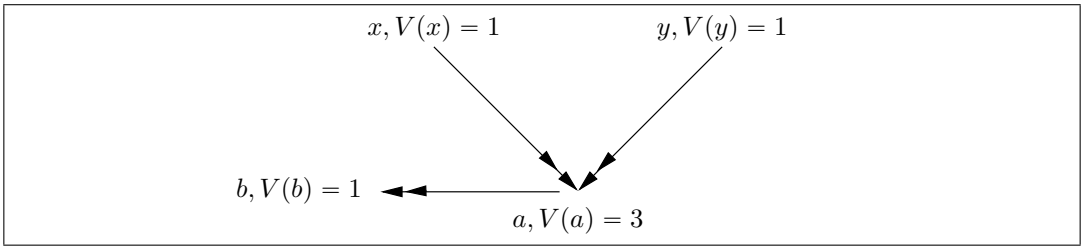


Figure 12

(*) $S = E_m^+ \cup E_m^-$.

Assume in order to reach a contradiction that there exists a z_0 such that z_0 is not in E_m^+, nor in E_m^-. z_0 must have some attackers z (i.e. zRz_0) for otherwise $z_0 \in E_1^+$.

Let $y_1, \ldots, y_k, u_1, \ldots, u_e, y'_1, \ldots, y'_r$ be all R attackers of z_0. Assume $y_1, \ldots, y_k \in E_m^+$, $y'_1, \ldots, y'_r \in E_m^-$ and that $u_1, \ldots, u_e$ are all the rest of the points which are neither in E_m^+ nor in E_m^-.

We bear in mind that there may not be any points y or u or y', in which case we write $k = 0, e = 0, r = 0$ respectively.

Since E_m^+ is not successful in V-attacking z_0, we have that $k < V(z_0)$. Since z_0 is not a member of E_m^-, we have that $k + e \geqslant V(z_0)$. This means that there exists at least one point z_1 (say $z_1 = u_1$) such that $z_1 R z_0$ and $z_1 \notin E_m^+ \cup E_m^-$.

We repeat the process for z_1 and get $z_2, z_3, \ldots$, an infinite sequence of pairwise different points (otherwise we get a cycle). This contradicts the finiteness of S and therefore (*) is proved.

Note that we get a unique "stable" extension.

□

Lemma 7.11. *Let (S, R, V) be any network, with or without cycles, such that $V(x) = 1$ for all $x \in S$. Then the V-semantic notions coincide with the Dung traditional ones.*

Proof. Note that since $V(x) = 1$ for all $x \in S$, we have that:

$$x \text{ is } V\text{-attacked by } \{y\} \text{ iff } yRx.$$

□

Example 7.12. *Consider Figure 12.*

This figure represents a network $M = (S, R, V)$, with $S = \{x, y, a, b\}$ and with $R = \{(x, a), (y, a), (a, b)\}$ and with $V(x) = V(y) = 1$ and $V(a) = 3$ and $V(b) = 1$.

According to our definition, the set $E = \{x, y, a\}$ is a V-complete extension, because x and y are in since they are not attacked and a is in because to be out we need 3 attackers which are in and we have only 2. So the set E is V-conflict free which V-protects its elements, (its elements are not V-attacked). We cannot add to E the element b since it is attacked by a. The set $E1 = \{x, y, b\}$ although V-conflict free, does not V-protect it elements. $E1$ cannot V-protect b against a since it cannot V-attack a. What is missing from our theoretical considerations is the option to define a new function indicating how many lives we have for each of the elements of this V-extension. We mentioned in the beginning of this Subsection that we have two options. Option 1 is that the number $V(x)$ remains unchanged. If we adopt this option then we have no problems. Option 2 was to reduce the $V(x)$ number in view of the attacks on x. There may not be enough attacks to take x out but in this option the number of lives of x $(V(x))$ is reduced. This option is problematic as we shall now see.

We now need to be careful with our notation for otherwise we get confused. The V-extension is $E = \{x, y, a\}$. It is a set of nodes. We can ask how many lives do the elements of this set have according to Option 2? We know the answer that each of these elements have now one life. Let us write the function V_E to indicate how many lives each element of the extension has. So we have in this case

$$V_E(x) = V_E(y) = V_E(a) = 1.$$

So the notion of V-extension E must also include a function V_E for the V-extension E. So the set theoretic approach models the view that $V(x)$ simply says how many "in" attackers are required to force x to be "out", but if there are not enough such attackers, then x remains "in".

However, the number of lives of x is reduced. This presents us with a problem:

Consider the same network with the new V_E, namely the network $M' = (S, R, V_E)$. This network has values all 1 for $\{x, y, a\}$ and 0 for b (which therefore can be ignored) and therefore the complete extension for it is, say, E' with $x = y =$ "in" and $a =$ "out" (and b is already "out" and is ignored, so we are really looking at the network without b).

Let us look at what is happening here in the following way. We apply our V semantics (Option 2) to M and get M'. If we apply our V-semantics (Option 2) again to M' we get M'' with E'. On the other hand if we use Option 1, and apply the V semantics (Option 1) to M we get M and apply again we still get M. So for Option 1 the process stabilises after one application but in Option 2 it does not.

What happens in traditional Dung semantics (see Subsection 2.1)? After one application we get an extension which is a set of conflict free elements. If we regard

this set as a network with no attack relation and apply the semantics again we get the same set again.

So we ask should we look at any semantics, traditional or new, as an algorithm for generating a sequence of networks which can go on until it stabilises?

Put differently, we ask: do we make a connection between E and E' and say that E' is a second level extension for M?

This makes the semantics concept like proof theory; we keep proving from the data until we stabilise and can prove nothing new any more. This is what we do in Semantic Tableaux.[19]

This process is especially interesting in the case of finite acyclic networks $M = (S, R, V)$. By Theorem 7.10, the network M' is unique, so we ask, if we continue the process and generate $M'', M''', ...$ what do we get at the end? Do we get the traditional Dung ground extension of (S, R)? The answer is no. Consider the network $N = (S, R)$ of Figure 5. In this network $S = \{x, y, z\}$ and $R = \{(x, y), (y, z)\}$. Let V be the valuation with $V(x) = 3, V(y) = 2$ and $V(z) = 1$. Then in N', z is out and x and y are in and in N'', y is also out. Neither case equals the Dung extension for (S, R).

Actually this example of the network $N = (S, R, V)$ above also shows that there is no way that N could be translated into a traditional Dung network (S_N, R_N) with possibly additional points (i.e. with $S \subset S_N$), because any traditional extension of any network is stable after the first step. We can never get a sequence like N, N', N''.

[19]The meaning in practice of the function V_E can be illustrated from Talmudic and Islamic law. The Talmudic legal system may require two independent witnesses to refute a claim. If I claim that I was standing on the sidewalk when the car hit me, then two independent witnesses are required to say that I was standing on the road. If I bring only one witness, the function V_E says we need to wait for one more.

In Islamic law we have the following example, and we quote from `http://www.islamhelpline.net/node/905` (visited on September 25, 2016):

> If the woman who is raped accuses that so and so specific person or people raped her, then there are only two ways an Islamic Court can convict the accused rapist/s: The accused rapist confesses to his heinous crime; or she produces four witnesses to justify her claim that so and so person raped her. If the accused rapist does not confess, and the woman is unable to produce the four witnesses; then the Court can levy upon her the case of kazaf or falsely accusing somebody. Under no circumstances can a woman who claims she was raped be charged, accused, convicted, or punished for zina (fornication or adultery) in an Islamic Court of Law. All she has to do is say that she was raped, and her word will be taken as the truth.

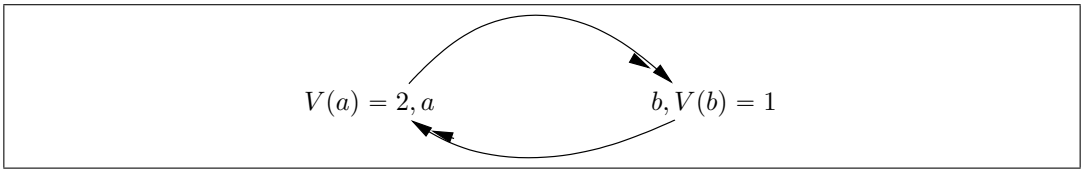


Figure 13

7.5 Algorithmic semantics for Abstract Valuation Frameworks with Multiple Lives Valuations

Theorem 7.10 above in the previous Section, showed that for the case of acyclic networks, there is an algorithmic way of obtaining the grounded V-extension, which coincides with the V-extension as defined set theoretically in Lemma 7.8. The correspondence is problematic in the case of networks with loops, and needs to be investigated. This is the task of this Section. The algorithmic semantics we will define we shall call VW-semantics, and VW-extensions. The formal machinery will come later in the Subsections.

To proceed in this direction, we need to look at more revealing examples with loops. It is good to look at loop examples before we decide how to handle loops.

Example 7.13. *Note that the propagation computation does not give the same results as the set-theoretic definition of Definition 7.6 and item 4 of this definition. This is because of the cyclicity of the network. We need the algorithmic VW-semantics*

Consider Figure 13

1. *If we propagate, we need starting points*
   (a) *Start with a. a kills b and we emerge with* $E = \{a\}$ *and* $V(a) = 2$.
   (b) *Start with b. b attacks a and reduces its life to* $V_E(a) = 1$ *and now a kills b. We emerge with* $E = \{a\}$ *and* $V_E(a) = 1$.
   (c) *Both a and b attack simultaneously. We emerge with* $E = \{a\}$ *and* $V_E(a) = 1$.
2. *If we calculate extensions set theoretically following Lemma 7.8, the only complete extension is* $E = \{a\}$ *with* $V_E(a) = 2$.

Example 7.14.

1. *Consider the loop in Figure 14*

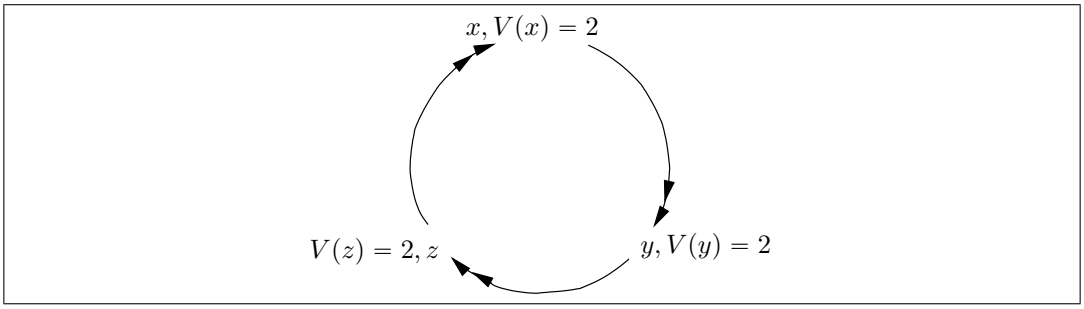


Figure 14

The network is $M = (S, R, V)$*, where* $S = \{x, y, z\}$*,* $R = \{(x, y), (y, z), (z, x)\}$ *and* $V(x) = V(y) = V(z) = 2$*. There is only one* V*-extension, (according to Definition 7.6) it being* $E = \{x, y, z\}$ *and we have* $V_E(x) = V_E(y) = V_E(z) = 1$*.*

Consider now $M_E = (S, R, V_E)$*. This has only one* V*-extension, it being* $\varnothing$*.*

2. *Let us now approach the extensions of Figure 14 differently, using the fact that* (S, R) *is a cycle. We go in steps:*

Step 1. *Choose an element in* S *and let it attack. Say we choose* $(x, V(x) = 2)$*. Since we are cycling and attacking, the* V *will change. So we subscript the* V *by an increasing index. Let* $V(x)$ *be* $V_1(x)$*. We keep the index "1" until we go a full cycle and cycle back to* x*, in which case we increase the index to 2.* x *attacks* y *and so we get* $(y, V_1(y) = 2 - 1 = 1)$*.*

Step 2. y *can still attack. It has* $V_1(y) = 1 > 0$*. It attacks* z *and we get* $V_1(z) = 1$*.*

Step 3. z *can attack* x *and we get* $V_2(x) = 1$*. We have returned to* x *and thus got* $V_2(x)$*.*

Step 4. x *attacks* y *and we get* $V_2(y) = 0$*. We use the notation* V_2 *because it is the next loop.*

Now we have several ways of continuing:

($W1$**):** *Stop.* y *cannot attack, we have* $V_2(y) = 0$*.*

The extension is: $V_{w1}(x) = V_{w1}(z) = 1. V_{w1}(y) = 0$*.*

($W2$): *Skip y and look at z, z has $V_1(z) = 1$. Strictly speaking, since we are now in the second cycle we should rename the V as $V_2(z) = V_1(z) = 1$. Anyway, z has 1 life so it can attack. So we let it attack and get $V_3(x) = 0$. It is $V_3(x)$ because we returned to x.*

The extension is $V_{w2}(x) = V_{w2}(y) = 0, V_{w2}(z) = 1$.

You see that the extension depends on where we start.

Let us call these VW-extensions. A formal definition will be given later in this Subsection. In the meantime, let us proceed with only an intuitive grasp of this concept, to be refined by looking at more examples, leading to the sequence of definitions beginning with Definition 7.16 below. So at the moment we know that the algorithmically (to be defined) VW-extensions depend on where we start. If we start with x, we get the extensions

$$V^x_{w1}(x) = V^x_{w1}(z) = 1, V^x_{w1}(y) = 0$$
$$V^x_{w2}(x) = V^x_{w2}(y) = 0, V^x_{w2}(z) = 1.$$

the other possible VW-extensions are obtained by symmetrical permutations. It is better to adopt the $W2$ computation option for the VW-semantics approach because mathematically we keep on going until nothing changes.

Example 7.15. *Let us check what VW-extensions look like for Figure 12.*

We have in mind the conjecture that for finite acyclic (S, R) the V-semantics option 2 and the VW-semantics are the same, if we start from all unattacked nodes in the graph, i.e. $\{x|\neg\exists y(yRx)\}$.

Figure 12 is acyclic. So let us check. We start the sequence of steps and define V_1.

Step 1. $V_1(x) = 1, V_1(y) = 1$.

Step 2. *x, y attack a so* $V_1(a) = 1$.

Step 3. *a attacks b so* $V_1(b) = 0$.
Stop.

What we get is the same as the level 2 extension E' of Example 7.12. See the proof of Theorem 7.10. This proof confirms that the conjecture is true.

We are now ready to define the VW-extensions for an arbitrary argumentation network (S, R, V), where we allow for loops.

The following sequence of definitions develops the semantics for general Abstract Valuation frameworks (AVF) for the case where the valuations are many lives (x is "out" if at least $V(x)$ attackers are "in"). For a further in depth analysis of the many lives option, see our new paper [44]. We are giving formal definitions to what we did in Examples 7.12, 7.15 and 7.25.

The level of writing is aimed at members of the COMMA (Conference on Computational Models of Argument) community

Given an AVF network (S, R, V), the semantics relies on resolving loop cycles in S through the use of step by step algorithm and then using the SCC ordering of the loop cycles. Thus every extension is stable (no undecided). This is reminiscent of the CF2 semantics (of [40]), and indeed we shall offer a comparison.

To start we the notion of an SCC, taken from [40].

Definition 7.16. *Let (S, R) be an argumentation network with $S \neq \varnothing$ and $R \subseteq S \times S$.*

1. *We say that a sequence $(x_1, \ldots, x_n)$ of elements of S is a cycle of length n if we have*
$$x_1 R x_2, x_2 R x_3, \ldots, x_{n-1} R x_n, x_n R x_1.$$
2. *Define a relation $x \approx y$ on S by setting $x \approx y$ iff $x = y$ or x and y share a cycle. That is, $x \approx y$ iff there is a cycle $(z_1, \ldots, z_n)$ of length n such that $x = z_j$ and $y = z_i$ for some $1 \leqslant i, j \leqslant n$.*
3. *Since $\approx$ is an equivalence relation on S (see [40]), let*
   - *$x^{\approx} = \{y | x \approx y\}$, for any $x \in S$.*
   - *$S \approx = \{x^{\approx} | s \in S\}$.*
   - *$R^{\approx} = \{(x^{\approx}, y^{\approx}) | aRb$ for some $a' in x^{\approx}, b \in y^{\approx}\}$.*

   $R^{\approx}$ is well defined and is an antisymmetric relation (see [40]).
4. *Let $\prec$ be the transitive-reflexive closure of $R^{\approx}$. That is, $x^{\approx} \prec y^{\approx}$ iff either $x^{\approx} = y^{\approx}$ or for some $z_1^{\approx}, \ldots, z_k^{\approx}, k \geqslant 1$ we have $x^{\approx} R^{\approx}, z_1^{\approx}, z_1^{\approx} R^{\approx} z_1^{\approx}, \ldots, z_{k-1}^{\approx} R^{\approx} z_k^{\approx}$ and $z_k^{\approx} = y^{\approx}$.*

Then $\prec$ is a partial acyclic ordering on $S^{\approx}$.

Our purpose is to define the VW-semantics for AVF of the form $(S, R, <, V)$ where $S \neq \varnothing$, S finite, $R \subseteq S \times S$ and V is a function on S giving natural numbers values in $\{0, 1, 2, 3, \ldots\}$ to elements of S. We added the value 0 for technical

convenience. $V(x) = m$ means that x has $m \geqslant 0$ lives. To be "out", it needs to be attacked by at least $m \geqslant 0$ attackers y such that $V(y) > 0$. Of course if $V(x) = 0$, then x is already out.

