Dimensions and Precedential Constraint: Factors Deriving from Multiple Dimensions

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Abstract. Current theories of precedential constraint attempt to incorporate dimensions into the reasons for decisions. We argue that this is an unnecessary complication, and precedential constraint can be handled using only factors. In our account the role of dimensions is to organise facts, and their effect operates at the factor ascription level, prior to precedential constraint being applied.

Keywords. Precedential Constraint, Factors, Dimensions

1. Introduction

Giving a formal account of precedential constraint has become an important topic in AI and Law since Horty's work in [8], later expanded in [12]. These papers importantly introduced the *reason* model. The idea behind this model is that the reason for deciding a particular case for a particular side is a conjunction of factors[1] favouring that side. The strongest reason for a side is the full set of factors favouring that side, and precedents show that the set of factors favouring the winning side was a stronger reason than the set of factors favouring the losing side. If we use the full set of factors for each side, as in [15] and [2], we have the *results* model. But it may well be that the winning side did not need *all* of its factors: if we allow the reason to be a subset of its factors (still stronger than the full set of factors for the losing side), we have the reason model. Clearly the reason model provides a stronger constraint than the results model. Some improvements to the account in [12] were suggested in [16].

Factors, however, do not tell the whole story. Factors in CATO [1] derive from the dimensions of HYPO [18]. Dimensions are aspects of a case which can take a range of values. One end will be most favourable to the plaintiff, the other most favourable to the defendant. Depending on the point on the range therefore, either side may be favoured, or neither may be favoured. If the point does favour

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[1]Factors have become a staple of case based reasoning since their introduction in CATO [1]. They are usually described as stereotypical patterns of fact that provide a reason to decide for one or other of the parties to the dispute. A factor always favours a particular side, and always favours the same side.
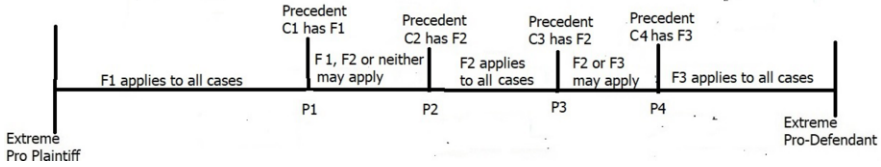
Figure 1. Dimension with three factors; F1 is pro-plaintiff, F2 is weakly pro-defendant and F3 is strongly pro-defendant. P1-4 are points on the dimension occupied by the precedents C1-4. F1 is present in C1, F2 in C2 and C3, and F3 in C4. The factors applicable in ranges P1-P2 and P2-P3 are not determined by C1-4.

a particular party (as shown in a precedent), then a factor favouring that side is considered present. Thus factors correspond to ranges on a dimension. In some cases, several distinct factors for a given side, with varying strengths, may be on a dimension. The relation between dimensions and factors is shown in Figure 1.

Clearly this notion of being favoured to different degrees is important. In 2017 Horty attempted to include dimensions into his reason model of precedential constraint, first reported in [9] and later expanded into [10]. This account was critiqued by Rigoni in [17]. Horty responded with a modified model in [11]. This line of work is summarised, and approaches compared, in [14].

What is common to all these approaches is that dimensions (or factors with magnitude) are included, along with factors, as part of the sets of reasons for deciding for a party. In this paper we shall argue that this is unnecessary, and that reasons should comprise *only* factors, ascribed on the basis of facts expressed in terms of dimensions. Dimensions are important, but their importance is cashed out into factors *before* the precedential constraints are applied.

In Section 2 we will provide an example, introduced in [15] and the main example of [10], which we will use throughout the paper. Section 3 argues that dimensions should not be considered as special types of factors, and so should not form part of the reasons. Section 4 suggests how factors relating to multiple dimensions should be treated and Section 5 offers some concluding remarks.

