Summary of Received Reviews and Comments

Reviews superseded by other reviews are shown in the grey color in the table. All times are GMT.

	date	PC member	subreviewer	Overall evaluation	Reviewer's confidence	Relevance of the paper to KR	Novelty	Significance	Technical quality	Discussion of related work	Quality of the presentation	Report from the field	If not accepted consider the...	Nomination for Ray Reiter...	Nomination for Marco Cadoli...
Review 1	Dec 26	Aniello Murano	Vadim Malvone	**-2**	**3**	3	3	2	3	1	4	1	1	1	1
Review 2	Dec 30	Francesco Belardinelli		**1**	**4**	4	4	3	4	4	4	1	2	1	1
Review 3	Jan 1	Thomas Ågotnes		**1**	**4**	4	3	3	5	3	5	1	2	1	1
Author response	Jan 7														
Comment 1	Jan 7	Gerhard Lakemeyer													
Comment 2	Jan 8	Francesco Belardinelli													

Reviews and Comments

Review 1	
PC member:	Aniello Murano
Reviewer:	Vadim Malvone <vadim.malvone@unina.it>
Overall evaluation:	**-2**: (reject)

Reviewer's confidence:	**3**: (medium)
Relevance of the paper to KR:	3: (fair)
Novelty:	3: (fair)
Significance:	2: (poor)
Technical quality:	3: (fair)
Discussion of related work:	1: (very poor)
Quality of the presentation:	4: (good)
Report from the field:	1: (No)
If not accepted consider the paper as a short paper:	1: (No)
Nomination for Ray Reiter Best Paper Award:	1: (No)
Nomination for Marco Cadoli Best Student Paper Award:	1: (No)
Review:	SUMMARY: This article studies hedonic games with dichotomous preferences. Hedonic games are cooperative games in which players desire to form coalitions (their particular desires are represented as a preference relation over coalitions). In hedonic games there are no explicit payoffs, as it is assumed that the benefit to a player is membership (in a coalition) itself. Dichotomous preferences means that each player divides the set of coalitions in which it occurs into two groups: satisfactory and unsatisfactory. After the definition of the game, the authors describe a series of solution concepts, including the concepts of Pareto-optimal and Nash-stable. Then the authors introduce a simple propositional logic that can be used to represent dichotomous preferences and express various solution concepts. EVALUATION:

The mathematics in this article is easy to follow, but the motivations and justifications are either hard to follow or missing.

In detail:

1. The paper does not justify hedonic games (irrespective of whether the preferences are dichotomous). Why are these games interesting?
Typically, one forms a coalition because one has some -other- goal in mind, and certain coalitions can help or hinder this other goal. How are hedonic games related to such scenarios? On the other hand, according to "On coalition formation games" by Hajdukova (2004), there are scenarios where it is not feasible to specify payoffs (for specific coalitions, or for agents in particular coalitions). E.g., individuals joining sports clubs. Hedonic games are those coalition formation games in which each agent forms preferences of coalitions in which he himself is involved. Then, hedonic games with dichotomous preferences are a further restriction (which the authors justify in the search for simplifications of hedonic games that can be compactly represented). If there is a strong justification for coalition formation games or hedonic games, the authors could make the case, or reference an exact place in a previously published paper where such a case is made.
Moreover, it would be highly desirable to have a good example from game-theory or MAS literature for hedonic games with dichotomous preferences (the authors have a running example to assist the reader in understanding the concepts, but no example for justifying the objects of study). Perhaps some version of the stable-marriage problem can be fruitfully viewed as an hedonic game with dichotomous preferences?

2. The authors do not sufficiently express the importance of their representation.
The main results of the paper show that one can express certain solution concepts for hedonic games with dichotomous preferences in a propositional logic. The authors do not say whether or not some other formalism for reasoning about games already exists for reasoning about these concepts (various "strategy logics" have been introduced in the last few years...connections with these should be, at the very least, mentioned).
Also, the authors say that SAT-solvers can be used to analyse these games since many solution concepts are expressible in their propositional logic. However, to lend weight to this argument (i.e., that there representation is significant because one can apply SAT solvers to it), the authors should further discuss or cite work about the computational complexity of the decision problems at hand.
E.g., some of the solution concepts are known to be NP-complete under various representations ("Core Stability in Hedonic Coalition Formation", Woeginger, 2013).
E.g., there are missing words in the conclusion, paragraph 3, which makes it hard to understand exactly how the work (Peters 2016a/b) relates to the propositional-logic representation, or whether this representation has any advantages over the ones cited in (Peters 2016a/b).