We need to use the truncated subtraction symbol defined below:

$$x \dot{-} y = \text{ def. } \begin{cases} x - y, \text{ if } x \geqslant y \\ 0 \text{ if } x < y. \end{cases}$$

Definition 7.17 (VW semantics for a complete cycle with a front F)**.**

1. *Let $M = (S, R, V)$ be an AVF network which is a complete cycle. This means that for any $x, y \in S$, there exists a sequence $t_1, \ldots, t_k$ in S such that*

$$xRt_1 \wedge t_1Rt_2 \wedge \ldots \wedge t_kRy.$$

   We allow $k = 0$, in which case the condition is xRy. We allow $x = y$ in which case the condition is xRx.

2. *A set $F \subseteq S, F \neq \varnothing$ is called a* Front*. Let us choose such an F. This choice determines what we are going to get in the next item 3.*

3. *We define a sequence of networks $M_i = (S, R, V_i, F_i), i = 0, 1, 2, \ldots$ by steps as follows:*

   (a) *Let $V_0 = V, F_0 = F$.*

   (b) *Assume that V_i, F_i have been defined and that $F_i \neq \varnothing$.*
   We define V_{i+1}, F_{i+1}.

      i. *Let F_{i+1} be the set of all y such that for some x in F_i we have xRy. This set is non-empty because (S, R) is a cycle.*

      ii. *Let $V_{i+1}(z) = V_i(z)$ if $z \notin F_{i+1}$.*

      iii. *Let $V_{i+1}(z) = V_i(z) \dot{-} \{$the number of $y \in F_i$ s.t. $V_i(y) > 0$ and $yRz\}$.*

   We stop the process when $V_{n+1} = V_n$. The process stops since at each step m some $V_m(z)$ is reduced.

4. *When we stop at step n, we say that the Front F* resolved *(S, R, V, F)* into *(S, R, V_n, F_n).*

5. *We say that $M = (S, R, VF)$ was resolved into $M = (S', R', V', F') = (S, R, V_n, F_n)$.*

Definition 7.18 (Front obtained externally)**.**

1. *Let (S_0, R_0, V_0) be a complete cycle and let S_1 be a set of nodes with $S_1 \cap S_0 = \varnothing$. Let $R_1 \subseteq S_1 \times S_0$. Thus the S_1 nodes attack nodes in S. Let V_1 be a valuation on S_1.*

2. *Define a cycle network $M = (S, R, V, F)$ as follows.*

   (a) $S = S_0$

   (b) $R = R_0$

   (c) $F = \{x \in S_0 | (\exists y \in S_1)(yR_1x)\}$

   (d) *V is defined by*

$$V(z) = \begin{cases} V_0(z), \text{ if } z \notin F \\ V_0(z) \dot{-} \{\text{number of } y \in S_1 \text{ such that } yR_1z \text{ and} \\ V_1(y) > 0\}, \text{ if } z \in F \end{cases}$$

3. *We say that (V, F) was induced on (S_0, R_0) by the external attackers system (S_1, R_1, V_1).*

4. *We say that the network (S_0, R_0, V_0) with the external attackers (S_1, R_1, V_1) is resolved into $M' = (S', R', V', F')$ when this AVF (namely M') is what resolves M (of item 2 above) according to Definition 7.17.*

Definition 7.19 (VW-semantics for general AVF, (S, R, V))**.** *Let (S, R, V) be given. We look at the acyclic network of SCC's for (S, R) as defined in Definition 7.16.*

1. *Let X_i be the top nodes SCCs in the ordering of Definition 7.16. These X_i are actually sets S_i being equivalence classes of elements of S, according to the equivalence relation of Definition 7.16. Let $M_i = (S_i, R_i, V_i)$ be the cycles defined using these top SCC equivalence classes, with $S_i \subseteq S$ is the set of elements of the cycle and with*

$$R_i = R \upharpoonright S_i$$
$$V_i = V \upharpoonright S_i$$

   There are several possibilities for M_i because of Definition 7.16

   (a) *$S_i = \{x_i\}$, one node with $\neg(x_iR_ix_i)$.*

   (b) *S_i is a proper cycle as defined in item 1 in Definition 7.17.*

2. *We arbitrarily choose a subset $F_i \neq \varnothing, F_i \subseteq S_i$. This choice determines the VW-complete extension of the VW-semantics (for our (S, R, V)) which we are defining. Different choices of F_i will give us different extensions.*

3. *We now have systems $M_i = (S_i, R_i, V_i, F_i)$. We are going to resolve cycles according to Definitions 7.17 and 7.18 by going down the acyclic ordering $<$ of Definition 7.16 as applied to our initial (S, R, V). Note that we use an inductive step by step definition. It is important to note that even if a cycle attacks another cycle, we resolve completely the top cycle first and only afterwards propagate the values as external attackers (as in Definition 7.18, item 4) to the next lower cycles. (Example 7.20 below illustrates this point.)*

   Step 1. *We are ready to resolve each M_i into $M_i' = (S_i, R_i, V_i', F_i')$ following Definition 7.17. We distinguish two cases as in (1) above.*

   (a) *$S_i = \{x_i\}$ with $\neg(x_i R x_i)$, let $M' = \{S_i, R_i, V_i, \{x_i\}\}$.*

   (b) *Otherwise for this case (b) let M' be as resolved as we do in item 6 of Definition 7.17.*

4. Inductive Step $k + 1$.
   Let us assume that we have already resolved cycles

$$M_i' = (S_i', R_i', V_i', F_i')$$

   at step k. We now resolve more cycles at step $k + 1$.

   Let $M_j^* = (S_j^*, R_j^*, V_j^*)$ be cycles in the ordering of the SCC's (according to Definition 7.16) that come immediately below at least one of the M_i' cycles. Actually we have that R_i' is R restricted to S_i' and $R_j^* = R \restriction S_j^*$ and $V_j^* = V \restriction S_j^*$. We use notation with $*$ to differentiate between higher cycles (in the ordering) and lower cycles so that we will not be confused between cycles.

   This means that for each S_j^* there exists at least one S_i' and $x \in S_i'$ and $y \in S_j^*$ such that xRy. (These xs are the external attackers (in the sense of item 4 of Definition 7.18). Also recall that our starting point was one big (S, R, V), which was divided into SCC cycles as in Definition 7.16.

   Let F_j^* be the set of all $y \in S_j^*$ such that for some S_j' and some $x \in S_j'$ we have xRy. Define $V_j^{**}(y)$ to be $V_j^*(y) \dot{-} \{$the number of elements x in some S_i such that xRy and $V_i'(x) > 0\}$.

   We now have a system of cycles $(S_j^*, R_j^*, V_j^*, F_j^*)$ which can be resolved according to Definitions 7.17 and 7.18.

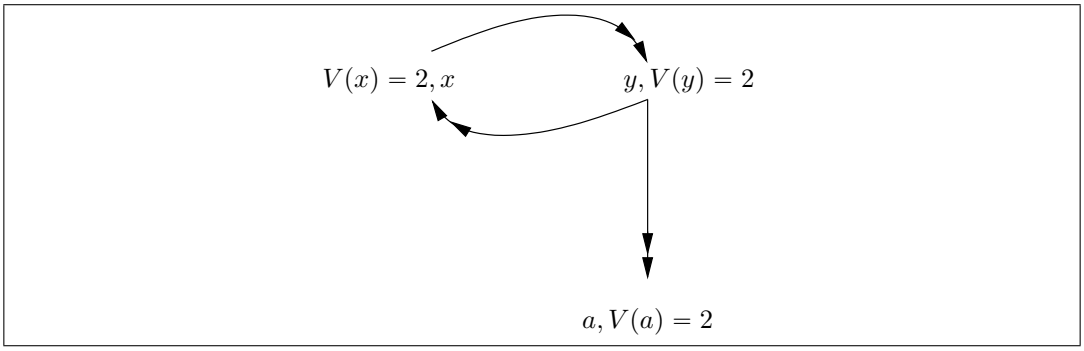


Figure 15

This completes step $k+1$.

5. *The process terminates at step n, for some n, because the original network is finite.*

6. *The extension we get is $(S, R, V^\sharp)$ where $V^\sharp(x)$ is defined as follows:*

   $V^\sharp(x) = V_i'(x)$ where x belongs to the cycle (S_i, R_i) and V_i' is the function obtained when the cycle was resolved at the appropriate step. Recall that we resolve a higher cycle without affecting any lower cycle and only after it is resolved do we let it act as a set of external attackers on the next lower cycle.

Example 7.20 (Two ways of resolving a network)**.** *This example illustrates our policy of resolving a higher cycle completely before we pass the attacks to a lower cycle. Consider Figure 15.*

We have two choices for the front for the top cycle $\{x, y\}$. Choose $F = \{y\}$. This will define one possible extension. We cycle through $\{x, y\}$, we do not attack a yet. We first resolve the top cycle $\{x, y\}$. y attacks x gives $V_1(x) = 1$, x attacks y gives $V_2(y) = 1$, y attacks x gives $V_3(x) = 0$. We are stable with $V'(x) = 0, V'(y) = 1$. We now let the cycle be an external attacker on $\{a\}$. We get $V'(a) = 1$ (because $V'(y) = 1$), so we get the following extension for the choice of $F = \{y\}$: $V'(a) = V'(y) = 1$ and $V'(x) = 0$. If we choose $F = \{x\}$, then by symmetry for the cycle $\{x, y\}$ we get the values $V''(x) = 1, V''(y) = 0$ and therefore since x does not attack a we get $V''(a) = 2$. So the network (S, R, V) of Figure 15, has two complete extensions which are also networks, namely, the networks (S, R, V') and (S, R, V'').

Note that we must mention the valuation as well because for example in V'', a is in with 2 lives.

We could follow an alternative policy and just let y attack wherever it can. We get

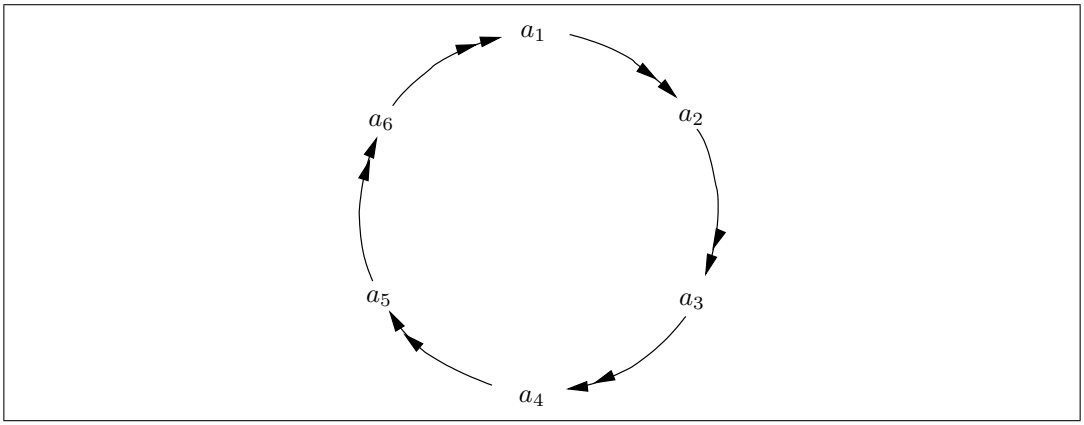


Figure 16

y *attacks* $x : V_1(x) = 1$
y *attacks* $a : V_1(a) = 1$
x *attacks* $y : V_2(y) = 1$
y *attacks* $x : V_3(x) = 0$
y *attacks* $a : V_3(a) = 0$.

The different extension we get for the starting choice $F = \{y\}$ *is* $V^*(y) = 1$, $V^*(a) = V^*(x) = 0$.

Example 7.21 (Comparison with CF2 semantics)**.** *CF2 semantics also resolves loops by taking maximal conflict free sets. When the valuation* $V \equiv 1$*, we get the ordinary Dung extensions for acyclic networks. What do we get for cycles?*

Consider Figure 16. This is a 6 cycle.

The CF2 semantics allows for the extension $\{a_1, a_4\}$*. Is there a set* F *of starting points which can get it in VW-semantics? The answer is yes.*

$$F = \{a_4, a_5, a_1, a_2\}.$$

What happens in general if we limit F *in the top cycles to only one point? I do not know.*

Remark 7.22 (Connection with weighted argumentation [41])**.** *This is an important remark. The material in the machinery of this Subsection has two components:*

1. *The nature and meaning of the numerical valuation* V *arising from the sex offender area and still to be refined and adjusted. See Footnote 23.*

2. *The step by step propagation protocols of Definitions 7.17, 7.18 and 7.19. These definition apply to any weighted system. All we need to tell the machinery of these definition is how to propagate the values of V from attackers to the target and get a new V' on the target. In other words we need to give a new definition replacing i the item (d) of Definition 7.18 by l formula giving a different mathematical formula for a new $V(z)$ in terms of its own original $V_0(z)$ and the V_1 Values of its attackers (and possibly values of its attack arrows).*

All we have here is a bunch of numbers attacking another number, yielding a new number. See [42] and [43], for example, for many ways of executing such attacks. The method of [41], however, is different from what is discussed in those papers and is different from what we are doing in this paper (the many lives approach). To explain the difference we can use two methods:

1. *We need to devise an example which can be addressed by all views, especially the view of [41] and the view of the many lives of this paper and show how the methods differ in this example.*

2. *Find a more general approach which can contain all candidates for comparison and embed/translate these candidates into this general approach and do the comparison there.*

The next Example 7.23 uses method (1). Method (2) is more complex and could be a subject for a separate paper. We do, however, give you an example in the spirit of method 2, namely Example 7.24.

Example 7.23. *We chose an example which can be addressed by both our method of many lives and the weighted approach of [41]. Consider the network of Figure 17:*

1. *First consider this figure as representing a weighted network in the sense of [41]. This has the form $(S, R, \mathbf{w})$, where $R = \{(x, a), (a, y), (y, a)(y, z)\}$, $S = \{x, a, y, z\}$ and $\mathbf{w}$ is a function from R into the positive real numbers $(0, \infty)$, which in this case is giving the identical value 1 to all attacks as shown in the figure 17. This system $(S, R, \mathbf{w})$ conforms with Definition 4 of [41, page 462].*

   Viewed as a many lives network we still have to say what the values 1 annotating the attacks mean. We read them as saying the attack is live. We do not yet say how many lives each node has. We can highlight the first technical difference between our paper and [41]

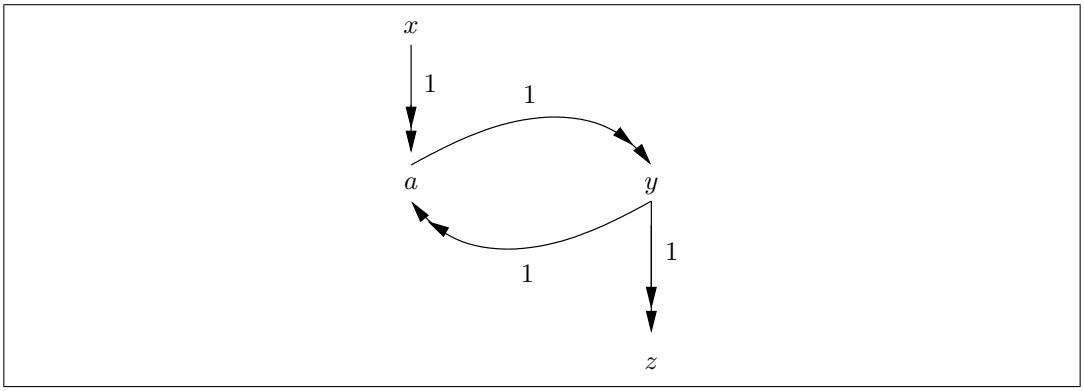


Figure 17

(d1): We annotate nodes with number of lives. [41] annotates attacks with strength. In itself this is a small technical difference but the real difference is what is done with the annotation. [41] uses the strength to cancel some weak attacks while we use the annotation to refuse weak attacks. [41] is part of the numerical world view and we are part of the non-monotonic logic world view. This will become clearer later in this example. The two approaches are orthogonal to each other and can be combined together . The strength of attacks can be aggregated and still be refused by the target.

Let us go on. [41] adds a number β which they call "inconsistency budget", which roughly means that any group attacks of combined strength less than β can be ignored. This is definition 5 in [41]. We can understand this number as our many lives number. Let us choose $\beta = 2$ and understand it in our context as the number of lives for each node. [41] now continues in a unique way. To define extensions for the network of Figure 17, it chooses an arbitrary set of attacks such that the sum of the weights of the attacks in this set is less than β. Since $\beta = 2$ and the attack weight is 1, this means we can arbitrarily choose in our case a single arrow. [41] then proceeds to do the following:

(a) cancel the chosen arrow

(b) proceed with the rest of the network (without the chosen arrow), ignore the weight and compute traditional extensions.

These are definitions 5 and 6 of [41] applied to our Figure 17.

[41] justify their approach in Section 3.2 of their paper

(d2): Note that [41] uses the weights as a licence for attacks to enter the traditional computation of extensions. So for $\beta = 2$, we can choose that the attack $\{y \twoheadrightarrow a\}$ is cancelled and now we compute traditional extensions for the remaining network. We can choose to cancel any single attack in the figure, and after such a choice is made, [41] does not use the weights any more.

Let us now see how we deal with Figure 17 in our paper.

