

Graded Group Responsibility: A Power-Based Approach

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1 Background and Motivation

The emergence of autonomous agents necessitates formal models to represent and reason about the responsibility of agents and agent groups for the outcome of their actions (see [1]). Recently, Bulling and Dastani [2] introduced a power-based notion of group responsibility. In their formal conceptualization, a minimal agent group C that is able to preclude a state of affairs S from a given state q is declared to be responsible in q for S . This is based on the rationale that, while we are reasoning at state q , the incidence of S critically depends on the allowance of C . Their approach (1) captures the *temporality* of responsibility as their notion is defined locally in each arbitrary state q , and (2) is focused on the *forward-looking* dimension of responsibility (in sense of [3]) as they formulate responsibility in terms of potentials of agent groups for a state of affairs that is not materialized yet.

Following the power-based notion of responsibility [2], we focus on quantitative degrees of group responsibility¹. Although some of the existing approaches are designed to measure the degree of responsibility, they either constitute a backward-looking (instead of forward-looking) notion of responsibility [5], provide qualitative (instead of quantitative) degree of responsibility [6, 7], or focus on individual (instead of group) responsibility [8]. To our knowledge, there is no forward-looking approach that measures the degree of group responsibility quantitatively. Such a notion would enable reasoning about responsibility of agent groups towards a state of affairs, e.g., collective decision making scenarios. We build on the notion of group responsibility in [2] and propose two degrees of group responsibility: *structural* and *functional* degrees of group responsibility.

2 Degrees of Group Responsibility

In our conception of *Structural Degree of Responsibility*, we say that any (agent) group that shares members with responsible groups (in state q) for a state of affairs, as defined in [2], should be assigned a degree of responsibility that reflects its proportional contribution in q . Accordingly, the relative size of a group and its share are substantial parameters in our formulation of the

¹ The full version of this work appears in [4].

structural responsibility degree. We emphasize that this concept of responsibility degree is supported by the fact that beneficiary parties, e.g., lobbyists in the political context, do proportionally invest their scarce resources on the groups that can play a role in some key decisions.

Functional Degree of Responsibility addresses the dynamics of responsibility in different states in a system with respect to a given state of affairs. We deem that a reasonable differentiation could be made between the groups which do have the chance of *becoming* responsible and those that do not. This notion addresses the eventuality of a state q' in which the group in question is responsible for a given state of affairs. This degree is formulated based on tracing the number of necessary state transitions from a reasoning state q towards a state q' in which the group in question is q' -responsible for the state of affairs.

3 Discussion

Our proposed notions enable the quantitative gradation of group responsibility. We emphasize that, due to their forward-looking nature, our notions are not applicable in scenarios from legal domain. We believe that in assessing culpability, the reasoning is about an already realized state of affairs (in past), where back-ward looking responsibility is applicable. Moreover, we follow [5] and believe that for attribution of liability, blameworthiness, and in principles such as *contributory negligence*, the level of knowledge of agents plays a significant role. Therefore, we aim to extend our responsibility notions and take into account the role of knowledge in these notions.

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