2. The Fiscal Domicile Example

The fiscal domicile example originates in [15], "the issue is whether a stay in another country changes one's fiscal domicile with respect to income tax". One consideration was the length of absence, which was mapped into two factors, the pro-change *longStay* and the con-change *shortStay*, in the manner of Figure 1. But, as observed by Horty in [10], "if several dimensions are present, strength along one dimension can be traded off for strength along another." Horty suggested that in the fiscal domicile example "another relevant dimension might be the percentage of the individual's income derived from organizations based in the foreign country, with particular percentages as values and larger percentages favoring change of domicile." Now it might be that a long absence may allow a small percentage, which would, with a shorter absence, be a reason to decide *no change*. This means that particular points on the dimension cannot be associated with a reason for a particular side, and so cannot be mapped into factors in the manner of Figure 1.

This problem has led to several ways of incorporating dimensions/factors with magnitude into the reason model. The approaches are summarised in [14]. The fiscal domicile example has been central to the subsequent discussions, and is what we will use in this paper.

3. Why Dimensions Are Not Reasons

Our view is that incorporating dimensions into the reasons is not the best approach. We have discussed elsewhere the idea that reasoning with a legal case falls into several stages. As argued in [5] and [7], deciding a legal case involves a sequence of stages:

- accepting facts on the basis of the evidence
- ascribing factors on the basis of the facts
- resolving the issues on the basis of the factors
- deciding the outcome of the basis of the issues.

Our view is that dimensions and factors with magnitude belong to the second, factor ascription, stage, whereas precedential constraint is concerned with the third stage, where factors, and only factors, are used to resolve issues[2].

Dimensions are quite distinct from factors in a variety of ways:

- A key characteristic of a factor is that it *always* provides a reason for a *particular* side, always the *same* side. In contrast, an absence of 12 months may favour change for high percentages, no change for low percentages, and perhaps even neither side for some medium percentages.
- Dimensions suggest a continuous increase in the favouring of a side. But *de minimis non curat lex* - the law does not concern itself with trifles. Factors enable us to distinguish *significant* differences on the dimension from insignificant ones. If we do want to indicate a significant difference in strength, we use a different factor. Thus in CATO it does not strengthen the defendant's case if there have been a hundred disclosures rather than a dozen. But it does strengthen the case if the information is in the public domain. So we have two (and only two) factors on the disclosure dimension: *Secrets-Disclosed-Outsiders* and *Disclosure-In-Public-Forum* [1].
- Ascribing a factor involves a legal judgement, that the pattern of facts does provide a reason to decide for a particular party. Saying that there has been an absence of 24 months is simply to state a fact of the case. Saying that 24 months absence, in the context of the income percentage, provides a reason, is the sort of legal judgement we associate with ascribing a factor.
- Pragmatically, precedential constraint of issues in terms of factors provides a straightforward account. Trying to incorporate dimensions adds complexity and creates problems (such as the collapse of the reason and results models in [10]). There seems no reason to seek out such complications when a simpler solution exists.

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[2]The accounts of precedential constraint described above jump straight from factors to outcome. The problems with this, and the reason why precedential constraint should be applied at the issue level, are discussed in [4].

Dimensions, in our view, belong entirely to the second stage of reasoning with cases, the move from facts to factors. Dimensions provide a way of organising the facts of the case, as described in [6]: they provide the attributes of a case for which we need to supply values. In terms of an entity-attribute-value representation, we have case-dimension-point.

Thus we see absence of a certain duration and income of a certain percentage as *facts* of the case, for which we use to ascribe factors to show their legal significance, if any, before we can move to the next stage and apply precedential constraint to resolve issues.

If a factor relates to a single dimension, there is no problem: we just use the method shown in Figure 1. But, as noted in [9], there are problems if we try to apply this when there are multiple interacting dimensions, as in the fiscal domicile example. In the next section we will explain how such cases can be handled.

4. Factors Relating to Multiple Dimensions

A solution to the problem was sketched in [3] and modelled using argumentation schemes in [5]. The idea is simply that whereas a single dimension provides a line on which certain ranges correspond to factors, two dimensions provide a two-dimensional space, in which *areas* correspond to factors. The factor itself is not absence or percentage, but *SufficientPercentageGivenAbsence*. After all, this is the reason why the case favours change, not the particular percentage or the particular absence. Precedent cases will show in which area certain points lie, and so indicate areas in which the factor is known to apply and not apply. Between such areas will be an, as yet, undecided area: cases falling here must be argued, and will then provide precedents to further tighten the bounds.