2. *If we follow finding extensions in the spirit of Definition 7.6 (even though Figure 17 contains cycles), we get the extension*

$$E_b = \{x = 2, y = 2, a = 0, z = 1\}.$$

3. *If we follow the computational approach of this Subsection, we get the following steps:*

Step 1. *$x = 2$, (x not attacked)*

Step 2. *x attacks a, so $a = 1$*

Step 3. *a attacks y, so $y = 1$*

Step 4. *We need to complete the cycle $\{a, y\}$. So y attacks a (we ignore the attack on z), so $a = 0$. This completes the cycle giving $a = 0, y = 1$.*

Step 5. *y attacks z, so $z = 1$.*
The extension we get is

$$E_c = \{x = 2, a = 0, y = 1, z = 1\}.$$

Example 7.24. *This example shows how we can combine the many lives approach with the general weighted numerical approach. Let $(S, R, \mathbf{w})$ be a general finite network with $R \subseteq S \times S$ and $\mathbf{w}$ a function giving weights in the real numbers $[0, \infty)$ to both arguments and attacks, namely,*

$$\mathbf{w} : S \cup R \mapsto [0, \infty).$$

Consider the general configuration for a node a shown in Figure 18.
We agree on the following interpretation:

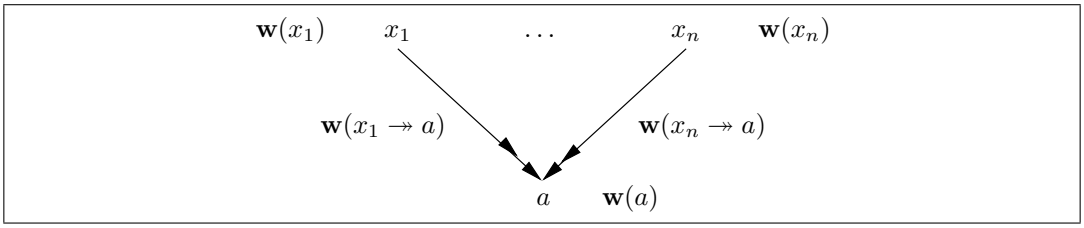


Figure 18

1. *For node $x, \mathbf{w}(x)$ is the strength of node x*

2. *For the attack $y \twoheadrightarrow z, \mathbf{w}(y \twoheadrightarrow z)$ is the strength of the resistance of the transmission of the attack of y on z. So if $\mathbf{w}(y)$ is greater the attack on z is greater, but if the resistance $\mathbf{w}(y \twoheadrightarrow z)$ is greater, less of the attack passes through and the effect of the attack is smaller.*

3. *The strength of the end result of the attack from y onto z is given by $\mathbf{f}(\mathbf{w}(y), \mathbf{w}(y \twoheadrightarrow z))$, where $\mathbf{f}(\alpha, \beta)$ is a continuous function satisfying the following*

   (a) $\mathbf{f}(0, \beta) = 0$

   (b) $\mathbf{f}(\alpha, 0) = \alpha$

   (c) $\mathbf{f}(\alpha, \infty) = 0$

   (d) $\mathbf{f}(\infty, \beta) = \infty$

   For example we can take $\mathbf{f}(\alpha, \beta) = \frac{\alpha}{1+\beta}$.

Let us now look again at Figure 17 and give it the following values as in Figure 19.

The method of propagation remains along the same (using the function $\frac{\alpha}{1+\beta}$) sequence of steps:

Step 1. *The value for x is 3, as it is not attacked.*

Step 2. *The value of the attack of x on a is $\frac{3}{2}$ (using the function $\frac{\alpha}{1+\beta}, \alpha = 3, \beta = 1$).*

Step 3. *The new value of a is $2 - \frac{3}{2} = \frac{1}{2}$*

Step 4. *a attacks y the value of the attack is $\frac{0.5}{1+2} = \frac{0.5}{3} = \frac{1}{6}$.*

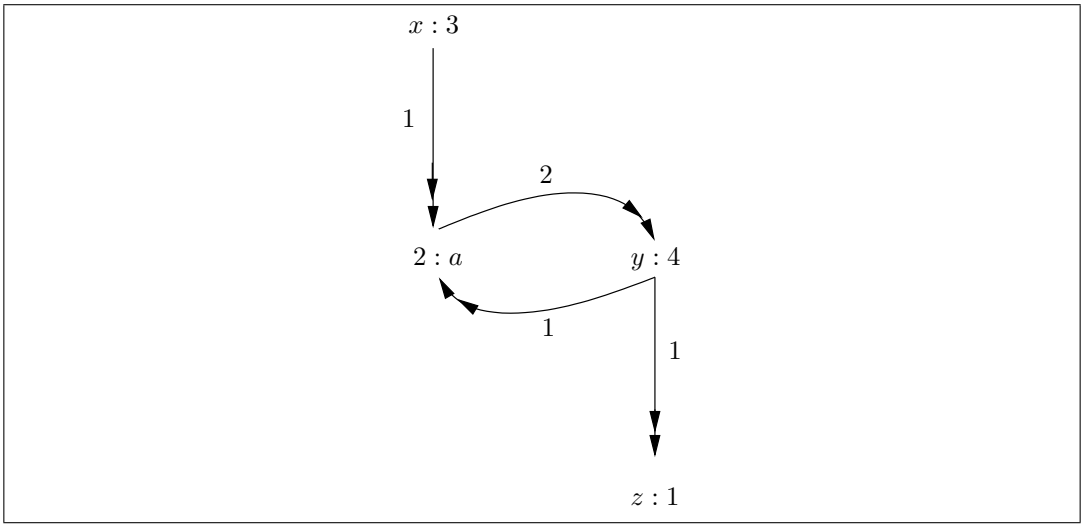


Figure 19

Step 4. *The new value of y is* $4 - \frac{1/6}{3} = 4 - \frac{1}{18} = \frac{71}{18}$.

Step 5. *y attacks a with value* $\frac{71}{18.2} = \frac{71}{36} = 1.9722$.

Step 6. *The new value of a is* $\frac{1}{6} \dot{-} 1.9722 = 0$. *Thus the stable loop solution is* $a = 0, y = 1.9722$.

Step 7. *The value of the attack of y on z is* $\frac{1.9722}{2} = 0.98611$.

Step 8. *The new value of z is* $1 - 0.98611 = 0.013888$.

The final extension is approximately/practically $x = 3, a = 0, y = 2, z = 0.013888$.

Example 7.25. *Consider the network of Figure 20 (see Definition 7.16).*

The SCC ordering of cycles is Figure 21.

We now calculate the extensions. We start with the top cycle 1 and work our way down the cycles. The steps are intended to define a new valuation V'. Each step modifies V into a new V_i. The index "i" increases as we move forward in steps along the arrows of the cycle.

Step 1. *Choose an element in cycle 1. Different choices would lead to possibly different extensions. Let us choose a. We have that a attacks b. We get that the original $V(b) = 2$ changes into the new $V_1(b) = 1$. Notice that even though a attacks*

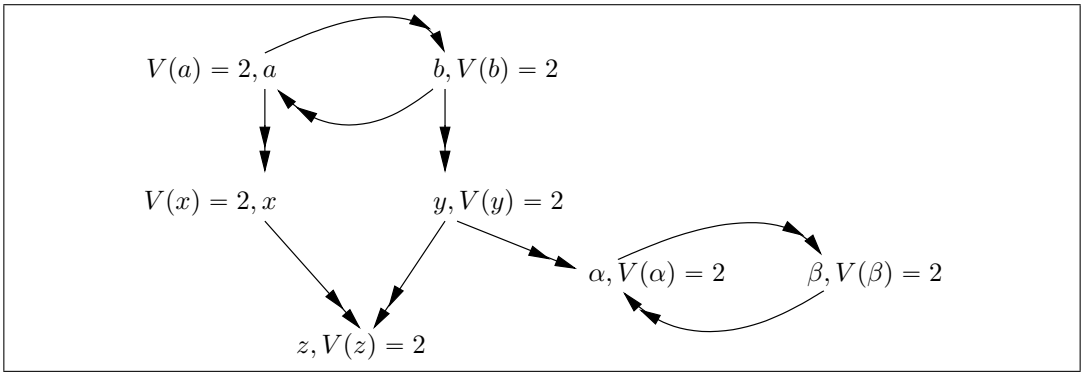


Figure 20

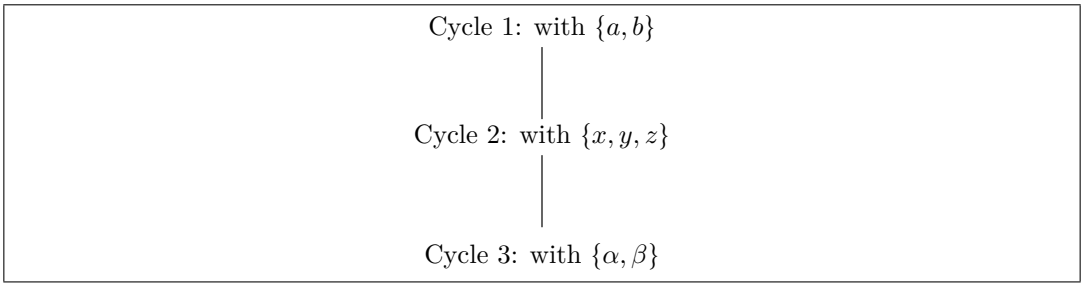


Figure 21

x in cycle 2, we do not attack cycle 2 until cycle 1 is completely resolved by cycling through it until no more changes to the valuation are introduced. It is then and only then that we use the new stable values we get for the elements of Cycle 1 to attack Cycle 2. This is our policy in defining extensions. There are other policies possible.

b attacks a, we get a new value for a which we call $V_1(a) = 1$. *Now we continue to move in Cycle 1 and observe that a attacks b and so the value of b changes again from* $V_1(b) = 1$ *to the value 0. Since this is another change in the value of b we increase the index of* V *and call it* $V_2(b) = 0$.

We stop, because b is no longer capable of attack. We are stopping with values $V_1(a) = 1$ *and* $V_2(b) = 0$. *We realise we have a minor accounting problem with the indices of* V. *On the one hand we want to emerge from Cycle 2 with a clearly named new valuation and on the other hand we need to increase the index of* V *as we run through the cycle. So let us adopt the highest index used, in this case the index is "2" and so we upgrade the index of* $V_1(a) = 1$ *to be* $V_2(a) = 1$. *Cycle 1 is resolved with the exit valuation* V_2 *with* $V_2(b) = 0.V_2(a) = 1$.

Step 2. *We now resolve cycle 2. We have a attacking x, so let us give it a new value $V_?(x)$. The question is what index to give V. This problem of indexing V needs to be systematically and formally defined and we do give a definition later in this Section. Meanwhile we just want to go on with our example, just to show the reader how the steps work. So let us use the index 3, since V_2 is expanding from Cycle 1 to the next cycle. So we have that the original $V(x) = 2$ becomes the new $V_3(x) = 1$. x attacks y, so $V_3(y) = 1$, y attacks z, so $V_3(z) = 1$. z attacks x so $V_3(x) = 0$. We get $V_3(y) = 1$ and $V_3(z) = 0$. So we continue and summarise our exit value from Cycle 2. Let us call it V_4. We have $V_4(y) = 1$ and $V_4(z) = 0$ and $V_4(x) = 0$.*

Step 3. *We now approach cycle 3. We have $V_4(y) = 1$. y attacks α, so $V_5(\alpha) = 1$. α attacks β, so $V_5(\beta) = 1$. β attacks α and so $V_6(\alpha) = 0$.*
Stop.

The extension we got is V', with

$$\begin{aligned} V'(a) &= V_2(a) = 1 \\ V'(b) &= V_2(b) = 0 \\ V'(x) &= V_3(x) = 0 \\ V'(y) &= V_3(z) = 1 \\ V'(z) &= V_4(z) = 0 \\ V'(\alpha) &= V_6(\alpha) = 0 \\ V'(\beta) &= V_5(\beta) = 1 \end{aligned}$$

Note the following:

1. *Jumping indices $V_1, V_2, \ldots$ is just for the purpose of keeping track of how we go through the loops/cycles.*

2. *We first choose a top cycle and an element in the top cycle and cycle through until stable. We do this for all top cycles and only then do we attack the next level. This is our choice of how to find complete extensions. The reader can choose otherwise. The reader will obtain in such a case a different semantics.*

We continue this example, and choose to start with b this time. By symmetry the top cycle 1 will be resolved with $V_2(b) = 1$ and $V_2(a) = 0$. We continue. Since b attacks y, we get $V_3(y) = 1$. y attacks z so we get $V_3(z) = 1$. z attacks x so we get $V_3(x) = 1$. x attacks y so we need to increase the index of V for y since the value changes and we get $V_4(y) = 0$. So we get, since the value of y is now 0, y cannot attack and so that the value of z does not change and remains $V_3(z) = 1$ and so $V_4(x) = 0$. We summarise and get $V_4(x) = 0, V_4(y) = 0, V_4(x) = 1$.

We now have to continue and make a choice with the third cycle 3. Since $V_4(y) = 0$*, we can choose to start with* α *or with* β*. We can use a rule if we want, to start with the geometrically marked* α *or ignore the geometry and also allow to start with* β*.*

If we start with α *we get* $V_5(\alpha) = 1, V_5(\beta) = 0$*, and if we start with* β *we get* $V_5(\beta = 1$ *and* $V_5(\alpha) = 0$*.*

The full extension will be with

$$V'(x) = V'(b) = 1$$
$$V'(a) = V'(y) = V'(z) = 0$$

and say if we choose in Cycle 3 to start with α *then* $V'(\alpha) = 1, V'(\beta) = 0$*.*

8 Better modelling of the case study

8.1 Initial discussion

The preliminary discussions of the previous Sections allow us to present a better model for universal distortions. Let us summarise what we got:

1. We agree that the arguments we use must be instantiated in the form of $\pm aOb, \pm C(a), \ldots$ where $a, b, \ldots$ come from some universe of discourse $U = \{a, b, \ldots\}$, and $O, C \ldots$ are predicates. This allowed us to use analogy on arguments. Let us accept this observation and from now on talk about arguments in general, accepting that these arguments are structured/instantiated as described above.

2. We accept the general schema of Figure 1. We have two systems P_1 and D, and D is connected to P_1 and is able to distort it. The question is what form does D take, and how does D communicate with P_1.

3. We accept that we should start with P_1 and D being argumentation networks and that there is an argumentation type connection from D to P_1. A change in D causes a universal distortion in P_1. So if $P_1 = (S_1, R_1)$ then this connection might be through a $D = (S_2, R_D)$, where S_2 is a set of additional points and R_D is a subset of $(S_1 \cup S_2)^2$. Another possibility for the connection is that P_1 is a network with a valuation, of the form $P_1 = (S, R, V)$, as in the previous Subsection 7.4 and D is a new different valuation $D = V_D$.

4. D must be compatible with intuition. It cannot be just any formal network. It must be intuitive and the connection with P_1 must be intuitive. Thus D

must be general enough to include/model the annihilator type distortion of Section 4.1 as well as the non-monotonic type distortion of Section 4.2 or the valuation type distortion of Subsection 7.4.

We shall see that the concept of the attack as informational input, [11], is a suitable concept for our purpose.

5. We agree that any formal connection from D into P_1 must be compatible with the following intuition:

   > (intuition): Let x be an argument in P_1 and let $A_x = \{y | yRx\}$. Then the disturbance coming from D tends to mitigate the force of the attack from A_x to x.

   This principle models the tendency of the offender to mitigate certain "in" arguments in order to allow himself to feel better and have a tolerable view of himself.[20]

Example 8.1. *Let us recall Figure 9 and the node z being attacked by $\{y, u\}$. Imagine that our offender would like to keep z "in", and would like to make it as difficult as possible for the attacks from y and u to be effective (z might be the statement that he, the offender, is an exemplary citizen, and y and u are counter-examples to that statements). He might say the following:*

1. *Both y and u must be "in". One attacker "in" is not enough, (i.e. requiring more "lives" for "being good citizen" one occasional failing does not refute it).*
2. *The attack of y is coming from a non-trustworthy source. Maybe a child who has not complained for many years.*
3. *The argument y has a low value $V(y)$.*

The point is that the language must also contain predicates $V_i(y), V_i(u)$, etc. What our offender is not likely to say is that he wants to have exactly one "in" attacker for z to be "in".[21] *This is the case of Example 4 of the mathematical paper on Abstract*

[20] Gadi Rozenberg notes from his experience that sex offenders tend to respond to any immediate attack on them by deflection, rather than using logical interference (in the sense of Dynamic Argumentation) with the network in order to weaken the attack. So for example, if we have the attack chain

$$x \twoheadrightarrow y \twoheadrightarrow \text{ Victim } \twoheadrightarrow \text{ Offender}$$

then the offender (if he is not a lawyer or a logician) will weaken the direct threat ("Victim") rather than be clever about it and weaken argument x or strengthen argument y.

[21] The emphasis is on the word "exactly", the offender might want at least 2, or 3 etc but not "exactly 2".

Dialectical Framework (ADF) [27]. See Subsection 2.2 for further discussion in relation to ADF.

