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# Towards Accurate Prediction of Healthcare Choices: The INTERSOCIAL Project

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Healthcare is under heavy pressure due to rising expenditures, an ageing population, high prices of new medical treatment options, and a substantial resource waste every year [1–4]. Accurate prediction of patients' choice behaviour enables better decisions in healthcare by avoiding poor policy decisions, trial-and-error implementation and demand–supply imbalance [5, 6]. Choice modelling via discrete choice experiments (DCEs) has demonstrated significant potential to accurately predict patients' choice behaviour [7–9]. A DCE is a stated preference method and is also referred to as a stated choice experiment, choice-based conjoint or simply a choice experiment. In a DCE, respondents are confronted with a series of carefully tailored hypothetical choice situations entailing two or more options, each characterised by a bundle of attributes with given attribute levels [10, 11]. DCEs have a solid foundation in random utility theory [12, 13] and include a Nobel prize-winning econometric approach commonly referred to as choice modelling [14]. The stated choices allow the ranking of *all* possible options (i.e. all combinations of attribute levels), including options not presented to respondents. Choice modelling has demonstrated its usefulness in various disciplines, including

marketing, transport and environmental economics, where it is mainstream for transport planning and policy development, marketing product development and pricing, and resource management decision-making [15, 16]. It is therefore not surprising that choice modelling has become commonly used in health economics as well [17, 18].

To support policy development based on choice modelling, external validity of stated preferences is widely recognised as an important research question [17, 19–21]. External validity is here defined as the degree of consistency of stated choices with actual choice behaviour [so-called 'revealed (true) choices' or 'actual utilization']. Despite the strong basis for internal validity [8, 22, 23], some of the usual assumptions made in choice modelling via DCEs may limit external validity. Extant choice models assume that choice processes are *independent* of the influence of people other than the decision-maker (in healthcare, for example, the patient, the physician, the healthcare consumer) in question, which is the almost universal practice in choice modelling applications in health, transport, marketing and environment. However, most healthcare choices are not made in a social vacuum! Thus, current choice models in healthcare (and beyond) fall short in terms of realistic representation of decision-makers' choice context [24]. Moving towards a social interdependent choice paradigm in a rigorous and theoretically sound manner is crucial for choice modelling to be useful for health policy development.

It is surprising that relatively little research has been focused on integrating social influences into healthcare choice models [25], especially given the importance of such choices in the overwhelming majority of health domains [22, 26]. Important questions include the following: Which key influencers (i.e. agents from the patient's own social network) are involved in common healthcare decisions? What decision rules are used? How do we measure and model stated choices for socially interdependent decisions to improve prediction of choice behaviour in healthcare? When and to what extent does taking social influences into

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account lead to more accurate choice behaviour prediction at an aggregate as well as an individual level?

The answers to these questions require research at the interface of sociology, (behavioural) economic, econometric, psychological and health sciences. Therefore, combining a mixed-method approach with researchers from different disciplines is essential, allowing these urgent and relevant questions to be answered, and so pave the way towards accurate prediction of healthcare choices. INTERSOCIAL—a public research initiative—has recently been launched to tackle these challenges [27, 28].

## 1 INTERSOCIAL: Aims, Objectives and Deliverables

INTERSOCIAL is an acronym for the research project ‘Towards a Social Interdependent Choice Paradigm for Ex-Ante Evaluation of Healthcare Policies’ [27]. This initiative focuses on generating and validating a social-interdependent choice paradigm to integrate social influences into choice models in healthcare. INTERSOCIAL is a 5-year project funded by the Dutch Research Council (NWO). The consortium of INTERSOCIAL includes eight academic institutions from Australia, The Netherlands, UK and US, one National Health Institute, and one international patient organisation, all adding their experience and perspectives to the project.

The main aim of INTERSOCIAL is to develop and validate a new choice paradigm, called the *Social Interdependent Choice Paradigm*. It is hypothesised that this paradigm will lead to more accurate predictions of choice behaviour in healthcare than current extant paradigms permit, and so advance the state-of-the-art to a point where more accurate ex-ante evaluation of health policies is feasible. To reach this main aim, INTERSOCIAL is divided into three interrelated phases, each having its own general objective(s) involving frontier research at the interface between sociology, (behavioural) economic, econometric, psychological and medical sciences.