This is, however, not the whole story. A trivial absence, say 1 month, will never be sufficient, whatever the level of income. So we will have another factor, based on absence alone, which is a reason against change, *InsuffientAbsence*. Similarly a sufficiently long absence may in itself be a reason for change, suggesting a pro-change factor *SufficientAbsence*. Note, however, that only one of *SufficientPercentageGivenAbsence InsuffientAbsence*, and *SufficientAbsence* will apply in a given case. This exclusivity of factors is not novel, but also featured in CATO, where, for example, *Secrets-Disclosed-Outsiders* and *Disclosure-In-Public-Forum* were barred from applying to the same case [1]. If a stronger factor on a dimension applies, the weaker must be excluded to avoid double counting. Similar factors may be provided on the income percentage dimension. The point is that a pair of dimensions may give rise to several factors.

This does raise the possibility of both the pro-change *SufficientAbsence* and the con-change *InsufficientPercentage* applying in a case. These are just factors from single, different, dimensions, and will be resolved using a preference between the factors, in the usual way.

The complete picture is shown in Figure 2. We have six factors, three pro-change, *SufficientPercentageGivenAbsence SufficientAbsence* and *SufficientPercentage* and three con-change, *InsufficientPercentageGivenAbsence*, *InsuffientAbsence* and *InsufficientPercentage*. They apply to the areas in Figure 2 as follows:
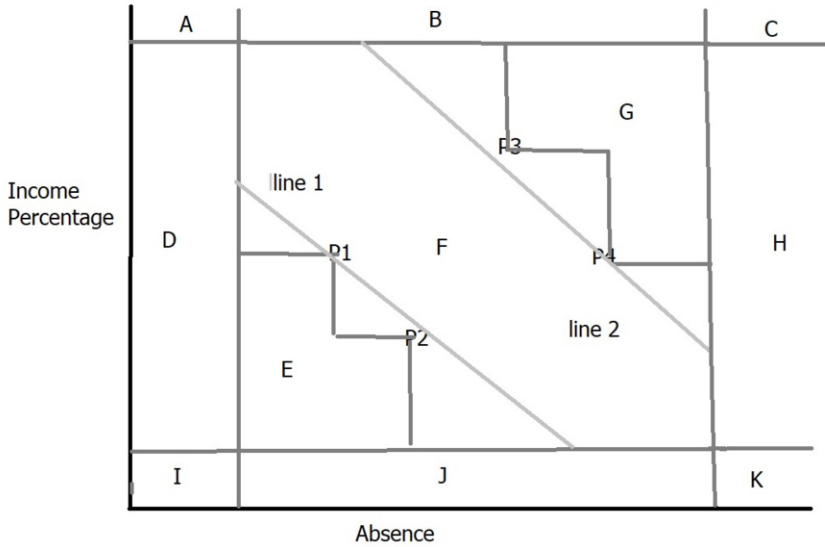
Figure 2. Factors associated with the dimensions absence and income percentage. P1 and P2 are precedents for no change and P3 and P4 are precedents for change.

A Both *InsuffientAbsence* and *SufficientPercentage* apply. Reasons for both sides so preference between the factors must be expressed if such a case arises.

B *SufficientPercentage* applies. Reason pro-change.

C Both *SufficientPercentage* and *SufficientAbsence* apply. Two reasons pro-change. Either or both may form the reason in the precedent.

D *InsuffientAbsence* applies. Reason con-change.

E *InsufficientPercentageGivenAbsence* applies, as determined by precedents P1 and P2. Reason con-change.

F Area as yet undetermined and it must be argued whether *InsufficientPercentageGivenAbsence* or *SufficientPercentageGivenAbsence* applies. Line 1 represents a strongly con-change interpretation and line 2 a strongly pro-change interpretation of the four precedents.