The reader might ask whether models of the form (S, R, V) are adequate, where S is a set of structured/instantiated arguments as discussed in Subsection 7.1 and V being a numerical valuation as discussed in Subsection 7.4. The answer is such models are almost OK, except that the valuations are in many cases not numerical but qualitative (such as "not reliable", "has an interest", "racist", "lying", etc). So we need a model that can take account of such valuations when calculating extensions. So even if we turn "unreliable" into a number, then the valuations $V(x)$ would be two dimensional (i.e. $V = (V_1, V_2)$, one dimension for reliability and one dimension for the number of lives. So if the sex offender says I am a good exemplary citizen and to successfully attack my statement I would require at least two reliable counter examples, then what do we do with three not so reliable such counter examples?[22] Obviously we need to consider n numerical valued functions $(V_1, ..., V_n)$ such that for each argument x we get a vector $\mathbf{V}(x)$ of values $\mathbf{V}(x) = (V_1(x), ..., V_n(x))$. So if x has say k attackers, $y_1, ..., y_k$, then the all values involved can be represented by an $(n \times k)$ matrix $\mathbf{M}(x) = [\mathbf{V}(y_1), ..., \mathbf{V}(y_k)]$. So we need a general function $\mathbb{B}_x$, (which may be dependent/tailored to the node x, that would take a general $(n \times k)$ matrix of numerical values $\mathbf{M}$ (n is fixed but k is arbitrary) and yield a vector of values $\mathbb{B}_x(\mathbf{M})$. We are not going to offer a detailed model, just the general pattern for the reader to see the direction we are going.[23]

We do adopt the Boolean approach of [27], see Subsection 2.3, where we attach a Boolean formula $\mathbb{B}_z$ to any z, but we must use a language with valuation predicates V_i as well.

Thus in Figure 9, for the node z, attacked by y and u we look at the equation of the form

$$\mathbf{V}(z) \leftrightarrow \mathbb{B}_z(y, u, (\mathbf{V}(y), \mathbf{V}(u))),$$

[22] Compare with the weighted approach of [41]. See the discussion in Remark 7.22.

[23] There is a clear connection here with what is known as weighted argumentation. Given a network (S, R), associate numerical real numbers value weights $W : S \cup R \mapsto [0, 1]$, and use these numbers in different ways to define new types of complete extensions. This is relevant to us, we can see how to use such systems to model sex offender distortions (they would change W). See [41] for a key paper on weights, with many central argumentation researchers as authors, and look up the references. The connection here will be pursued in a subsequent paper.

See, however, Remark 7.22, discussing the connection, after we give some technical result there.

One of the referees remarked that potentially , one could formalize cases where an argument is perceived as strong when attacked only by weak arguments (in the sense that if only weak, i.e., easily counterable, arguments can be found against an argument, then this argument is perceived as acceptable, or even perceived as stronger than without the weak arguments).

and perhaps we allow $\mathbb{B}_z$ to only be monotonic (up or down) in each variable. This view and its generalisations is now illustrated in some more simplified examples.

Example 8.2. *Consider the network of Figure 9. Assume we have further a valuation V on elements of S. Say $V(s)$, for $s \in S$, which gives s a red colour. The Bench-Capon basic approach (see Definition 2.7) would be to decide for example that red coloured nodes cannot be attacked by non-red coloured nodes. So for example, if we let*

$$V(z) = V(u) = \top$$
$$V(x) = V(y) = \bot$$

then y cannot attack z.

So we can write for any $s \in S$:

- *$In(s)$ iff $[\neg V(s) \wedge \bigwedge_{yRs} \neg\ In(y)] \vee [V(s) \wedge \bigwedge_{yRs \wedge V)y)} \neg\ In(y)]$.*

The above approach does not allow us to decide point by point whether we want to allow points y such that $\neg V(y)$ (non-red) points to attack points x such that $V(x)$ (x red) points.

We cannot for example ignore V altogether.

The idea we get from ADF is that we can write a tailored formula (as far as V is concerned) for each $s \in S$. We have two requirements, however, which make us different from ADF. The first is that the tailored formula we use must be a formula of predicate logic and not just a numerical/propositional formula on the "in" and "out" values of the geometrical attackers of s (namely on $\{x|xRs\}$). The second is that we, however, do not go as far as ADF and do not wish to change the basic Dung approach, namely we wish to keep the understanding that s is "in" iff all of its "tailored" attackers are "out". The technical property we need is that the formula we use be monotonic in the number of attackers which are "in".

8.2 Abstract valuation frameworks (AVF), the equational approach

Given a system (S, R, V_i^y), this Section deals with the equational approach for the case where all properties V_i^y, for arguments $y \in S$ are propositional. The reader is invited to recall Remark 2.6, Definition 2.7, Definition 2.8, and Remark 2.9, for a better understanding of what we are doing here

Definition 8.3.

1. *Let S be a finite non-empty set of elements. We consider a classical propositional language based on the elements of S. The language has the atomic*

propositions I_n^y, and $V_1^y, \ldots, V_k^y$ for each $y \in S$. The V_i^y are propositional constants describing properties of the node y. I_n^y is a constant intended to mean (y is "in").

2. *We also have a binary predicate xRy, on S. For every $x \in S$, let $A(x) = \{y | yRx\}$.*

3. *Let $\mathbb{B}_{In}^x$ and $\mathbb{B}_V^x$ $x \in S$, be Boolean formulas in the propositional language with $\{I_n^y, V_1^y, \ldots, V_k^y | y \in A(x) \cup \{x\}\}$. We assume monotonicity of these Boolean formulas in the propositions I_n^y.*

4. *Let Δ be the theory with the axioms (for each $x \in S$)*

$$I_n^x \leftrightarrow \mathbb{B}_{In}^x$$

$\mathbb{B}_V^x$ gives a weighted V value for x in terms of I_n and V_i

5. *Let **K** be the three valued propositional logic with the truth table of Figure 22. This is Kleene strong logic of indeterminacy [28, 29].*

6. *A system (S, R, Δ) as defined above, in item 4 of Definition 8.3, is called an AVF with Bench-Capon valuations.*

7. *Any Kleene model of Δ is called a complete extension.*[24]

8. *Note that we yet have to address the question of existence of such models for a given choice of Boolean $\mathbb{B}$ as in item 3 above. Existence can be obtained as outlined in item 1 of Remark 8.8.*

Remark 8.4. *Consider Definition 8.3, and the system (S, R, Δ). Then the following holds:*

1. *If the language does not contain any V_i and $\mathbb{B}_{In}^x$ does not contain I_n^x (unless xRx holds) then we get the the simple Boolean fragment of Brewka and Woltran Boolean ADF for the choice of monotonic formulas.*

2. *If the language contains a single V_1 and the wffs $\mathbb{B}_{In}^x$ and $\mathbb{B}_V^x$ for each $x \in S$ are as below then we get the Bench-Capon valuation system, where*

$$\begin{aligned} \mathbb{B}_{In}^x &= [V_1^x \wedge \textstyle\bigwedge_{yRx \wedge V_1^y} \neg I_n^y] \vee [\neg V_1^x \wedge \bigwedge_{yRx} \neg I_n^y] \\ \mathbb{B}_V^x &= V_1^x. \end{aligned}$$

[24] Note that it is not true that the complete extensions of an ADF are all Kleene-models of the given framework. In fact a complete extension needs to be a fixpoint of the given characteristic operator as used in the respective ADF semantics papers. Being a Kleene-model is not sufficient.

[h]

A	B	$\neg A$	$A \wedge B$	$A \vee B$	$A \rightarrow B$
0	0	1	0	0	1
0	$\frac{1}{2}$	1	0	$\frac{1}{2}$	1
0	1	1	0	1	1
$\frac{1}{2}$	0	$\frac{1}{2}$	0	$\frac{1}{2}$	$\frac{1}{2}$
$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
$\frac{1}{2}$	1	$\frac{1}{2}$	$\frac{1}{2}$	1	1
1	0	0	0	1	0
1	$\frac{1}{2}$	0	$\frac{1}{2}$	1	$\frac{1}{2}$
1	1	0	1	1	1

Figure 22

3. *The Kleene extensions of item 7 of Definition 8.3 are too general and not under control. As solution to equations we do not know what they look like and what they mean. The sex offenders case has more specific properties which can be used to construct better semantics. We shall see this later in the next Subsection.*

Definition 8.5 (Abstract valuation framework (AVF))**.** *Let (S, R, V_i^x, I_n^x) for $x \in S$ and $i = 1, \ldots, k$ be as in Definition 8.3. Further, let $\mathbb{B}_{In}^x, \mathbb{B}_V^x, x \in S$ be as follows*

1. *$\mathbb{B}_{In}^x$ has the form $\mathbb{B}_{In}^x = \bigwedge_{yRx \wedge B_V^y} \neg In^y$.*

2. *$\mathbb{B}_V^x$ is either monotonic up or monotonic down in each V_i, in any model of Δ, (Δ as defined in item (4) of Definition 8.3) for example $\mathbb{B}_V^x$ might be taken as $\bigwedge_i V_i^x$.*

Example 8.6. *Let us take another look at Figure 9 and try and express using AVF, the restriction that we accept that z is out if at least two in nodes attack z. We do this by having in the V-language a V_s for each $s \in S$ and let $V_s^y = \top$ exactly when $y = s$. So basically we can now talk about the elements of S. All we need to write now for z is*

$$\mathbb{B}_V^z = \bigvee_{E \subseteq A(z) \wedge |E| \geqslant 2} \bigwedge_{y \in E} In^y.$$

We use this B_V^z in B_{In}^z of item 1 of Definition 8.3.

Definition 8.7 (Equational AVF with V constant)**.** *Let (S, R) be an argumentation network and let for each $s \in S$, let $V_i^s, i = 1, \ldots, k, s \in S$ be additional atomic symbols*

all pairwise disjoint. Consider the atoms of S and V_i^s as variables ranging over $[0,1]$. We can also view $V_i : s \mapsto V_i^s$ as variables for functions with domain S and range $[0,1]$.

Thus we can view the atoms $V_i^s, s \in S, i = 1, \ldots, k$ to syntactically denote the value of V_i at $s \in S$. Let $\mathbf{h}$ be an assignment, giving for each $V_i^s, s \in S, i = 1, \ldots, k$, a particular value $\mathbf{h}(V_i^s)$ and creating a function $\mathbf{h}(V_i)$ from S into $[0,1]$.

Let $\mathbf{F}_V^s$ for each $s \in S$ be a Boolean function built up from the variables $\{y, V_i^y | yRs \vee y = s\}$ and the functions

$$\begin{aligned} \neg x &= 1 - x \\ x \vee y &= \max(x, y) \\ x \wedge y &= \min(x, y). \end{aligned}$$

$\mathbf{F}_V^s$ is a function for a fixed s, with the variables s and y (such that yRs holds) and all the variables $V_i^y, i = 1, \ldots, k$, and all y such that yRs and s.

For a given $\mathbf{h}$, we can substitute the numerical values $\mathbf{h}(V_i^y)$ in F_V^s and get what we denote by $\mathbf{F}_{V,\mathbf{h}}^s$, which is a function without the variables V_i^y, because these have been instantiated with numerical values.

Assume $\mathbf{h}$ is given. Thus all the variables $V_i^s, s \in S$ have numerical values. Consider the set of equations, for each $s \in S$ as follows $\mathrm{Eq}_{\max}(\mathbf{h})$.

$$s = 1 - \max_{yRs}(\min(y, \mathbf{F}_V^s))$$

These equations have the elements of S as the unknowns. Let $\mathbf{f} : S \mapsto [0,1]$ be any solution of the above equations. Then $\mathbf{f}$ is called a complete $\mathrm{Eq}_{\max}$ extension of the network $(S, R, \mathbf{h}(V_1), \ldots, \mathbf{h}(V_k))$ where (S, R) is the geometrical argumentation network and $\mathbf{h}(V_i), i = 1, \ldots, k$ are the fixed $[0,1]$ valuations.

Remark 8.8.

1. *Note that since all functions of Definition 8.7 are continuous, by Brouwer's fixed point theorem (see Wikipedia [64]), there is always a solution to $\mathrm{Eq}_{\max}(\mathbf{h})$. Using this solution we can get a 3 valued model of "in" being value 1, "out" being value 0, and the other values being "undecided".*

2. *Note that if we do not have any V_i, nor any $\mathbf{F}_V$, then the system becomes the ordinary equational approach, equivalent to the traditional Dung argumentation. See Subsection 2.4.*

3. *The function $\mathbf{h}(V)$ assigns a function to V from S to $[0,1]$. We normally assign numerical strength valuation as values $1, 2, \ldots$. This is not a problem. There are many continuous functions matching the intervals $[1, \infty]$ with $[0,1]$. For example, $f(x) = 1 - \frac{1}{x}, f(1) = 0$ and $f(\infty) = 1$.*

4. $\mathbf{h}$ *is fixed. So the values* V_i^y *do not participate in the equations as variables.*

5. (S, R) *does not have initial values* $\mathbf{f}_0 : S \mapsto [0, 1]$.

Example 8.9. *Consider the network of Figure 5 and assume that*

$$\begin{aligned} V_1(x) &= 0.4 \\ V_1(y) &= V_1(z) = 0.8. \end{aligned}$$

Assume that $\mathbf{F}_V^s = V_1$.

The equations for the figure would be:

$$\begin{aligned} x &= 1 \\ y &= 1 - \min(x, V_1(x)) \\ z &= 1 - \min(y, V_1(y)) \end{aligned}$$

We get

$$\begin{aligned} x &= 1 \\ y &= 1 - \min(1, 0.4) \\ &= 0.6 \\ z &= 1 - \min(0.6, 0.8) \\ &= 0.4 \end{aligned}$$

We get new values for x, y, z *but* V_1 *does not change. We have no equations to get new* V_1.

Note that we can introduce distortion by lowering the value $V_1(x)$ *of* x *to* $V_1'(x) = 0.1$.

So the value for y *would be*

$$\begin{aligned} y &= 1 - \min(1, 0.1 \\ &= 0.9 \end{aligned}$$

a much higher value.

Recall that $1 =$ *"in", and* $0 =$ *"out", and otherwise various degrees of undecided.*

Example 8.10. *Let us look at the network of Figure 6. First we need to convert the* V *values into values in* $[0, 1]$. *We use the formula* $V_1(a) = 1 - \frac{1}{V(a)}$. *So we get:*

$$\begin{aligned} V_1(y) &= 0 \\ V_1(z) &= 0.8 \\ V_1(x) &= \tfrac{2}{3} \\ V_1(u) &= 0.5. \end{aligned}$$

Using the equational approach, we get:

$$\begin{aligned} y &= 1 \\ z &= 1 \\ x &= 1 - \max(\min(y, V_1(y), z, V_1(z)) \\ &= 1 - \max(0, 0.8) = 0.2 \\ u &= 1 - \max(\min(x, V_1(x)) \\ &= 1 - \max(0.2, \tfrac{2}{3}) \\ &= \tfrac{1}{3} \end{aligned}$$

8.3 AVF, the set theoretic fixed point approach

The equational approach of the previous Subsection 8.2 has two drawbacks. In the general case, the formulas $\mathbb{B}_s$ need to be formulas of predicate logic, involving labels $V_i(y)$ from a possibly different annotation language $\mathcal{A}$. We don't know how to solve predicate equations in Kleene's logic. Even if we did know how to do that, we would not know the meaning of what we are getting as solutions. We need a set-theoretic approach, if possible. So here we go:

We develop our abstract argumentation approach within the framework of labelled deductive systems (LDS), [58]. The basic idea of LDS is to annotate a given system with labels from some algebra of labels and manipulate both units of the system and their labels. Using labels we can unify the treatment of many similar systems as well as get general generic results.

This Subsection generalises the many annotated argumentation systems including numerical and graded systems into one general framework.

In other words, the semantic machinery of this Subsection is much more general than what we need, but we get it at no extra cost (of developing formal approaches)!

Our LDS systems have the form $(S, R, V, \mathbb{B})$ where $S \neq \varnothing, R \subseteq S \times S$, V is an annotation function giving each element of $S \cup R$ (i.e. each argument and each attack arrow) a label value in some given algebra $\mathcal{A}$. To be specific, think of $\mathcal{A}$ as the predicate V_i^y, $\mathbb{B}_s, s \in S$ all reside. $\mathbb{B}_s$ is a formula which updates the V_i^y annotation. For each subset $E \subseteq S \cup R$ we get a new set of annotations $\mathbb{B}_s(E, x)$ to the node x.

Let us leave the meaning and use of $\mathbb{B}$ vague as above, but insist that we are able to define three attack relations between sets $E \subseteq S$ and nodes $x \in S$.

$\alpha_{\mathbf{d}}(E, x), \alpha_{\mathbf{a}}(E, x), \alpha_{\mathbf{p}}(E, x)$.

The index **d** stands for administrative attack, **a** stands for ordinary killing attack and **p** stands for protective attack. Every protective attack is a killing attack and every killing attack is an administrative attack. To illustrate, consider the many lives model. Assume x is a sex offender which is attacked by y. Assume z attacks y to protect x. z attack on y is a protective attack and must be very strong. y attack

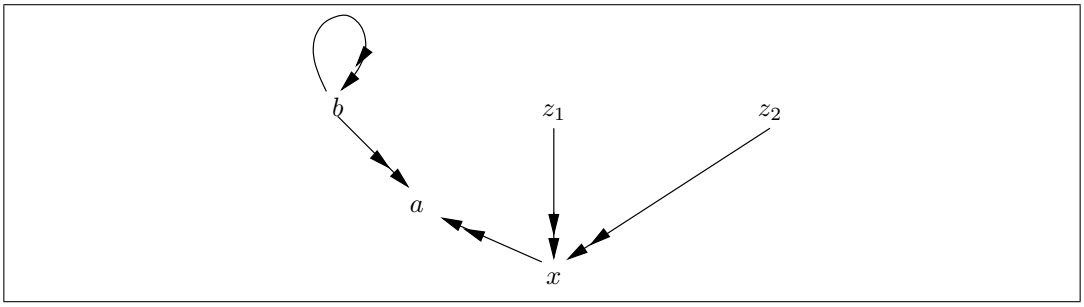


Figure 23

on x is a killing attack and is not that strong. It may be that both y and x are still alive because they have enough lives to survive. But they have been attacked so they are damaged but not dead. So how many lives have they lost? The administrative attack will settle that.