3. As the previous points suggest, the related work section is very sketchy, which makes it very hard to judge this paper in context. Here are some further examples.
E.g., the connection with (Bonzon, et al. 2012) is unclear. Can the present work be used to reason about the games in (Bonzon, et al. 2012)? The authors simply state that (Bonzon, et al. 2012) is about efficient

	coalitions in Boolean games and say that their work "shares some common ground". E.g., the authors cite (Dreze and Greenberg, 1980) for the notion of hedonic. However, the games in (Dreze and Greenberg, 1980) look very different from the hedonic games of this paper (each agent has a consumption set X of reals for some good). What is the relationship? E.g., (Peters, 2016) represents hedonic games with dichotomous preferences using different atomic propositions (i.e., one for each agent, rather than one for each pair of agents). The implication/relevance of this should be discussed.
Confidential remarks for the program committee:	
Time:	Dec 26, 22:58
Review 2	
PC member:	Francesco Belardinelli
Overall evaluation:	**1**: (weak accept)
Reviewer's confidence:	**4**: (high)
Relevance of the paper to KR:	4: (good)
Novelty:	4: (good)
Significance:	3: (fair)
Technical quality:	4: (good)
Discussion of related work:	4: (good)
Quality of the presentation:	4: (good)
Report from the field:	1: (No)
If not accepted consider the paper as a short paper:	2: (Yes)
Nomination for Ray Reiter Best Paper Award:	1: (No)
Nomination for Marco	1: (No)

Cadoli Best Student Paper Award:	
Review:	This paper hinges on hedonic games with dichotomous preferences, that is, cooperative games where players desire to form coalitions and the players' preferences are structures binarily (they are either satisfied or unsatisfied by the coalition they end up in.) The original contribution of the paper consists in showing that some solution concepts in this class of games can be characterised by propositional formulas. In turn this paves the way for the use of SAT solvers to analyse the features of hedonic games. Relevance The paper fits within the broad category of Game Theory and Social (Rational) Choice Theory, therefore is it somewhat relevant for KR, even though the subject does not directly deal with knowledge representation (unless a really broad sense of knowledge is considered.) Novelty The contribution is certainly novel. It might not be ground-breaking, but it is certainly non-trivial and advances the state of the art. Particularly interesting from my perspective is the link with logic and the possibility to use SAT solvers to solve questions in Game Theory. Significance The charaterisation of solutions concepts by means of propositional formulas is of interest for the reasons spelt out by the authors on p. 6. Namely, characterisations + SAT solvers allow to look for and check partitions satisfying a number of different criteria. However, on this point we'd like to hear more from the authors. Hedonic games are unquestionably of interest, as these arise in many different areas (economics, game theory, etc.); while the restriction to dichotomous preferences is less clear. Noticeably, the paper lacks a compelling example of dichotomous preferences in hedonic games and this hinders the significance of the contribution in my opinion. What would be an interest case of dichotomous preferences in hedonic games in real life? Without such a use case the paper risks to be an exercise, although interesting and non-trivial, on the application of logical tools to Game Theory. I would be grateful to the authors if they elaborate on this point in the rebuttal phase.