Phase I (‘Theory Development’) will develop a theory of socially interdependent decision-making, primarily to achieve accurate predictions of choice behaviour in healthcare. This phase aims to obtain in-depth insights and answer the following questions: How and to what extent are patients’ preferences influenced by their own social network in common healthcare decisions? How do we classify these influences and decisions? What kind of influence does each agent of that social network exercise? Which information and exogenous factors play a role? What decision rules are used? A three-step approach will be used. Step 1 conducts a systematic review to generate a variety of (non-)overlapping insights into socially interdependent decision-making, starting with the process (who,

what, when) and how to measure stated preferences for such a decision. Step 2 conducts focus groups and semi-structured interviews among decision-makers (in this case, patients) and their influencers (e.g. partner, physician) to fill remaining gaps detected in step 1 and to unravel the underlying mechanisms differentiating socially interdependent processes that impact choice behaviour. Step 3 consolidates the findings and formulated hypotheses of steps 1–2 via the Delphi method among experts from different medical fields.

Phase II (‘Method Paradigm’) will translate the theory developed in phase I into a social interdependent choice method paradigm. This phase (1) generates conceptual models for common choice processes in healthcare; (2) determines data requirements for modelling choice behaviour prediction in healthcare; (3) develops a framework for collecting/measuring social interdependent decisions; (4) develops choice models reflecting social interdependence, including mechanisms of influence; and (5) determines calibration techniques to go from stated choices to revealed choices in a reliable way. Phase II of the project is an important distinguishing mark of the work, in that the measurement, statistical tools and methods will be directly suggested by and aligned with the theoretical propositions from phase I (i.e. theory driven).

Phase III (‘Proof-of-Principle’) will empirically validate the *Social Interdependent Choice Paradigm* developed in phase II and aim to determine when and to what extent revealed choice behaviour is predictable in healthcare. Specifically, (1) surveys among decision-makers (patients) will be conducted that contain socially embedded DCEs (SE-DCEs) that are designed according to state-of-the-art knowledge and insights from phases I–II. (2) Field data will be collected among the same respondents who filled out the survey of phase III, which is the only way to test to what extent revealed choice behaviour is consistent with SE-DCE-derived predictions at an individual level. This will show whether the *Social Interdependent Choice Paradigm* leads to more accurate choice behaviour prediction at an aggregate and individual level (i.e., hypothesis testing). (3) Telephone interviews, based on the I-Change model [29, 30], will take place with respondents that show discordance between stated choices and revealed choices despite the *Social Interdependent Choice Paradigm*, but also with a “successful” sample. The first group will permit us to figure out possible reasons for not predicting well. The second group permits us to figure out if the reasons for predicting well are due to the innovations developed by the INTERSOCIAL consortium. Based on phases I–III findings, a guideline will be provided about when and to what extent patient choice behaviour in healthcare is predictable, including improvements in DCE studies to reach more accurate ex-ante evaluation of healthcare policies.

## 2 INTERSOCIAL: Ambitions and Impact

INTERSOCIAL is designed to make a range of important contributions to the fields of choice modelling, choice behaviour prediction in healthcare, and health policy development. First, INTERSOCIAL is unique worldwide and highly innovative. The rigorous approach followed in INTERSOCIAL to include social influence in choice modelling will move substantially beyond earlier attempts [25, 31]. The project will take a variety of (non-)overlapping insights from different fields into account and integrate cross-domain sciences to fill important gaps in predicting choice behaviour in healthcare. It will advance theoretical aspects and provide a deeper understanding of the underlying mechanisms between derived preferences, social influences and choice behaviour, which has the potential to positively impact both decision-making and preference elicitation in healthcare (and beyond). Second, INTERSOCIAL is the first project ever that will empirically and thoroughly test whether and when choice behaviour can be predicted using SE-DCE in real-life healthcare settings. Third, INTERSOCIAL will lead to methodological advances that are needed to develop valuable choice behaviour prediction models and evolve current practice, both due to its broader scope and closer emulation of what happens in the real-world. More generally, the proposed research is ground-breaking as it develops tools that have the potential to reliably predict choice behaviour, and so advance the state-of-the-art to a point where robust ex-ante evaluation of health policies is feasible. A successful conclusion of this project will open new horizons, not only for decision-making in healthcare, but also for other fields that use choice modelling.

In summary, the ambition of INTERSOCIAL is to pave the way towards accurate prediction of healthcare choices through incorporation of social influences. The strongest demonstration of the value of INTERSOCIAL will come from acceptance of its tools for those who *investigate* choices (academics) and for those who *make* choices in healthcare at a macro or micro level (policy makers, patients, clinicians, care insurance companies and pharmaceutical companies).

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