We assume $\alpha_{\mathbf{p}} \subseteq \alpha_{\mathbf{a}} \subseteq \alpha_{\mathbf{d}}$.

Assume that for each of these attacks we have:

- E attacks x and $E \subseteq E'$ then E' attacks x.
- E does not attack x and $E' \subseteq E$ then E' does not attack x.

Example 8.11. *Let*

$$\alpha_{\mathbf{a}}(E, x) \text{ iff } \exists y \in E, yRx$$
$$\alpha_{\mathbf{d}}(E, x) \text{ iff } \exists y \in E(yRx \vee xRy)$$
$$\alpha_{\mathbf{p}}(E, x) \text{ iff } \exists z_1, z_2 \in E, \text{ such that } z_1 \neq z_2 \wedge z_1, z_1Rx \wedge z_2Rx.$$

Consider the network of Figure 8.11

Then in this network we have $E = \{z_1, z_2, b\}$ $\alpha_{\mathbf{p}}$ *attacks* x*, and* $\alpha_{\mathbf{a}}$ *attacks* a *and* $\{a\}$ $\alpha_{\mathbf{d}}$ *attacks* x*.*

Definition 8.12.

1. *We say that* E *is* at peace *iff for no* Y, a *in* E *do we have* $\alpha_{\mathbf{a}}(Y, a)$ *holds.*
2. E *protects* x *if for every* Y *s.t.* $\alpha_{\mathbf{a}}(Y, x)$ *holds we have* $Y - \{y | y \in Y$ *and* $\alpha_{\mathbf{p}}(E, y)\}$ *does not* $\alpha_{\mathbf{a}}$ *attack* x*.*

Lemma 8.13. *If* E *is at peace and protects its elements and* E *protects* x *then* $E \cup \{x\{$ *is at peace and protects its elements.*

Proof. Assume not at peace, get a contradiction.

Let $Y \subseteq E \cup \{x\}, z \in E \cup \{x\}$ be such E **a**-attacks x.

Case 1. $x \notin Y, x \neq z$ contradicts E at peace.

Case 2. $x \notin Y, z = x$. We have Y **a**-attacks x. Since E **p**-protects x, E must **p**-attack some elements $y_1, \ldots, y_k$ s.t. $Y = \{y_j\}$ does not attack x. Since Y does attack x, there must be at least one y_1 s.t. E **p**-attacks y_1. But **p**-attack implies **a**-attack, again a contradiction.

Case 3. $Y_o \cup \{x\}$ attacks z and $z \neq x$. Since $z \in E$, E **p**-attacks elements of $Y_o \cup \{x\}$. E cannot attack any elements from Y_0 so E attacks x but this is now case 1, which is impossible.

Case 4. $x \in Y, z = x$. so we have $Y_o \cup \{x\}$ attacks x. Since E protects x, E attacks $Y_0 \cup \{x\}$ but E cannot attack any of its elements. □

Lemma 8.14. *If E admissible and protects x then $E \cup \{x\}$ protects itself because E protects all elements of $E \cup \{x\}$ so $E \cup \{x\}$ does this as well because of the monotonicity condition.*

Lemma 8.15. *There exists an admissible set $E \subseteq S$ s.t. E = all elements it protects.*

Proof. Start with $\varnothing$. It protects its elements and is at peace. Suppose $\varnothing$ protects x then $\{x\}$ protects x and is at peace.

Continue to increase the set using Lemma 8.14, until we reach a maximal st. This is the set E we need. □

Example 8.16. *Start with $\varnothing$. It is at peace and* **p***-protects its elements. Suppose the empty set can also* **p***-attack. Suppose it protects x. Then x cannot* **a***- attack itself. If x* **a***-attacks x then $\varnothing$ must* **p***-attack x. So $\varnothing$ cannot protect x. Therefore x cannot attack x.*

Definition 8.17. *Let $(S, R, V, \mathbb{B})$ be an LDS system as defined in this Subsection, and assume that we have the notions of* **d**, **a**, *and* **p** *attacks respectively to go with it. Using the notions of* **a** *and* **p** *attacks we can identify the family of sets E which are admissible and are equal to the set of all the elements E protects. We can now use the notion of* **d** *attack to update the annotation of each element x in E. Let x be any element x in E such that E* **d** *attacks x. Let the new annotation of x be $\mathbb{B}(E, x)$. If x is not* **d** *attacked by E, leave its annotation unchanged.*

Let V_E be the new annotation on E. We refer to the system (E, R restricted to $E, V_E, \mathbb{B}$ restricted to E) together with the **d**, **a**, **p**, *respective attacks restricted to E, as an E complete extension of the original system.*

Example 8.18. *Consider a network with node b only such that bRb holds . Let us use the* **a** *attack and* **p** *attack of Example 8.11.Then node b* **a** *attacks itself but does not* **p** *attack itself. Therefore the extension we get is* $\{b = 0\}$*, not* $b =$ *undecided.*

If we take the attack notion to be Dung style then b both attacks and protects itself and so must be undecided

We close this Section at this point, in the spirit of Option E3, discussed in Section 1.

9 Comparison with the literature

Given a network (S, R), let us ask ourselves how can we interfere with its traditional complete extensions and semantics. Frankly, since the network is abstract and not instantiated, there is not much we can do. We can ask for some elements in S to be out (resp. in) and vice versae. If we further want to talk about a universal mass interference, (or universal distortion as we call it) we can talk about interfering with a large set of elements.

This is not satisfactory because we cannot give a good qualitative description of the interference, since all the elements of S are atomic. All we have is the Geometry of the relation R. For this reason papers in the literature tend to be technical and deal with local interference (recall Remark 3.2).

Looking at application areas where universal distortions occur, we saw that we need some logical description of the interference and for this reason we resorted to Bench-Capon valuations, or non-monotonic attacks . We can consider major distortions arising from some qualitative considerations in any instantiated approach such as ASPIC or ABA.

As far as we know, ours is the first paper to deal with universal distortions.

Let us now compare with some specific sample of papers in the literature. Fortunately in many cases it is easy just to quote their abstract, to see how different (from our paper) and local the interference is.

1. **Papers [30]–[32], of Baumann and Brewka.**
   In these papers the authors study a Dung-style argumentation framework by adding finitely many new arguments which may interact with old ones. They study formally what can happen. These papers are mathematical studying questions like the effort needed to enforce a set of arguments E, measured in terms of the minimal number of modifications needed to turn an argumentation framework (AF) A into a framework A'. such that A'. has an extension containing E. These papers deal with local distortion from our point of view.

2. **Argumentation meets AGM revision.**
   Here we have a series of papers applying revision theory to argumentation. An

argumentation network can be revised by adding one more argument, like paper [21] or by adding (integrating with) an entire new argumentation network like in [20]. We stress again that these papers are technical following a generic recipe for mathematical research. We may be able to use them in applications of universal distortion in some areas.

3. **Dynamic Argument Systems.**
   As we have already said, Argumentation Dynamics deals with local distortions, taking a few arguments out, or disconnecting some attacks or adding new elements or new attacks. The distortions we look at are global and follow a meaning . The reader can look up other papers under the dynamic argumentation title in the references.

We do want to mention one paper of Brewka which we particularly like. It is the Brewka's paper [33] which seems promising for applications. It is not directly related to universal distortion but it can serve as an example which can easily be distorted, a sort of realistic semi-theoretical example.

It presents a formal model of argumentation based on situation calculus. It models interacting agents seeking common ground. There are protocols for such interactions and so distortions in our sense can be viewed as changing or distorting the protocols.

10 Conclusion

We discussed universal distortions in reasoning networks. We gave formal definitions but most importantly followed a real life case study of a sex offender. The case study presents a challenge to the argumentation community. We need to expand our research horizons and model the rich world of logical and argumentation therapy for sex offenders. Let us explain why. Start with a simple network with $\{a, b\}$ and aRb and bRa. Assume we have valuation V with values $V(a) > V(b)$. Thus there is only one extension $a = \text{in}$, $b = \text{out}$. Our "offender" suffers from a universal distortion such that his value function V' has $V'(b) > V'(a)$. Hence his extension is $b = \text{in}$, $a = \text{out}$. This is certainly compatible with our case study, where the sex offender tried to minimise the severity of his offences. Our challenge is how to use therapy and correct the situation? We can appeal to the notion of audience of [6], and say to the sex offender everyone but you thinks that $V(a) > V(b)$. This will not work in practice. We need a much richer "envelope space" to operate with, as our patient resists therapy. The professional therapist discovered experimentally that in the case of sex offenders they, the offenders, can see the distortions in other offenders but

not in themselves. So they use group therapy. The offenders themselves are used as the envelope space. It is significant that the therapist community actually use argumentation as a major instrument of remedy. We need to define such a space and within its framework define therapsuting steps. In our case it is an attack on V'. We can get ideas from practice in case studies. We thus develop a formal theory of Enveloping Spaces which go beyond audiences. The sex offender case is relatively easy. The area is well established. There are more difficult cases. How about a universal distortion caused by belief in ISIS ideology? What envelope space do we use? Note that ISIS employs positive propaganda for itself. Would our sex offender's therapy work successfully if there were international organisations saying this is a good thing? Think of the time of Plato and relationships between older men and young children. That was the expected norm then. How do you use therapy there?

On the technical side, we developed the following generalisations of argumentation networks:

1. The concept and idea of Universal Distortion in a reasoning system, of which this current paper is just a start. The concept exists in human reasoning and behaviour and so can be applied in formal systems which attempt at modelling such reasoning. These include Abstract argumentation but also ASPIC and ABA and indeed many other systems.

2. We generalised Bench-Capon valuation systems and looked at many lives valuations (Subsection 7.4) and generalised to Matrix valuations (Subsection 8.2). More importantly, we can come up with a new notion of proof theoretical semantics where the semantics for a valuation network is another valuation network. Further development of these ideas in a subsequent paper. We also showed that it is connected to Abstract Dialectical Frameworks. The formulas $\mathbb{B}_s$ we need to use for AVF are predicate formulas and need be monotonic in the $I_n(x)$ predicate appearing in the formula. Our way of presentation for our area makes these parts of ADF more intuitive for the sex offender case.

3. We showed a connection with several communities who use logic and argumentation, opening strong application opportunities for the Argumentation community. These are vast exciting future prospects. There is a danger that the argumentation community will become too technical and start feeding upon itself. This is a dangerous, but natural, development which has already happened to the non-monotonic community and was recognised as such by that community. We hope it will not happen to us if we keep looking at applications.

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Appendices

A Investigative interviews with child victims of sexual offences

Children have a universal distortion in the sense that when very young children do not have clear boundaries between reality and imagination. Therefore when a sexually abused child is interviewed special care must be taken to make sure the fact are identified.

The following are guidelines for how such interviews are conducted in Israel, as well as experimental facts about how children respond in interviews.

What is the best way to conduct an exploratory interview with the sexually abused child?

Sexual abuse is unique because usually the victim-witness is a child, pitted against an adult perpetrator who has an overpowering interest in covering up the offence.

Sometimes a criminal charge comes about as a result of a false accusation from a spouse — for instance, a wife might try to reinforce her claim for a divorce by making a false accusation which could be of financial benefit to her.

Under Israeli law, the interview has to be recorded, with the place, participants and beginning time all noted aloud at the start. At conclusion, the interviewer has to note the end time. The length of the recording must correspond exactly to this timing.

During the interview, the investigator must specify the non-verbal articulations that occur in the room: for example, noting that the child looks down to the a ground in response to a certain question, or recording instances of the mother making signals to the child, etc.

The general principle of the investigative interview is to create an environment which allows the child freely to communicate past experience and outline specific aspects related to the offence from the general to the specific.

The investigator should be prepared for the interview. That means he needs to read all the background he needs to know, the charges (if any), and any other information. He needs to think ahead about which questions to ask, for which he must make a model. However, he should also be sufficiently flexible to adapt to what is happening in the room. For example the perpetrator may suddenly start crying during the interview.

Stages of the interview

1. *Building a connection with the child*
   At this opening stage the researcher must devote sufficient time to make contact with the child and this will differ between individual children. If the child is agitated, the investigator must calm and reassure him.

   At this stage, the researcher should pay attention to the child's linguistic abilities and what happens to him when he becomes excited or when he is talking about unpleasant or sad things.

   The interviewer should ask the child to introduce himself and talk about a pleasant event he has experienced, or about his kindergarten. In other words, the child should be encouraged to relax by describing things and events unrelated to the offence. This stage should help the investigator in assessing the child's abilities and so in planning the future of the interview.

2. *Checking a child's ability to distinguish between reality and fantasy*
   This is a critical step. The interviewer needs to clarify to the child that he should tell the truth and only the truth. In such cases it is permissible to use the terminology of children's stories suitable to the mental age of the child. For example, it could be that the interviewer asks the child to remember what happened to Pinocchio when he lied, and that it is not only not permissible to lie but that the interviewer will be able to see a lie for what it is. It is, though, important to make sure that the child knows the difference between true and false. If the child cannot distinguish these two, it is a problem which the investigators should take into consideration.

3. *Presentation: The purpose of the interview*
   The interviewer should explain to the child that he is assisting in an investigation and needs information about what happened, in order to help. The investigator should not make promises he cannot fulfil. It is very common for a child witness to ask about secrecy and it is especially important not to promise the child that such secrets will remain in the interview room. The investigator should also tell the child what will happen later in the process and explain the role of the police Ð to the extent that the child can understand. If the investigator considers that this is a problem, he will have to arrange special care for the child.

4. *The child's free expression in describing the event*
   The interviewer should allow the child to speak about the event or events, giving his perceived version and his opinions about what had happened, in

his own words and without hindrance. This is a stage where no questions are asked and the researcher should let the child say, without interruption, what he remembers even if it is obvious that there are contradictions. This step should be conducted according to the pace of the child, patiently, calmly, without corrections or questions despite any opinions the investigator might have about inconsistencies and discrepancies

5. *Questioning: direct and indirect*
   The purpose of this step is to expand the knowledge of the investigator with respect to events described during the free narrative. The researcher needs to think about the child's opening narrative and expand the information. Leading questions should be avoided. For example, asking a child what happened on his birthday implies that something did in fact happen on his birthday. It is not permissible to instruct the child with such questions. The investigator should also use the language of the child. For instance, children have their own names for their genitalia. At this point questions should be formed in the nature of requests — "Can you tell me more about this event?", "You can tell me about the man, you said". The investigator should keep in mind that events can be a vague memory if the incident remembered at the age of 13 actually happened when the child was 6. The investigator should pay attention to the child's response to questions such as what happened, when it happened, and who participated.

   The child's responses should come without direct questions. Investigators often worry if an answer is incomplete but the question can be revisited at a later stage. If the child does not answer the question the investigator needs to go back possibly putting it in another way, but without pressure, so that the child will not give a response just because he feels stressed.

   The investigator must remember that leading questions can reduce the admissibility of the testimony during a trial. There are exceptions for children who cannot express themselves but in such cases anatomical dolls, drawings and other props may be used in the form of a game to help with data collection.

6. *Ending the interview*
   At this stage the interviewer must thank the child for his participation regardless of the outcome (even if the researcher did not achieve his goal). The interviewer must ask the child if he has questions and if the child does have questions the interviewer should answer them if possible. The interviewer must keep open a line of communication in the event that the child remembers something — for example, giving a telephone number.It is recommended to

end the session with something neutral (as at the beginning of the interview) and tell the child that they might meet again. The second phase, following the interview, is done without the child, in which the researcher listens to the recording.

Evaluation of the investigative interview

Assessment of the interview has several aspects:

1. Interview material is important in terms of whether the material gathered contains enough information in order to build a court case.

At this point the interviewer should consult with the police interrogator to assess whether or not there is enough accumulated material to file charges. If necessary, the researcher can summon the child again but the recommendation is that there is as little time as possible between the first and the second interview.

2. The Children's Investigator will determine the extent of the injury to the child.

This will determine the treatment plan as well as the legal position of the child. Physical evidence will be found from medical examinations and can support the case. The test for mental health is more complex. Some idea of the state of the child's mind will be indicated in the first interview and the interviewer has to assess this and the effect it will have on the child's evidence. The investigator will have to evaluate whether it is necessary to visit the scene of the crime, whether the child is capable of identifying a criminal in a line-up, or if the child could be stood as a witness in court. In other words, a balance has to be struck between the operations of the Law and the possibility of further damage to the victim. In most cases researchers refuse to let the child appear in court, which can expose him to the possibility of being a victim a second time. However, occasionally it is deemed a restorative experience, giving the child the chance to experience the reward of showing strength and courage. This will happen only when a child is over the age of 11 years, when the incident is very serious and when the offender is not known to the family.

3. Evaluation of reliability.

The investigator must check whether the child's evidence is reliable. A distinction should be made between the sort of minor mistakes which are made in normal discourse and a full-fledged lie. Eligibility is also a factor. Eligibility is the child's ability to give any sort of a report about a past experience. This is a necessary first requirement but it is not a guarantee of reliability. There is a debate about the

competence of children to testify in court, in four main areas. Eligibility is the legal framework which defines the ability to distinguish fantasy from reality and truth from falsehood.