	Technical Quality The technical quality of the paper correspond to the standards of a high-quality conference such as KR. The results provided in the paper appear to be technically sound. Full proofs are provided. I've checked some details and was not able to find any apparent mistake. Hereafter I consider some specific points related to the paper. It looks like dichotomous preferences correspond to a bipartite-graph structure on the preference relation. Are the authors aware of any particular feature of bipartite graphs that can be used computationally on dichotomous preferences? The manipulation of boolean assignments reminds me of the Dynamic Logic of Propositional Assignment (DLPA). Indeed, DLPA has already been used to represent the preservation of formulas under boolean reinterpretation, for instance in Argumentation Theory (paper by Herzig et al in KR2014). It seems to me that something similar is going on here and probably the authors are well aware of this relationship. Discussion of Related Work The related work is discussed in depth. It is obvious that the authors have a profound knowledge of the current research in this area. All relevant contributions are compared and different accounts for the representation of various classes of hedonic games are contrasted with the proposed approach. Quality of Presentation The paper is well-written and well-referenced. All background notions are clearly introduced in the preliminaries, thus making the paper accessible to a non-expert audience. The examples are really useful to illustrate the various notions and solutions concepts. Minor points and typos p. 3 lx, l. -3: there is a strange sequence of characters.
Confidential remarks for the program committee:	
Time:	Dec 30, 10:53

Review 3

PC member:	Thomas Ågotnes
Overall evaluation:	**1**: (weak accept)
Reviewer's confidence:	**4**: (high)
Relevance of the paper to KR:	4: (good)
Novelty:	3: (fair)
Significance:	3: (fair)
Technical quality:	5: (excellent)
Discussion of related work:	3: (fair)
Quality of the presentation:	5: (excellent)
Report from the field:	1: (No)
If not accepted consider the paper as a short paper:	2: (Yes)
Nomination for Ray Reiter Best Paper Award:	1: (No)
Nomination for Marco Cadoli Best Student Paper Award:	1: (No)
Review:	The topic of the paper is coalition formation. It studies a setting where agents have preferences (only) over the coalitions they join (i.e., over which other members they contain) - so called hedonic games - and, furthermore, where these preferences form two equivalence classes - dichotomous hedonic games. The paper shows how formal logic can be used to represent (preferences in) such games, arguing that this gives more succinct representations. Key results are logical characterisations of solution concepts for hedonic games, for the special case of dichotomous hedonic games. Hedonic games have been of some interest in KR related fields recently. More generally, coalition formation as well as the logical formalisation of game theoretic solution concepts, have been of broad interest in the AI community for some years now. An example is Boolean games, to which the formalism in the current paper is closely related. I find the setting well motivated: hedonic games are of interests to

researchers in our field, and dichotomous preferences are very common not only in AI/KR but also in other fields (as the authors argue).

The paper is very well written. Technical details are clear and well defined (with some minor exceptions, see below), and the results seem to be sound.

The results of the paper are not very surprising. Indeed, everything is finite, and it is a relatively straightforward exercise to encode preference relations and solution concepts in propositional logic. Still, the paper does it in a careful and detailed way, taking care of all subtleties, which I think could be of value. For me, the main contribution of the paper is that it demonstrates exactly and in detail how a standard SAT solver can be used to solve key problems involving solutions concepts for dichotomous hedonic games (I encourage the authors to make this more explicit in the abstract).

On the more negative side are the following concerns.

- Boolean hedonic games are presented (e.g., in the abstract) as a part of the novel contributions of the paper. However, they are already used in (at least) (Peters 2016a).

- The authors claim (already in the abstract) that they "develop a succinct representation for such games". However, that Boolean hedonic games is a more succinct than other representations is not substantiated by the results in the paper.

- When it comes to related work, I would have liked to see a better comparison with other representations of hedonic games on the one hand, and with (Elkind and Wooldridge 2009) on the other.

In sum, I think the paper has valuable contributions, if perhaps a little on the weak side in particular in light of other recent work on hedonic games (e.g., Peters). It seems to me that there is an opportunity to make the specifications of solution concepts more succinct by considering a more sophisticated language.

Some more minor remarks:

- p. 2, "for S a coalition in partition \pi_{-T}": this is not a partition (according to the definition given above). Same further down.

- p. 4, "We write ... L_i for ... L_{\{i\}}": at this point in the paper, the only definition of L_{\{i\}} is found by taking N to be \{i\} in the definition of L_N above. But then L_{\{i\}} becomes the emtpy language. By reading further down I realise that you must mean the new definition of L_S for a general set S. First of all, this should be defined first, and second, it is confusing that you use the same notation for different things.

- Proof of prop. 1, "(A0) and (A1) ensure that..": and MP!