G *SufficientPercentageGivenAbsence* applies, as determined by precedents P3 and P4. Reason pro-change.

H *SufficientAbsence* applies. Reason pro-change.

I Both *InsufficientPercentage* and *InsufficientAbsence* apply. Two reasons con-change. Either or both may form the reason in the precedent.

J *InsufficientPercentage* applies. Reason con-change.

K Both *InsufficientPercentage* and *SufficientAbsence* apply. Reasons for both sides so preference between the factors must be expressed if such a case arises.

Thus all necessary trade-offs and balancing between related dimensions can take place at the factor ascription level, allowing the precedential constraint to be determined solely in terms of factors.

5. Concluding Remarks

In this short paper we have shown that it is unnecessary to incorporate dimensions into the reasons used in formalising precedential constraint: it is sufficient to use only factors as in [12], offering a simpler option.

Moreover we argue that restricting dimensions to the the level of facts used in ascribing factors is more faithful to the process of legal reasoning with cases. Many precedents concern factor ascription rather than preferences between sets of factors [13], and so to ignore this stage misrepresents such precedents.

Although we have discussed only factors related to two dimensions, it can be straightforwardly generalised, so that three dimensions give rise to a three dimensional space with factors occupying volumes and so on.

References

[1]   Vincent Aleven. *Teaching case-based argumentation through a model and examples*. Ph.d. thesis, University of Pittsburgh, 1997.

[2]   Trevor Bench-Capon. Some observations on modelling case based reasoning with formal argument models. In *Proceedings of the 7th ICAIL*, pages 36–42, 1999.

[3]   Trevor Bench-Capon and Katie Atkinson. Dimensions and values for legal CBR. In *Proceedings of JURIX 2017*, pages 27–32, 2017.

[4]   Trevor Bench-Capon and Katie Atkinson. Precedential constraint: The role of issues. In *Proceedings of the 18th ICAIL*, pages 12–21, 2021.

[5]   Trevor Bench-Capon and Katie Atkinson. Using argumentation schemes to model legal reasoning. *arXiv preprint arXiv:2210.00315. Presented at the 4th European Conference on Argumentation*, 2022.

[6]   Trevor Bench-Capon and Floris Bex. Cases and stories, dimensions and scripts. In *JURIX*, pages 11–20, 2015.

[7]   Joe Collenette, Katie Atkinson, and Trevor Bench-Capon. Explainable AI tools for legal reasoning about cases: A study on the European Court of Human Rights. *Artificial Intelligence*, page 103861, 2023.

[8]   John F Horty. Reasons and precedent. In *Proceedings of the 13th ICAIL*, pages 41–50, 2011.

[9]   John F Horty. Reasoning with dimensions and magnitudes. In *Proceedings of the 16th ICAIL*, pages 109–118, 2017.

[10] John F Horty. Reasoning with dimensions and magnitudes. *AI and Law*, 27(3):309–345, 2019.

[11] John F Horty. Modifying the reason model. *AI and Law*, 29:271–285, 2021.

[12] John F Horty and Trevor Bench-Capon. A factor-based definition of precedential constraint. *AI and Law*, 20(2):181–214, 2012.

[13] Jack Mumford, Katie Atkinson, and Trevor Bench-Capon. Explaining factor ascription. In *Proceedings of JURIX 2021*, pages 191–196, 2021.

[14] Henry Prakken. A formal analysis of some factor-and precedent-based accounts of precedential constraint. *AI and Law*, 29(4):559–585, 2021.

[15] Henry Prakken and Giovanni Sartor. Modelling reasoning with precedents in a formal dialogue game. *AI and Law*, 6:231–287, 1998.

[16] Adam Rigoni. An improved factor based approach to precedential constraint. *AI and Law*, 23:133–160, 2015.

[17] Adam Rigoni. Representing dimensions within the reason model of precedent. *AI and Law*, 26:1–22, 2018.

[18] Edwina L Rissland and Kevin D Ashley. A case-based system for Trade Secrets law. In *Proceedings of the 1st ICAIL*, pages 60–66. ACM, 1987.