The four main areas are as follows:

- **Imagination** — the conventional wisdom is that small children have difficulty distinguishing between fantasy and reality. This in itself is often used as a reason to doubt their testimony. Various studies have produced no definite answer as to what age children can distinguish between an event that really happened and a construct of the child's imagination. Most studies indicate that children over the age of 6 resemble adults in their ability to identify whether or not the source of the event is a product of inner thoughts or the result of an external factor.

  The consensus is that adults with their more developed cognitive skills and life experiences will always be able to perceive the difference between truth and fantasy. An adult will know, for instance, when some incident is contrary to the laws of nature. Studies show that despite a general doubt as to the ability of children to make such distinctions, clinical experience has demonstrated that children seldom invent significant events that happened in a way that trigger doubt about whether the act described actually happened. This is especially true when allowing the child to describe the act in his own words without help or prodding from instructors or without the use of tools that may implant presuppositions from the questioner. We must distinguish between fabrication and falsity because the fabrication and false report is related to the reliability, not to competency. In case of fabrication and false reporting the lying is done intentionally for a variety of different reasons.

- **Language** — Children have a limited vocabulary which is much less descriptive than adults. A child's vocabulary is usually very dependent on the environment in which he has grown. If the child has been raised in an educationally impoverished environment, the child's vocabulary will be more restricted than if he were raised in an enriched environment, but whatever the environment language at the disposal of the child is more meagre than it would be for adults. It is therefore more likely that his testimony would be interpreted wrongly or that the child will understand the questions and the investigator wrongly. Therefore the researcher should carefully evaluate the linguistic ability of the child and to be aware of nonstandard Hebrew, accepting it rather than trying to change it. It should be remembered that the child may be influenced by the investigator's style of speech so it is important to ask the

questions in his own language style.

- **Memory** — the debate on the eligibility of children to serve as witnesses often concentrates on the child's ability to remember and describe their experiences. Research on memory has generally been carried out in laboratories, which means we are talking about experiments which might differ materially from real life experiences or the trauma of having to testify in court. The relationship between memory and age is affected by various factors. There is a connection between memory and stress. Studies have also shown that small children are more likely than older children and adults to have memory distortion. These distortions are larger the further back the event is in the past. When the researcher discusses it he must not ignore the element of trauma. People who go through a traumatic event tend to remember it in more detail than they would recall a commonplace incident. It is the same for small children, there are many events during the day although a child will encounter many experiences during a normal day, if he is injured, he will remember that particular incident more clearly than the others. Certainly he will remember sexual trauma.

  As for the contention that stress affects memory, various studies have been conducted examining how memory operates under stress but results are still inconclusive. Some studies seem to show that the memory is even sharper, while others show that the memory completely shuts down. We can therefore say that the results are not conclusive in either direction. However, not all sexual abuse is painful and traumatic. In other words, not all sexual abuse may impair or enhance memory. Even when recalling events which we did not understand or we have suppressed, information which we recover after the passage of time is problematic. For example, Flynn took her research subjects from different ages, showed them an emotional element to an event, which would help them remember the event, and they found that after five months, children reported less information than they initially reported. That is, as time goes on we lose information. It was also found that children six years old reported less information than nine year old children (who could remember relatively more), meaning that younger children are losing more information. Memory can facilitate the interview stage. Memory is a building process in which adults and children are trying to recover the memory.

- **Suggestibility** — regardless of the memory capacity of children, there are doubts about their eligibility as witnesses in light of their exposure to the effects of leading or misleading questions. Suggestibility can also result from

impaired memory and also from misinformation from the interviewer. Studies have shown that you can easily affect the memory of adults by using leading questions, particularly when the subjects are asked, using a leading question, to recall events with a personal meaning. It is well known that the way you frame a question can determine the outcome of, for instance, a referendum. Drafting the questions in a certain way may create biases. Adults questioning children can also create biases. In the case of kindergarten-age children who were exposed to some form of suggestion or interference after an incident, this reportedly influenced the children's accounts of the incident some time afterwards. In other words, they absorbed incorrect information being aired during the interference. Among schoolchildren there is less suggestibility but it is unclear by how much. Most experiments dealing with suggestibility cannot be set up using real trauma and even if it some sort of trauma is involved it will be one experienced in a group rather than alone. However, child sexual trauma is experienced alone. We have no studies which can give an answer about the memory of a child who has experienced a true trauma of this type. But there is consensus on one thing: when a subject is recalling a key traumatic event, leading questions will have less affect in distorting memory than they would if they were directed at a subject remembering comparatively ordinary happenings.

B Therapy Groups of Sex Offenders

We mentioned in the paper that therapy groups of 8-14 sex offenders takes about 20 months. We also said that the objective is to make sex offenders realise, by means of argumentation and logic, that they are doing wrong. This appendix explains how this work. It is hoped that researchers in argumentation will get a better view of how the sex offenders therapist community works and hopefully get involved in offering help and interact with this community. This Appendix introduces two types of dedicated therapy groups for sex offenders and examines the pros and cons of each method of therapy by addressing different aspects of each and examining its logical and practical charactristics.

In order to achieve this goal, we focus on two types of groups: "closed groups" (groups with fixed membership) and railway Groups (open groups with a non-fixed, variable membership).

In jail, the treatment groups usually include about 14 adult sex offenders which is an enormous number and there is definitely a price for dealing with such a large group.

In the opinion of Dr. Rozenberg, the optimal number of participants in groups is no more than 8.

We asked ourselves many times what are the advantages and disadvantages of each type of group and what is the preferred method. To answer this question first of all we explain what a dedicated group is for sex offenders

We are talking about a therapy group with cognitive behavioural orientation (CBT). The patients are treated by this method because other methods were not found to be effective enough. Probably the reasons are:

1. at least to begin with, sex offenders are poorly motivated to accept responsibility for their behaviour

2. sex offenders perceive themselves as victims and they can talk incessantly about their victimization

3. We also believe that in dynamic group therapy we get insight and this is important, although insight is only a part of the therapeutic process, but at this point we can say that the CBT sex offender therapy has a lot of dynamic elements, which we shall discuss later on.

Why group therapy? The simple answer is that statistically it is the most effective treatment. The logic behind it is that sex offenders feel exceptional. They know they are deviants and in group therapy the feeling that they are not alone and that there are other people with similar problems often allows them to become more open and receptive ("openness"). The group helps mitigate the embarrassment and helps the therapist to confront patients. Sex offenders are much more receptive to each other than to other people and so if the group works well, things that patients say to each other are sometimes more important and have more influence than the therapist.

The treatment, based on a model of Bengis (1986) is called "relapse prevention". The goal of the treatment is to prevent future attacks on other victims.

Main goals:

A. raising the level of awareness of the sex offender about the range of behaviour options available to him.

B. developing coping skills and strategies of self-control.

C. creating a sense of control in the sex offender over his life.

Basic assumptions:

A. There is no cure for the disorder, but the subject can learn how to avoid repeating the offending behaviour (therapists are not magicians and do not know how to effect a complete cure for such things as perverted fantasies. Neither can we completely heal mental disorders).

B. When a perverse thought appears, the individual still can choose to avoid violence.

C. model SUD = seemingly unimportant decisions . Sometimes even taking seemingly unimportant decisions may lead to an offence.

   For example, a sex offender with a paedophilic disorder who is asked to deliver packages on a regular basis to an office which happens to be next door to a kindergarten. The seemingly unimportant decision to accept the job may lead to abusive behaviour.

D. the offence is planned and not impulsive

E. Not every lapse is a relapse. A violation of one of the risk factors = lapse and relapse= makes a new sex offence. Even if the patient made the wrong decision, and got himself into a dangerous situation (lapse), still he can recognise it withdraw, and thereafter can learn to avoid it, and not say to himself, I stumbled, what can I do?

   Let us take this opportunity to express what we believe. We are not sure that all therapists would agree with us. We believe we should talk with simple language to the offenders and not expect drastic changes in their emotional ability in a short time. We have to remember where these people came from and to where they return. For us, it is important that the therapeutic content will survive in everyday life. Also, we do not think we have a mandate to change the culture of the person and have no right to tell the patient whether or not to get engaged, whether or not, to marry several women or one. We believe we are allowed to intervene only if we see a direct correlation between the offender's approaches to future possible offences.

The character of groups: "Closed Groups" mean that you cannot get new patients to join during the group process and the group therapy therefore has a clear beginning, middle and end. Open (railway) groups are groups where patients can join at different stages The generally accepted practice is that the group has two therapists: a man and a woman. It is good for modelling and shows how two can communicate, and can even disagree but can still respect each other without using

stereotyped behaviour. The underlying idea of this approach is to reduce extremes of disagreement. It should be pointed out that research on the juvenile probation service found no difference in the success of the group according to the gender of the practitioner

After a brief review of the nature of the groups and the basic assumptions/ let us examine the advantages and disadvantages of open and closed groups.

We will divide this as follows:

1. Nature of the group,
2. Planning
3. Sorting of candidates
4. Therapist
5. Integration of new participants
6. Completion of the therapy.

1. The nature of the group. A closed group is a set with linear characteristics, where the group members are supposed gradually to change, reach enlightenment, to gain knowledge (although this word is not good enough to explain the process because it becomes experiential work, requires emotional and mental involvement, etc.). The patients should identify major patterns within their personalities and learn new ways to conduct themselves. This is circular work. The group works on a particular subject and only after all the members finish working on a specific theme are they allowed to move to the next item.

An open group however, is spiral and the group moves inconsistently. The progress often moves backwards and forwards through the beginning, middle and the end. This method allows us to examine the same issue in different periods and to attack it at different times. The patient is able to do so in a different developmental stage of the group and of himself. While a closed group is relatively regular, the open group is characterized by much lability. In order to understand the movement and development of the open group we must remember the "moods" of Bion theory.

The open group "mood" swings could be dependent, aggressive, avoiding observation, watching, rational, emotional, controlled, uncontrolled, shrinking, and expanding. Sometimes the movement of the group resembles a sort of tango, where the progress is three steps forward and two steps to the side, but it has no distinct development phases. In the open group the therapist must hold all the required information and all the time to must try to combine all the puzzle pieces together and pick up on necessary issues.

2. Planning. Due to the nature of the closed group the therapists in the planning stage can construct a series of gradual and consistently logical contents and to stick to them, adjusting is required only when you need to make changes to the content in on them the working group Before the therapist works in depth on a particular topic it is best to start with less intimidating content, to create links between the participants and gradually to go from easy to hard. For example, in prison we allow patients to work on trust, to describe experiences of their lives. The therapist should express empathy and increase collaboration, in such a way as to reduce defensiveness and allow them to develop direct reactions of empathy towards the victims. In the case of a closed group we do not have a created situation in which a new patient drops in and might be asked to relate to risk factors before working on the assault cycle and before he figures out the trigger, or manipulation and planning of his act. Such a situation certainly can happen in an open group .

3. Sorting of candidates. In a closed group, sorting and choosing the candidates must be very rigorous as if we make a mistake, nobody else can fill the space until the end of the group process and we cannot allow someone else who needs the treatment to take advantage of it. Regarding a decision about the maximum number of participants in a group we think there's room for some flexibility. We have observed over time, mainly because of the need to meet the demand, that we needed to increase the number of participants in our therapeutic groups. We took into account that larger groups meant (mean) mean slower progress and a longer time for the group therapy to reach its end The average treatment lasts for almost two years (in the past, with fewer participants, the process was shorter).

In an open group, we can be less meticulous in choosing the candidates or in cases of doubt we can consider allowing a candidate temporarily to join the group. We can and do, tell him that he goes into a two months trial period, and then later on we make the final decision regarding suitability. Of course, this situation involves difficulties. The patients have problems with frequent changes, which challenges their need for a sense of order and regularity. We should also mention that letting in a person into therapy and then removing him could further undermine his self-image, increase a sense of failure (many patients have a very low self-image) and of course it must be noted that for a patient, the retirement from dedicated treatment (whatever the reason) also increases the sexual risk level. Despite all of that, at least this is something less drastic, less cutting, knowing that it is possible to get a person an opportunity. We feel that a therapist sorting candidates for an open group can make a more relaxed assessment and can take more time for important decisions.

The closed group does not have this advantage, even if we set up a preparatory short group prior to the closed group meetings in order to examine who is ready for

the process and who is not.

4. Role of the Therapist. When dealing with an open group the therapist must be much more alert and make sure that the complicated group dynamics, with people coming in and out and going around in circles in treatment will ensure the proper treatment of all the

In the case of Open an open group the therapist does not have the luxury of a gradual and systematic progress. A study conducted in 2006 by Dr. Avraham Ofek which explored youth sex-offending groups says: "this railway method (open group) is good for youth and hard for therapists" the difficulties he found being those of regression and repetition. Research indicates that stress on the therapists is much heavier in open groups than in the closed groups. In open groups the therapists have to become acrobats, ensuring that all the patients, although they joined the group at different times, will be treated on all the basic issues of a dedicated sex offenders group. Already at this point we can say that one way to ensure that most of the required content has been addressed is to perform a number of assault cycles for every patient (it is difficult to believe how circles seem different at different times).

In our estimation, closed groups are more appropriate for training new therapists at the beginning of their careers, because with the closed group, the new therapist has the opportunity to observe and learn consistently about intervention, and identifying the logic behind the gradual construction of the contents and development of a group. Probably learning from an open group can be confusing and overwhelming., For that reason, a trainee therapist might consider joining the open group during later stages after viewing closed groups.

5. Integration of new participants. About joining new patients in open groups, there is the fear that the veteran (i.e. senior members) would get bored, having to repeat procedures they have already learned. The therapist must be very creative and try to reach the same goal using various techniques and adjusting the techniques to form the group. Yalom claims that, adding a new member successfully, depends partly on timing: there are better and less good times to add members. During a crisis and struggles it is harder to integrate a new member or if he is admitted, the fear is that the energies are directed to the new member which may disturb the flow of conversation about a burning issue. The most convenient time for admitting a new member, according to Yalom, is when the group is not really moving forward.

A social worker named Tamir Ashman adds that the number of joiners is important. According to Ashman, it is important to induct two members simultaneously, in order to facilitate the process. According to Ashman, when the group is experi-

encing a period of crisis, it is hard to absorb a new single member but if two or three join, they are able to create leverage and start a fresh viewpoint. Even if the burning issue is forgotten, the process will return to it in another way, with the perspective of the new people. This can create dynamics that allow a more productive viewpoint. Ashman claims that two patients joining at the same time is the optimal number In my experience I have not been able to find a formula definitively to establish what is the optimal number. It depends greatly on the members' personalities and the state of the group. I can also say that if the group is in crisis, with no trust between members and no significant progress, it is a mistake to insert a new person. We have to focus on the obstacles and only then, to add. The fear is that the entrance of a new patient will delay the group work and hurt the trust and intimacy which has been created, but certainly it can be said that the integration of a new person at an appropriate time allows "freezing" of the image of the group and gives an opportunity to review the progress. For example, with the joining of new participants all are asked to describe their offences and we can see a difference in description, with the adding of relevant information, etc.

One of the significant advantages of an open group is that it allows for a change of status and position in the group. In a closed group almost everyone establishes a position in the heirarchy of the group and it is very difficult for an individual to change status thereafter. In open groups every patient has more opportunity for a change of status. A 'back-bench' member of the group might very well become a veteran who can give the newer members the benefit of his experience. The very important thing is that the new patients constitute for the veteran a kind of mirror of where they were to where they are now (I cannot count the number of times I have heard a patient say "In the past, I thought the same as you...") and this is certainly a very new experience for both. One sees where he should strive to get and the veterans have a chance to see the progress they have made, which helps improve their self-image. This lets the veterans look "sideways" on themselves

In the past I had very clear positions on specific situations, for example that new patients are not allowed to join during the process of the departure of an old patient. Today I am really not sure about this. Life is always more powerful than us and all kinds of different situations develop. I thought that somebody's introduction during veteran's separation was unfair to both with neither getting enough attention. But I found that this situation can make a substantial contribution to the treatment of all the patients in the group. Letting a person enjoy telling about the process he just finished and giving him the responsibility of introducing the new one to the group. This actually helps to reduce anxieties and fears, while the new member sees that it is possible to finish the treatment and to change himself. Mostly, new patients enter naturally into an existing commitment and we can see fewer power struggles

with the therapists. This is the type of barometer that shows the patient where he wants to go and the others to demonstrate what they have done.

I talk a lot about how the nature of the group affects patients, but I should say that for therapists it is an exhausting task of trying to assess whether or not it is time to add a new patient. What did we miss? How much time must we devote to each subject, etc. Also, due to the nature of the group we have to decide on the recommendations to shorten or extend the duration of the stay. About the finish Ð I will deal with this after I have described the group.

The Therapy process For closed groups, Treatment focuses on the emotional, cognitive and behavioural aspects and the steps upon which the Group focusses are as follows

1. Familarization. Everyone gives his name and important facts about himself
2. "I and the other" patients are asked to use drawings of themselves and of significant figures in their lives and the work on drawings allows focussing on the life history of the individual. Other methods at this stage are guided visualisation, therapy cards, "Anibi".
3. Empathy or identification of emotions. Work on the different feelings and emotions of the patient and the others. This can be done using pictures with facial expressions, writing a letter to a victim and a letter from a victim, reading the testimonies of the victims and so on.
4. List of sex offender's arguments during therapy. These were listed in Subsection 7.5 in the body of the paper above.
5. Addressing emergency pressures. Aggressiveness, assertiveness, passivity. The patients are asked to describe such challenges and how they dealt with them
6. Sexual functioning. It is imperative that we convey to the patient not only what is prohibited, but also what are the alternatives.
7. Offence Cycle, see [52]. This can be identified as a summary of the therapy progression.
   (a) trigger: this is what sets of the pattern of behaviour. The trigger need not have any sexual connection.
   (b) feelings and thoughts (cognitive distortions)
   (c) disinhibitors: alcohol, drugs or pornography
   (d) planning

(e) focus on the offence

(f) reconstruction of the process.