	- p. 4, def of trans: ijk should be different. - p. 6, "By T-separating Boolean vector..": something wrong with this sentence. - Lemma 3: why is the game given here, it does not play any role. - p. 6, "In the remainder of this section...": something wrong with this sentence. - Proposition 3: why "let i be a player with goal \gamma"? i's goal is already given. - p. 7, "Algorithms for computing..": something wrong with this sentence. - p. 9, "existence of partition.." -> partitions - p. 9, "he shows that all..": something wrong with this sentence. - p. 9, "first version of our paper": better to cite it properly or not at all. - Acknowledgments, thanks to the three anonymous reviewers for their "valuable remarks": I am very impressed by the clairvoyance. You are welcome! :-)
Confidential remarks for the program committee:	
Time:	Jan 01, 05:21

Response Letter	
Response:	We thank the reviewers for their useful and constructive comments. REVIEW 1 Hedonic games: These are a popular game theoretic model used to capture many social, political, and economic group formation scenarios, and can be seen as a generalization of the stable marriage setting. We will elaborate on it in the paper. Please see the paper by Bogomolnaia and Jackson for further motivation. Dichotomous preferences are prevalent everywhere such matching/allocation (see e.g. paper by Bogomolnaia, Moulin, and Stong 2005), and voting (approval). Relationship to work by Peters: Our work in fact predates that of Peters, as an earlier version was presented at the LOFT 2014 workshop. It was the starting point of Peters's work, as he clearly acknowledges in his AAAI-16 paper. The goal of our work to circumvent computational hardness result by making it possible to use SAT solvers, and hence is different from other works including Peters's.

Relationship to stable marriage: Hedonic games are a *generalisation* of 2-sided matching problems, with a much richer structure. Our game model could certainly be used to capture a class of matching problems, but it is not clear what the value would be - this is not the main thrust of our work.

The connection to Bonzon et al. and more generally to standard Boolean games lies only in the fact that players' preferences are dichotomous and represented succinctly by propositional formulas. Because there are no explicit actions in our setting, it is impossible to use it to reason about Boolean games. Note that Boolean hedonic games are not a generalization of standard Boolean games.

Our work is the only logical framework (as far as we know) for reasoning about hedonic games. Strategy logics are far enough from our setting (which has no explicit actions nor strategies).

REVIEW 2

Dichotomous preferences apply to various scenarios in which agents may deem outcomes as acceptable or unacceptable. This may even work for general preferences where agents impose a minimum threshold for happiness. Also, hedonic games are a generalization of matching with two-sided preferences, where dichotomous preferences are considered important as witnessed by some important papers, e.g., Bogomolnaia and Moulin (Econometrica 2004).

Because dichotomous preferences may make use of complex formulas involving conjunctions, disjunctions and negations, it is unlikely that we'll find interesting features of bipartite graphs that can be used computationally on dichotomous preferences.

DPLA shares some common point with standard Boolean games (through the control assignment function) but again, agents do not perform any assignments nor any kind of explicit actions in our hedonic game setting.

REVIEW 3

Peters (2016): see our answer to Review 1.

As the number of coalitions including a given player is exponential in the number of all players, many succinct representations have been proposed for hedonic games. Boolean hedonic games provide another way of succinctly representing hedonic games.

Hedonic Coalition Nets of (Elkind and Wooldridge, 2009) certainly have a family resemblance to our work, but are intended for modelling arbitrary hedonic games, rather than hedonic games with dichotomous preferences. The "logic" component of HC-nets is simply using Boolean conditions on rules, and the logical aspects of HC-nets were not developed nearly so deeply as our formalism.

Time:	Jan 07, 11:30 GMT

Comment 1	
PC member:	Gerhard Lakemeyer
Comment:	Dear All, please, have a look at each others' reviews and the author response and start a discussion. Have your opinions about the paper changed? Best, Gerhard
Time:	Jan 07, 20:16

Comment 2	
PC member:	Francesco Belardinelli
Comment:	In my opinion the paper is interesting and the results non-trivial. Given the technical machinery, this kind of results will probably attract more attention from the community in logic then from game-theorists. However, given the scope of KR, this is not necessarily a drawback. So, I lean towards acceptance.
Time:	Jan 08, 08:32

Add Comment

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