Finally we work on how to deal with risk situations. We use films and other means of engaging the senses

8. The closed groups make several "stations" in the process These stations involve stopping and getting feedback which allow the patients an opportunity to test themselves while the therapists can use this to assess the progress and identify points to reinforce and improve.

6. Completion of the therapy. I now come to the last part: finishing closed groups. Closed groups have a set time to finish the process. If treatment can be described as linear, at the end of it we can look at the path we have taken and then disengage. As a group we wind up the process and go our separate ways. This is a very exciting process of termination and hope. We must add that the professional literature talks about how the patients can enhance the effectiveness of the treatment by constantly reviewing the content they worked on in the group. Therefore each client receives the file containing all of his homework, confessions and other things he worked on. We succeeded in organising a reunion for one group of graduates from a prison programme and I can say it was exciting to see the patients after a short period and I am sure it was studied and also significant for us and for them. I would definitely recommend that these class reunions be continued. In open group therapy the situation is different. According to Tamir Ashman, one of the disadvantages of an open group is that it does not deal with the group "here and now" and there is no processing of a separation experience because in contrast to closed groups the patients do not say goodbye to the group, but the group says goodbye to the patient.

In a closed group the therapist can say goodbye to all the patients in a winding-up ritual and thereby has the chance not only to review the progress that the participants have made but to take satisfaction from seeing that the patients have more insight and from the anticipation that they can be better, more well-integrated members of society than before they started the treatment. In railway groups the problem is that there is no such opportunity for a formalised parting nor will any parting take effect with all participants simultaneously. The therapist merely says goodbye to one and then immediately receives a new patient. Sometimes this makes it very difficult for the therapist to gain a sense of achievement and job fulfilment.

Finally, I want to say that I talked about advantages and disadvantages of both methods and tried to propose solutions to reduce the disadvantages of each method, but one thing I have not been able to find a solution to is the experience of the

therapist in an open group. In a closed group, the therapist handler finishes with patients, then has a break before taking on a new group. However, in an open group the therapist works through the process, seeing patients grow but instead of finishing the treatment, but then having the therapist then has to start work with other patients in an unending flow with no break, no grand finale, but only a continuous conveyor belt of patients.

C Child Sex Offenders, Adults and Children in the UK, by Steve Spurr, Independent Social Worker

C.1 Background

The author is an independent social worker in the UK who had previously worked for children's services departments in London and the South East of the UK for over 30 years dealing with child protection and allegations of abuse against adults working with children. In London the author developed a project that assessed the risks posed by juvenile child sex offenders and also a scheme to identify and protect teenage victims of sexual exploitation by adult offenders. This paper details the agencies involved in this work in the UK and the systems and procedures guiding their work from a social work perspective. Common examples of distorted thinking by perpetrators, institutions and employers are listed along with case studies of adult and child offenders. The paper concludes with the author's personal view of the reasons why greater success in eradicating child sex abuse has not been achieved and what might be done to overcome this.

C.2 Introduction

The prevalence of sexual offences against children in the UK has received a great deal of attention in recent years due to a growing understanding of the scale of the issue and its consequences for victims. During the past 30 years, the discourse has changed from complicit suppression of the problem to a state of moral panic and confusion over how to deal with the rising number of offenders and the risks they present. The growth of social media on the internet has provided new opportunities for offending and for offenders to normalise their cognitive distortions in relative privacy.

The range of types of sexual abuse against children is wide, extending from abuse within families and close relationships, through abuse by trusted adults in schools, churches and other institutions, to community based exploitation by gangs and organised groups.

The response by government and agencies in the UK has been to encourage professionals to work together to identify children most at risk and to prevent known offenders having access to children. Preventative and educational programmes have also dominated the landscape, but the consensus remains that offences and victims are increasing in number and that sexual abuse is a common experience for many children.

Faced with this situation, the UK government set up the Munro Review of Child Protection[25] and two formal inquiries, firstly the Inquiry into Child Sexual Exploitation in Gangs and Groups[26] which looked at organised networks of adults who had systematically sexually abused hundreds of vulnerable teenage girls in urban cities and secondly the Independent Inquiry into Child Sexual Abuse[27] to work with victims and survivors to determine the scale of the wider problem and to make recommendations for action.

This recent history and the ongoing investigations of institutional employees and the Crown Prosecution's determination to prosecute historic offenders, including high profile celebrities triggered by the Savile[28] affair, has led to widespread anguish that the sexual abuse of children is deeply ingrained in UK society and that a long term strategy is needed to effect change.

C.3 How the UK child sexual abuse system works

The legislative framework for the UK has been created through the criminal law of offences against children, by the Children Acts 1989 and 2004 and the publication of statutory guidance which followed. The most significant interagency guidance is called Working Together to Safeguard Children[29], which along with its supplementary guidance gives detailed advice to a range of agencies on how to proceed with all types of abuse, including child sexual abuse. Other disciplines such as medicine, police, probation and social work have developed guidance to approach

[25]Professor Eileen Munro's review reports, (2011) resulted in recommendations to free up local authorities from bureaucratic and compliance burdens and to give them more scope for professional judgement, enabling them to create new solutions

[26]Inquiry into Child Sexual Exploitation in Gangs and Groups, Office of the Children's Commissioner 2011 to 2013

[27]An independent statutory inquiry established by the Home Secretary under the 2005 Inquiries Act with the aim of conducting an overarching national review of the extent to which institutions in England and Wales have discharged their duty of care to protect children against sexual abuse.

[28]The celebrated disc jockey and children's BBC television presenter Sir Jimmy Savile was accused.

[29]Working together to Safeguard Children — A guide to inter-agency working to safeguard and promote the welfare of children. Most recently revised in March 2015

specific requirements regarding investigation, treatment and prevention. Universities run research programmes using evidence based theory and are informed by the voices of children and families. The result is a well-developed expert system, operated by many thousands of practitioners in the UK, but which is largely unknown to the general press or public.

C.4 Statutory requirements

Section 11 of the Children Act 2004 places duties on a number of specific organisations which provide services to children requiring them to safeguard and promote the welfare of children.

The agencies are:

- Local authorities and district councils, public health, housing, sport, culture and leisure services, licensing authorities and youth services;
- National Health Service organisations;
- Police
- National Probation Service
- Governors/Directors of Prisons and Young Offender Institutions
- Directors of Secure Training Centres
- Principals of Secure Colleges
- Youth Offending Teams/Services

These agencies are co-ordinated in a local authority area by Section 13 of the Children Act 2004 which requires the local authority to form a Local Safeguarding Children Board to oversee joint working; by providing policies for all aspects of safeguarding children work, to ensure staff are trained, that outcomes are monitored and effective, that services for children are planned and that inquiries into child tragedies may be carried out and lessons learned. Individual agencies retain their own accountabilities and responsibilities for service delivery but Local Safeguarding Children Boards are able to make clear to an organisation where improvements are needed.

In day to day practice the requirements to safeguard children and report abuse or suspected abuse are devolved to every organisation dealing with children and overseen by the governance of the area's Local Safeguard Children Board. It is

important to note at this point that the UK does not have a mandatory reporting requirement for child abuse other than that placed on teachers and other children's professionals to report suspected or actual Female Genital Mutilation.[30]

C.5 Schemes to regulate and assess offenders

The investigation of offences and the assessment of offenders is high tariff work with severe consequences for victims, perpetrators, society and professionals and so many scientifically validated tools and scales have been developed in many countries.

Of greater interest here are the organisational models for professionals to work together on the identification, investigation and harm reduction of offenders in the UK.

Such schemes have typically been developed by Police and Probation services, the community of therapeutic professionals working with victims and offenders and the large number of Local Authorities who are tasked with protecting children and vulnerable adults in local areas of the UK.

- The Government's Disclosure and Barring Service which requires professionals and volunteers working in Regulated Activity[31] to undergo regular criminal records checks
- MAPPA or Multi Agency Public Protection Arrangements. These are groups of professionals from agencies involved in safeguarding such as Health, Housing, Education, Probation, and Social Work, led by the police and tasked with making risk assessments and risk management plans for sex offenders and other dangerous adults.
- Local authority multi agency panel meetings concerning young offenders similar to the MAPPA model, convened with a view to early intervention and prevention.
- Local authority procedures to hold Child Protection Conferences[32] and to initiate Court Proceedings where the risk to a child is directly attributable to the actions or inactions of the parents or carers.

[30] Section 5B of the Female Genital Mutilation Act 2003 places a statutory duty upon teachers along with regulated health and social care professionals in England and Wales, to report to the police where they discover that FGM appears to have been carried out on a girl under 18.

[31] Regulated Activity is work which involves close and unsupervised contact with vulnerable groups including children, and which cannot be undertaken by a person who is on the Disclosure and Barring Service's Barred List.

[32] A meeting of parents and professionals to decide whether a child protection plan is needed to protect a specific child, held under the guidance of Working Together to Safeguard Children 2015.

C.6 How investigations are managed

Reports of abuse, or referrals as they are commonly known, are made to the local authority or the police where the child lives or is found.

Local authorities have teams of social workers in Children's Services departments (previously known as Social Services) which allocate them to qualified workers for an assessment and to talk to the children.

Police forces have specialist child abuse teams and sexual offence teams which investigate allegations of criminal activity.

The local authority and police always work jointly where the referral concerns sexual abuse of a child where:

- the child and perpetrator are in the same family or household
- where a child sexually assaults another child or adult
- where the adult perpetrator is in a position of trust with children, for example teachers, scout leaders etc. and all professionals and volunteers who work with children
- where a child is being targeted by an organised network for sexual exploitation.

(Note that in the UK a child is anyone under the age of 18 years.)

The police in the UK will investigate reports of sexual assault without the assistance of children's services only where there is no family or trusted adult connection to the offence or where the offence against a child is an historic one. Health professionals are often involved in supporting the work of social workers and police, particularly in cases where medical and psychological evidence may be sought. The following are examples of referrals where police and children's services work together:

> A child tells her teacher that her father tickles her private parts whilst he bathes her
> A child says that his grandfather rubs his bottom when he places him on his lap
> A father of young children downloads indecent images of children
>
> A child tells her mother that a boy at her school has placed his hand up her skirt
> A boy forwards on indecent images of his girlfriend to his friends
> A boy grabs the breasts of a woman walking home

A teenager complains that her teacher is sending her inappropriate texts
A 17 year old student tells his friend that he has had sex with his college tutor
A child is touched indecently by her music tutor

A parent is worried that her daughter is missing overnight and returns with new jewellery
An older girl encourages younger girls to meet her boyfriend's adult friends
A taxi driver offers teenagers free rides in return for sexual favours

A 14 year old girl tells her friend she has had sex with an adult man she likes
A teenage boy is asked to help run a disco by a man who then tries to have sex with him
A teenage boy who thinks he is gay has consenting sex with an adult man

There are many other variations but these serve to illustrate the wide range of possible case types which are jointly investigated by police and social workers. The examples can be grouped into 5 categories, viz:

1. Abuse within the family, extended family or household
2. Abuse by one child on another
3. Abuse by an adult in a position of trust
4. Abuse by an organised network
5. Abuse by a stranger or non-family member

The procedures and methods of each of these types of investigation are broadly similar but differ in detail as follows.

Type 1) Abuse within the family, extended family or household

These referrals are typified by the risk being from within the child's family unit and where an assessment is required to ensure the child's protection.

Common features encountered during investigation are:

- Family denial in order to keep the child
- Child accused of fabrication
- Older child rejected by family
- Child forced to retract allegation by family
- Older child retracts voluntarily
- Inconclusive outcome with no prosecution possible

Type 2) Abuse by one child on another

It is now known that most adult sex offenders begin offending in their teenage years and thus early intervention and prevention of further offending can be extremely helpful as challenges to distorted thinking is more likely to be successful at this age.

Common features include:

- Distinguishing sexually harmful behaviour (victimising) from sexually problematic behaviour (inappropriate behaviour)
- Distinguishing experimental behaviour from exploitative behaviour
- Distinguishing sexually motivated and offensive behaviour from silly behaviour (e.g. mooning)
- Distinguishing between consensual and non-consensual (or compliance and non-compliance)
- Family denial
- Family rejection
- Exclusion from education
- Precursors include neglect, lack of boundaries, attachment problems,
- Not always a victim of prior sexual abuse.

Type 3) Abuse by an adult in a position of trust

These referrals involve the rapid evaluation of risk to other children and a consideration of the employment position of the alleged perpetrator.

Commonly encountered features include:

- Disbelief by colleagues, parents and employers
- Previous unreported incidents emerge during investigation
- Complex management of confidentiality and publicity
- Containment of public and employer anxiety
- Attempts by organisation to minimise or cover up
- Feelings of guilt by the victim.

Type 4) Abuse by an organised network

These referrals often involve teenage children who have been groomed or controlled and may not be aware they are being exploited.

Commonly encountered features include:

- Victims not trusting authorities
- Victims labelled as out of control rather than at risk
- Poor mental health and self-harm
- Exclusion from education
- Frequently missing from home or care
- Victims controlled by use of public or family shaming, money, alcohol and drugs
- Victims encouraged to recruit further victims.

Type 5) Abuse by a stranger or non-family member

These referrals may be the result of online grooming or from direct contact and involve helping parents and other significant adults to protect children, who as in the previous classification, may not be aware they are being exploited.

Commonly encountered features include:

- Victims' use of social media
- Low self-esteem of victims
- Risk taking behaviour of victims.

C.7 Unconvicted and suspected offenders

People who are suspected of committing sexual offences and those who have been tried for offences and have been found not guilty by a Court pose particular challenges.

For those who have never been charged and where there are grounds to suspect they have a sexual interest in children which may lead to an offence being committed, there are limited options available. Where a Court can be persuaded that an offence is likely, then it has the power to grant a Sexual Risk Order[33] which may also include a ban on foreign travel. Local Multi Agency Public Protection Panels may also put a risk management plan in place to monitor such individuals in order to reduce their risk of offending.

People who have been brought to trial and found not guilty will sometimes proclaim their innocence, particularly those who are public figures such as entertainers, politicians and church leaders. Their protestations of innocence often include statements that they have been "cleared completely" by the Courts, whereas in strictly legal terms, the prosecution has failed to prove the case "beyond reasonable doubt", a high threshold for criminal proceedings which exceeds the "balance of probability" threshold which is applied in civil proceedings and all child protection safeguarding work. Indeed many public figures who have endured lengthy and publicly reported police investigations into suspected historic child sex abuse and who are ultimately not charged will use this declaration of innocence as a means to denigrate the police, the prosecutors and often the complainants themselves. There are cases currently being reported in the UK where former suspects are suing the Police for wrongful

[33]Sexual Risk Order — granted by a magistrate on application by the police where a conviction or caution has not been made but there is a risk of harm. Made under Part 2 of the Sexual Offences Act 2003.

investigation but also cases where suspects have been convicted of sexual offences many years after initial charges or investigations had been unsuccessful.

C.8 Offenders' cognitive distortions and defences

Offenders commonly lie and deny their offending behaviour as their first strategy, but when challenged will often rationalise their conduct in a number of ways. They will deny completely any wrongdoing and place the responsibility on the victim and investigators to provide evidence, they will minimise the extent of the offence and its harm, (sometimes in order to distract from a more serious offence) or they will justify offending based on distorted thinking.

All of these defences are important to the offender to enable him to overcome his natural internal constraints in order to begin offending and to continue by justifying his behaviour which runs counter to universal social norms concerning sex with children.

Early intervention will help to reduce the effect of distorted thinking and prevent the offending behaviour becoming entrenched and reinforced through the reward of pleasure. This principle underlies the importance of intervening positively with young offenders who will be more open to change and will enable a lifetime of sexual offending to be curtailed.

- Outright denial:
  - They are lying or fantasising
  - They want to make money out of me
  - They are suffering from a false memory
  - My ex-partner has coached her into making the allegation
  - They've got together and ganged up against me because of a grudge
- Partial denial:
  - I had no idea they would take it that way
  - I was asleep/drunk at the time and didn't know what I was doing
  - I was only trying to teach him how to hold the musical instrument/cricket bat
  - I must have been very naŢve and didn't mean any harm
  - I won't be so trusting again because it leads to trouble
- Justification:

  - The child wanted to do it and enjoyed it
  - I taught her about sex in a kind way
  - She took advantage of me
  - He had a crush on me and I didn't want to upset him

- Entitlement:

  - I deserve sex as a reward as my job is so worthy and demanding
  - God has granted me this behaviour as I am so dutiful to Him
  - I was abused as a child and so I am only doing what was done to me

Such feelings of entitlement occur elsewhere, for example a motorist who cannot drive through on a green light because a driver in front has failed to notice the lights have changed, is tempted to drive through the red light because he feels disadvantaged by the actions of the other motorist. The motorist does not consider he has committed a traffic offence in driving through the red light in these circumstances.

C.9 Case studies

Adult offenders, sexual exploitation, family incest, child on child

The following examples have been provided to demonstrate the range and variety of case types that occur, rather than to represent "typical" cases. They are all from practice experience in one London borough and have not been embroidered or altered in any way so as to give a plain description.

Adult offenders

1. Serial offender, child-like wife, sought ways to re-engage with children The offender N was convicted of indecent assault on 2 children who subsequently gave evidence as adults. N was working as an IT teacher in a London primary school where he had access to over 300 children aged between 5 and 11 years. He was seen at school by a teacher colleague to be viewing an image of a naked child on his computer monitor and this was reported to the head teacher who contacted police and children's services. A joint visit by police and a senior manager from children's services confirmed the presence of a small number of indecent images of young children on his school computer. The school's hard drives were removed for copying and further investigation and his home was searched and computers seized.

The searches revealed thousands of indecent images as well as discs containing a history of direct sexual abuse on children going back 30 years. Another disc contained stories of abusing children which were thought to be "fantasy diaries".

N admitted the offences of making indecent images of children but denied any direct contact abuse. Police investigators made extensive enquiries in the UK and other countries where N had worked in order to identify some of the victims. Five adult males were identified and acknowledged they had been abused by N when he and his wife acted as babysitters for their families. Only two of the victims were willing to make statements and give evidence against N, the others said they did not want the memories of the abuse re-awakened.

N was convicted and sentenced to four and half year's imprisonment, serving half of this. He attended sex offender treatment programmes whilst in custody and on release sought employment and activity which would have offered him further access to children.

N was required to sign the Sex Offenders Register[34] and be monitored for a period of 10 years by the local Multi Agency Public Protection Panel, (a group of agencies working alongside police specialist officers tasked with continuously assessing risk to the public from sex offenders). This panel subsequently authorised disclosure of his offending history to a Buddhist temple, a teaching staff agency and a tourist guide agency in order to allow these organisations to be able to carry out their own risk assessments. He was subsequently expelled from these groups as a result of the disclosures.

N applied for permission to travel abroad with his wife, herself a diminutive and child-like woman. This was refused and a sex offenders travel ban order issued by a court as he was considered to be a high risk of offending in other countries.

Children's services were concerned that N would continue to seek contact with children and so made an unannounced visit to his home where children's toys and games were seen, which was a concern as the couple were childless. A follow up visit by police with a software tool for determining whether a computer had been used to download indecent material resulted in N confessing he had been accessing indecent images of children on the internet. N was immediately recalled to prison to serve out the remainder of his sentence and was later convicted of further downloading offences resulting in an additional sentence.

[34] A requirement under UK legislation which enables Police and Probation Services to monitor convicted offenders through knowledge of the home address

N continues to be monitored in the area where he lives.

2. Secondary school teacher, sex with school cleaner and a student, student afraid to report, information passed to next school.

   D was a secondary school science teacher in a mixed school for pupils aged 11 to 18 years. He was an attractive, charismatic and confident man who was popular with staff and students. His teaching subject was in great demand because of a national teacher shortage for the sciences.

   Another member of teaching staff had discovered D and a 15 year old student after school hours in a classroom resources cupboard which had been locked by a key from the inside. D's explanation was that he and the pupil had been searching for equipment and denied the door had been locked. The pupil was interviewed by senior school staff and a social worker but made no complaint or allegation against D. The pupil later disclosed that D had been giving her extra tuition with regard to a forthcoming critical examination and that she had gone into the cupboard voluntarily when they were interrupted by the other staff member. The pupil refused to make a statement or be interviewed by police about the matter and it was considered in her best interests to let the matter rest until after her examinations when she would be asked again.

   D was suspended by the school pending an investigation and it was discovered that he had been flirtatious with many of the school female staff including the school cleaner who said that she was having occasional sex with him after borrowing money from him for a pressing debt.

   The pupil would not confirm that anything improper had occurred and D resigned from the school without any action being possible against him.

   D obtained another teaching appointment in another secondary school in a different district and was due to start the next term. He had not given honest details about his previous employment and so the new school did not seek a reference from his last school and were therefore unaware of the cupboard incident.

   A link made by the police that D had applied for the new teaching post was made through the school applying for a criminal conviction check. The check was clear as he had never been convicted of an offence but it triggered knowledge of the incident which was disclosed to the new school and led to their offer of employment being withdrawn.

3. School caretaker, conspiracy, community alarm.

R was a male school caretaker aged 58 who had worked in several schools in the district over the past 35 years. He was well known in the area and via the local press for decorating the garden of his school based bungalow with festive figures at Christmas time.

A woman living in Australia emailed the headteacher of her old secondary school in the UK to say that she had been sexually abused by R when he was the caretaker of that school some 30 years previously. The email was passed to the Police and Children's services who advised the headteacher to seek the woman's permission to pass the email to the authorities to respond to. The headteacher sent a supportive email to the woman who consented to the proposed action and who subsequently made a lengthy disclosure to Police in Australia who passed on her statement to the UK Police.

The UK Police sought out class contemporaries of the woman complainant who were then interviewed and three of them made similar allegations of abuse. It was determined that none of these women had retained contact with each other since leaving the school.

The caretaker was suspended and told to leave his school based bungalow accommodation. His wife and son mounted a vociferous campaign against the school and local education authority resulting in anxiety and panic amongst the school staff and local community.

Special support was given to the staff of the junior school where the caretaker had last worked and measures were taken to determine whether any of the children had been abused by R. The risk or likelihood of them having been abused was considered to be low as the children were all under the age of 11 years and were therefore always accompanied by teaching staff. The nature of the allegations against R was that he had groomed several 15 year old girls who had come to see the ponies he kept on the secondary school grounds. It was therefore thought unlikely he could have had such unsupervised access to younger children in his last school, although the possibility was never completely excluded.

R protested his innocence saying that the girls had borne him a grudge for not allowing certain privileges and that they had conspired together. Evidence of letters written between the first complainant and R produced at the trial conclusively convinced the jury of his guilt and he was sentenced to six years imprisonment. R attempted to appeal his conviction but the appeal was disallowed.

R's family never accepted his guilt and continued to hector and harass the local

education authority and some school staff. Legal action to protect individuals and to evict the family from the school accommodation was necessary.

4. Solo GP, work experience victims, airplane complainant.

   P was a General Practitioner (GP) who practised alone in a small surgery in the local area. His wife was the practice manager and nurse. He had been practising for many years and also undertook visits to the US to take part in clinical research.

   Two 14 year old girls were given short work experience placements with P at his surgery following his offer to their local secondary school. The girls were given administrative tasks in the surgery and complained to their parents that they had each been touched sexually by P.

   The Police evaluated the girls' statements and recommended to the General Medical Council that P be suspended from his general practice. P's wife began a public campaign outside of the surgery to protest her husband's innocence.

   The Police looked into P's background and discovered that several years previously he had been arrested at London airport on his return from the US as a result of a female passenger alleging that he had touched her sexually during the flight as he sat next to her. The woman complainant was due to take a connecting flight out of London and was reluctant to miss her connecting flight in order to make a formal police statement. The complaint against P was therefore not investigated nor pursued.

   This information could not be used in P's trial for the assault against the girls as it was not legally admissible and the woman complainant did not wish to resurrect the matter. However P was convicted of indecent assault and sentenced to two years imprisonment and a fine of č50 to be paid to each girl. P appealed his conviction and his barring from the medical profession unsuccessfully.

5. Dentist

   K was a local dentist with a thriving practice. He was detected by Police to have downloaded indecent images of children on his home computer.

   K was arrested and his professional association suspended him from practice.

   The images that K had downloaded were of the most serious kind as they depicted the sexual torture of young children.

   K did not have any children of his own but there was considerable concern that he had access to children in his work and that they would at times be

unconscious through anaesthetic.

K was convicted and received a nominal suspended sentence. The judge made an order banning him from treating children but remarked that he hoped this would not affect his successful business. K's professional association attempted unsuccessfully to erase his registration.

6. Teaching Assistant, previous concerns, church work, university application.

   F was a 23 year old teaching assistant working at a local secondary school. He had previously volunteered at a church youth club and his mother was a special needs teacher at another school. A friend of a 14 year old girl at his school reported that she had been told that her friend had been in a sexual relationship with F and had felt that it was not right. The 14 year old was interviewed and confirmed that she had been groomed by F over a period and that she had recently had sexual intercourse with him.

   F was arrested but not before he had been alerted through social media and he had been able to delete material on his home computer.

   The investigation discovered that there had been several occasions when the church youth club and the school could have reported F for inappropriate behaviour which would have alerted them to his sexual interest in children. The church and school managers became defensive and feared a legal action against them by the victim and her family.

   F was sentenced to four years imprisonment and on release sought to volunteer in another youth club and also applied to a youth work university course. Disclosures were made by Police to the church and university and these options were refused to him.

A sexual exploitation case

M was 15 years of age when she came to attention for going missing frequently from her family home for several days at a time. Her father was abusive to her mother and had left the home 3 years previously. M associated with older men in the local area and there were serious concerns that she was abusing alcohol and drugs and receiving these and money from these men. A risk management plan was put in place but this only served to increase professional anxiety about her risky behaviour. A Child Abduction Notice[35] was sought which named several adult males and had

[35]Granted by a court under section 2 of the Child Abduction Act 1984 which bars an adult from associating with an under 16 year old child, usually used in cases of kidnapping but relevant here to protect children from undesirable adults.

the effect of warning them not to associate with M. M continued to behave riskily and was taken into the care of Children's Services after being found in a drug user's household and alleging rape.

M was placed in a children's home under a Secure Accommodations Order[36] in a children's home in Wales, many miles distant from her home area. She resumed her education and her health and emotional well-being improved. She applied to be released from the Secure Order and was returned home eight months later whereupon she immediately resumed her risk taking behaviour with her former associates. The Child Abduction Notice was now no longer effective as M had reached the age of 16 years which is the upper limit under the Act — an anomaly with the Children Act definition of a child being up to the age of 18 years.

M continued to lead a chaotic and troubled life and her suspected existence through prostitution and pornography was confirmed. She became pregnant at 17 and decided to see the pregnancy through. She was placed in a highly nurturing mother and baby unit some distance from her home where she gave birth and was successfully re-housed with her child.

A family sex abuse case

T was a 13 year old girl who lived with her twin brother, her older brother and mother and father. The father appeared to be quiet and unremarkable and was employed; the mother was a chronic user of alcohol and she later died. T disclosed that her father had been sexually abusing her to the extent of full sexual intercourse for several years. He had also forced T and her twin brother to have sex together. The twins were removed from their home and placed in separate children's homes and the father was charged with several serious sexual offences. The father was required to live separately from his wife and older son and it transpired that he had been sadistically sexually abusing his wife throughout their marriage.

T's fury at her father led her to exaggerate and fabricate some of the evidence she gave against him, which led to him being found not guilty of all of the charges.

T grew up despondent and angry seeking the affection of strangers through sexual contact. T openly prostituted herself and became addicted to alcohol and drugs. She subsequently had several babies all of which were removed by Children's Services owing to the inability of T to safely care for them.

T's twin brother managed to complete his education and became a youth worker.

[36]Made under the Secure Accommodation Regulations 1991 and which satisfy section 25 of the Children Act 1989 where a child can be deprived of their liberty if they are at serious risk of harm to themselves or others.

A child on child case

J was an able 15 year old boy who had come to his school's attention over the previous 2 years for a number of incidents which were; touching a girl's breasts, making simulated sex noises in class, "humping" or simulating dry sex with a girl, and being found in the girls' toilets.

A was a 14 year old Eastern European girl with low self-esteem at the same school who had an interest in J and who had previously given him oral sex in a local park.

J persuaded A by text to meet him and 3 other boys in the school toilets where she was encouraged to provide all 4 boys with oral sex in turn.

The incident resulted in A being bullied by other girls and she left the school and her family moved to a different area.

The 4 boys were known to the police for being gang members involved in criminal activities. Their parents refused to co-operate with the school or children's services. The police could not investigate the incident as A said that she had acted willingly in an effort to please J.

There were concerns that A might have been particularly vulnerable as it had been suspected that she had been sexually abused by adults whilst in homeless person's accommodation upon arrival to the UK.

The girl's behaviour was thought to be sexually problematic behaviour (inappropriate) in relation to her willingness and the boys' was considered to be sexually harmful behaviour (victimising) due to the coercive and exploitative nature.

C.10 Issues for practitioners

Practitioners are advised to be aware of many factors which although not exclusive, are strongly connected to sex offenders.

- The scale and extent of offending is not accurately known but is likely to be vast
- The details of the offence must be obtained from official sources and not from the offender or their family
- Offenders commonly admit lower order offences to conceal more serious ones
- Offenders groom the protective adults first
- Half of all offenders don't have a gender preference and many will offend against both sexes and all ages

- Non-contact internet offences doesn't imply contact offences haven't already happened
- Women are also sex offenders, but often because of a chaotic lifestyle, are ill, are manipulated by a male or because they have been victimised
- Offenders often have a distorted sexual development so change is unlikely to be easy
- Most offenders aim to please their victims as well as control them
- Offenders lie, so best to approach with "healthy scepticism" and "respectful uncertainty"[37]
- A systematic assessment of risk is far better than gut instinct.

C.11 How failures can occur

Lack of experience and confidence amongst professionals:

> Almost all cases of adult child sex offenders have features where previous concerning behaviour had been noted by colleagues or family members and where these concerns were not acted upon. With child offenders the situation is more complex as many behaviours might be better judged as inappropriate, problematic or just silly. Offenders know that they are more likely to go undetected if they groom protective adults before attempting to groom and abuse a child. Behaviour such as gradually pushing boundaries in relation to contact with children to suggest that they are trustworthy might be the offender testing what he is able to get away with. Reporting a colleague for worrying behaviour is a big step for many staff who may be junior to the suspect and who may not have had any training. Reporting a child and risking labelling them a sex offender is a difficult decision.

Professionals and employers relying on offence information from offenders:

> Offenders are often highly skilled at presenting the details of their offence in the most positive and minimal light. Crucial details such as the true age of the victim, the use of coercion or substances, and the premeditated nature of the offence are rarely volunteered and professionals and employers can be persuaded to give the offender a second chance.

[37] Lord Laming in his report The Victoria Climbie Inquiry, 2003

Misplaced sympathy, rule of optimism:

> Most people including trained professionals are naturally sympathetic and wish to see the best in others to the extent that their judgement can be affected when dealing with cases. Nobody would want a family unit to be destroyed through an unfounded allegation of abuse. Offenders are skilled at portraying themselves as the victim and attracting a sympathetic and therefore an inadequate response from the employer, investigator or assessor. This is true even for the Courts in the UK as in the case of the dentist above where the judge expressed the hope that he could continue to practice, a comment that may have helped him successfully appeal against erasure from his professional register.

Arrogance of employers, church, institutions, BBC:

> Large organisations have traditionally thought themselves capable of dealing with internal problems due to their inflated view of their own abilities and because of the reputational harm that would ensue if the matter was passed to external authorities. The history of sexual abuse of children by members of the clergy does not need any repetition here and the recent UK experience of the BBC in the UK which failed to control Jimmy Savile over many decades is an example of where even the most reputable of organisations can fail absolutely.

Poor employment practices:

> Although good employment practice should prevent individuals from resigning during investigations into misconduct, it still commonly occurs, even in organisations such as the Police where the practice is allowed in "exceptional cases". Similarly, employers are often tempted to avoid an investigation altogether on the basis that a "compromise agreement" is reached with the employee suspected of abuse. This serves the employer well in avoiding bad publicity and potential costs, but is at the expense of future victims. The current practice of not providing meaningful references to future employers other than to confirm dates of employment can also serve to protect abusers from exposure. There is no mandatory duty to report suspected abuse as already discussed and this remains a disputed issue amongst safeguarding experts in the UK.

C.12 Recommendations for future management

There have been many recent examples of sound action to improve the performance of professional staff such as better training and tighter regulatory frameworks. How-

ever this has inadvertently served to increase the burden and workload on these groups which has resulted in referral thresholds rising unacceptably and delays and oversights occurring.

Several high profile investigations in the UK have also led to the whole system being discredited by the press in the eyes of the public through very lengthy police investigations which at their conclusion led to no prosecution. The Independent Inquiry into Child Sexual Abuse is currently struggling to continue its work having suffered the loss of its first three chairpersons and the withdrawal of victims' groups and a series of senior legal resignations.

Commentators have said that making incremental changes and additions to an already over complex system is unlikely to work and that a total reform and redesign process is required. This is most unlikely to occur soon in the UK where the current preoccupation is on the withdrawal from the EU and the associated economic issues.

In a similar way, calls to make reporting of suspected abuse mandatory and for court procedures to be improved will be ineffective if the agencies and courts are not well enough resourced to implement the changes fully.

Alternative and practical suggestions to improve the effectiveness of the overall system should include leaders in central and local government and the professions giving firm direction to the need to protect children more actively. The novelty of the realisation of the extent of child sexual abuse has begun to fade in recent years with the result that an assumption has been made that everything is under control; this needs to be urgently re-addressed.

The government looked thoroughly into the need for change in the Munro Report which amongst many recommendations promoted the importance of early intervention through early help to families under pressure. This is an important principle and highly relevant to child sexual abuse prevention but one where double funding streams would be required to ensure the present arrangements can be maintained whilst the changeover to a preventative rather that reactive system is implemented.

Austerity measures, currently in place in the UK, have been shown to have an undue impact on the most vulnerable members of society which largely features women and children. It is hoped that a possible future change of policy will result in greater investment in quality staff and services which can operate a well-designed if not highly complex system. Investing in and promoting the status of the services that operate the system will result in better performance and morale.

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